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#### **MEASURING RETURN ON INVESTMENTS**

In Chapter 4, we developed a process for estimating costs of equity, debt, and capital and presented an argument that the cost of capital is the minimum acceptable hurdle rate when considering new investments. We also argued that an investment has to earn a return greater than this hurdle rate to create value for the owners of a business. In this chapter, we turn to the question of how best to measure the return on a project. In doing so, we will attempt to answer the following questions:

- What is a project? In particular, how general is the definition of an investment and what are the different types of investment decisions that firms have to make?
- In measuring the return on a project, should we look at the cash flows generated by the project or at the accounting earnings?
- If the returns on a project are unevenly spread over time, how do we consider (or should we not consider) differences in returns across time?

We will illustrate the basics of investment analysis using four hypothetical projects: an online book ordering service for Bookscape, a new theme park in Brazil for Disney, a plant to manufacture linerboard for Aracruz Celulose and an acquisition of a US company by Tata Chemicals.

#### What Is a Project?

Investment analysis concerns which projects a company should accept and which it should reject; accordingly, the question of what makes up a project is central to this and

the following chapters. The conventional project analyzed in capital budgeting has three criteria: (1) a large up-front cost, (2) cash flows for a specific time period, and (3) a salvage value at the end,

*Salvage Value*: The estimated liquidation value of the assets invested in the projects at the end of the project life.

which captures the value of the assets of the project when the project ends. Although such projects undoubtedly form a significant proportion of investment decisions, especially for manufacturing firms, it would be a mistake to assume that investment analysis stops there. If a project is defined more broadly to include any decision that results in using the scarce resources of a business, then everything from strategic decisions and acquisitions to decisions about which air conditioning system to use in a building would fall within its reach.

Defined broadly then, any of the following decisions would qualify as projects:

- Major strategic decisions to enter new areas of business (such as Disney's foray into real estate or Deutsche Bank's into investment banking) or new markets (such as Disney television's expansion into Latin America).
- 2. Acquisitions of other firms are projects as well, notwithstanding attempts to create separate sets of rules for them.
- Decisions on new ventures within existing businesses or markets, such as the one made by Disney to expand its Orlando theme park to include the Animal Kingdom or the decision to produce a new animated movie.
- Decisions that may change the way existing ventures and projects are run, such as programming schedules on the Disney channel or changing inventory policy at Bookscape.
- 5. Decisions on how best to deliver a service that is necessary for the business to run smoothly. A good example would be Deutsche Bank's choice of what type of financial information system to acquire to allow traders and investment bankers to do their jobs. While the information system itself might not deliver revenues and profits, it is an indispensable component for other

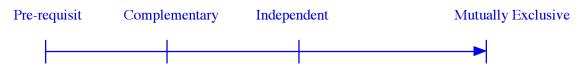
revenue generating projects.

Investment decisions can be categorized on a number of different dimensions. The first relates to how the project affects other projects the firm is considering and analyzing. Some *Mutually Exclusive Projects:* A group of projects is said to be mutually exclusive when acceptance of one of the projects implies that the rest have to be rejected.

projects are independent of other projects, and thus can be analyzed separately, whereas other projects are mutually exclusive—that is, taking one project will mean rejecting other projects. At the other extreme, some projects are prerequisites for other projects down the road and others are complementary. In general, projects can be categorized as falling somewhere on the continuum between prerequisites and mutually exclusive, as depicted in Figure 5.1.

#### Figure 5.1 The Project Continuum

#### Figure 5.1: The Project Continuum



The second dimension that can be used to classify a project is its ability to generate revenues or reduce costs. The decision rules that analyze revenue-generating projects attempt to evaluate whether the earnings or cash flows from the projects justify the investment needed to implement them. When it comes to cost-reduction projects, the decision rules examine whether the reduction in costs justifies the up-front investment needed for the projects.

#### Illustration 5.1: Project Descriptions.

In this chapter and parts of the next, we will use four hypothetical projects to illustrate the basics of investment analysis.

- The first project we will look at is a proposal by Bookscape to add an *online book ordering and information service*. Although the impetus for this proposal comes from the success of other online retailers like Amazon.com, Bookscape's service will be more focused on helping customers research books and find the ones they need rather than on price. Thus, if Bookscape decides to add this service, it will have to hire and train well-qualified individuals to answer customer queries, in addition to investing in the computer equipment and phone lines that the service will require. This project analysis will help illustrate some of the issues that come up when private businesses look at investments and also when businesses take on projects that have risk profiles different from their existing ones.
- The second project we will analyze is a *proposed theme park for Disney in Rio De Janeiro, Brazil.* Rio Disneyworld, which will be patterned on Disneyland Paris and Walt Disney World in Florida, will require a huge investment in infrastructure and take several years to complete. This project analysis will bring several issues to the forefront, including questions of how to deal with projects when the cash flows are in a foreign currency and what to do when projects have very long lives.

- The third project we will consider is a *plant in Brazil to manufacture linerboard* for Aracruz Celulose. Linerboard is a stiffened paper product that can be transformed into cardboard boxes. This investment is a more conventional one, with an initial investment, a fixed lifetime, and a salvage value at the end. We will, however, do the analysis for this project from an equity standpoint to illustrate the generality of investment analysis. In addition, in light of concerns about inflation in Brazil, we will do the analysis entirely in real terms.
- The final project that we will examine is Tata Chemical's proposed acquisition of Sensient Technologies, a publicly traded US firm that manufactures color, flavor and fragrance additives for the food business. We will extend the same principles that we use to value internal investments to analyze how much Tata Chemicals can afford to pay for the US company and the value of any potential synergies in the merger.

We should also note that while these projects are hypothetical, they are based upon real projects that these firms have taken in the past.

#### Hurdle Rates for Firms versus Hurdle Rates for Projects

In the previous chapter we developed a process for estimating the costs of equity and capital for firms. In this chapter, we will extend the discussion to hurdle rates in the context of new or individual investments.

#### Using the Firm's Hurdle Rate for Individual Projects

Can we use the costs of equity and capital that we have estimated for the firms for these projects? In some cases we can, but only if all investments made by a firm are similar in terms of their risk exposure. As a firm's investments become more diverse, the firm will no longer be able to use its cost of equity and capital to evaluate these projects. Projects that are riskier have to be assessed using a higher cost of equity and capital than projects that are safer. In this chapter, we consider how to estimate project costs of equity and capital.

What would happen if a firm chose to use its cost of equity and capital to evaluate all projects? This firm would find itself overinvesting in risky projects and under investing in safe projects. Over time, the firm will become riskier, as its safer businesses find themselves unable to compete with riskier businesses.

#### **Cost of Equity for Projects**

In assessing the beta for a project, we will consider three possible scenarios. The first scenario is the one where all the projects considered by a firm are similar in their exposure to risk; this homogeneity makes risk assessment simple. The second scenario is one in which a firm is in multiple businesses with different exposures to risk, but projects within each business have the same risk exposure. The third scenario is the most complicated wherein each project considered by a firm has a different exposure to risk.

#### 1. Single Business; Project Risk Similar within Business

When a firm operates in only one business and all projects within that business share the same risk profile, the firm can use its overall cost of equity as the cost of equity for the project. Because we estimated the cost of equity using a beta for the firm in Chapter 4, this would mean that we would use the same beta to estimate the cost of equity for each project that the firm analyzes. The advantage of this approach is that it does not require risk estimation prior to every project, providing managers with a fixed benchmark for their project investments. The approach is restricting, though, because it can be usefully applied only to companies that are in one line of business and take on homogeneous projects.

### 2. Multiple Businesses with Different Risk Profiles: Project Risk Similar within Each Business

When firms operate in more than one line of business, the risk profiles are likely to be different across different businesses. If we make the assumption that projects taken within each business have the same risk profile, we can estimate the cost of equity for each business separately and use that cost of equity for all projects within that business. Riskier businesses will have higher costs of equity than safer businesses, and projects taken by riskier businesses will have to cover these higher costs. Imposing the firm's cost of equity on all projects in all businesses will lead to overinvesting in risky businesses (because the cost of equity will be set too low) and under investing in safe businesses (because the cost of equity will be set too high).

How do we estimate the cost of equity for individual businesses? When the approach requires equity betas, we cannot fall back on the conventional regression approach (in the CAPM) or factor analysis (in the APM) because these approaches require past prices. Instead, we have to use one of the two approaches that we described in the last section as alternatives to regression betas—bottom-up betas based on other publicly traded firms in the same business, or accounting betas, estimated based on the accounting earnings for the division.

#### 3. Projects with Different Risk Profiles

As a purist, you could argue that each project's risk profile is, in fact, unique and that it is inappropriate to use either the firm's cost of equity or divisional costs of equity to assess projects. Although this may be true, we have to consider the trade-off. Given that small differences in the cost of equity should not make a significant difference in our investment decisions, we have to consider whether the added benefits of analyzing each project individually exceed the costs of doing so.

When would it make sense to assess a project's risk individually? If a project is large in terms of investment needs relative to the firm assessing it and has a very different risk profile from other investments in the firm, it would make sense to assess the cost of equity for the project independently. The only practical way of estimating betas and costs of equity for individual projects is the bottom-up beta approach.

#### **Cost of Debt for Projects**

In the previous chapter, we noted that the cost of debt for a firm should reflect its default risk. With individual projects, the assessment of default risk becomes much more difficult, because projects seldom borrow on their own; most firms borrow money for all the projects that they undertake. There are three approaches to estimating the cost of debt for a project:

- One approach is based on the argument that because the borrowing is done by the firm rather than by individual projects, the cost of debt for a project should be the cost of debt for the firm considering the project. This approach makes the most sense when the projects being assessed are small relative to the firm taking them and thus have little or no appreciable effect on the firm's default risk.
- Look at the project's capacity to generate cash flows relative to its financing costs and estimate default risk and cost of debt for the project, You can also estimate

this default risk by looking at other firms that take similar projects, and use the typical default risk and cost of debt for these firms. This approach generally makes sense when the project is large in terms of its capital needs relative to the firm and has different cash flow characteristics (both in terms of magnitude and volatility) from other investments taken by the firm and is capable of borrowing funds against its own cash flows.

• The third approach applies when a project actually borrows its own funds, with lenders having no recourse against the parent firm, in case the project defaults. This is unusual, but it can occur when investments have significant tangible assets of their own and the investment is large relative to the firm considering it. In this case, the cost of debt for the project can be assessed using its capacity to generate cash flows relative to its financing obligations. In the last chapter, we used the bond rating of a firm to come up with the cost of debt for the firm. Although projects may not be rated, we can still estimate a rating for a project based on financial ratios, and this can be used to estimate default risk and the cost of debt.

#### **Financing Mix and Cost of Capital for Projects**

To get from the costs of debt and equity to the cost of capital, we have to weight each by their relative proportions in financing. Again, the task is much easier at the firm level, where we use the current market values of debt and equity to arrive at these weights. We may borrow money to fund a project, but it is often not clear whether we are using the debt capacity of the project or the firm's debt capacity. The solution to this problem will again vary depending on the scenario we face.

- When we are estimating the financing weights for small projects that do not affect a firm's debt capacity, the financing weights should be those of the firm before the project.
- When assessing the financing weights of large projects, with risk profiles different from that of the firm, we have to be more cautious. Using the firm's financing mix to compute the cost of capital for these projects can be misleading, because the project being analyzed may be riskier than the firm as a whole and thus incapable of carrying the firm's debt ratio. In this case, we would argue for the

use of the average debt ratio of the other firms in the business in assessing the cost of capital of the project.

• The financing weights for stand-alone projects that are large enough to issue their own debt should be based on the actual amounts borrowed by the projects. For firms with such projects, the financing weights can vary from project to projects, as will the cost of debt.

In summary, the cost of debt and debt ratio for a project will reflect the size of the project relative to the firm, and its risk profile, again relative to the firm. Table 5.1 summarizes our analyses.

Project Characteristics	Cost of Debt	Debt Ratio
Project is small and has	Firm's cost of debt	Firm's debt ratio
cash flow characteristics		
similar to the firm		
Project is large and has cash	Cost of debt of comparable	Average debt ratio of
flow characteristics	firms (if non-recourse debt)	comparable firms
different from the firm	or the firm (if backed by the	
	firm's creditworthiness)	
Stand-alone project	Cost of debt for project	Debt ratio for project
	(based on actual or	
	synthetic ratings)	

Table 5.1 Cost of Debt and Debt Ratio: Project Analyses

Illustration 5.2: Estimating Hurdle Rates for Individual Projects

Using the principles of estimation that we just laid out, we can estimate the hurdles rates for the projects that we are analyzing in this chapter.

Bookscape Online Information and Ordering Service: Because the beta and cost of equity that we estimated for Bookscape as a company reflect its status as a book store, we will re-estimate the beta for this online project by looking at publicly traded Internet retailers. The unlevered total beta of internet retailers is 4.25,<sup>1</sup> and we assume that this project will be funded with the same mix of debt and equity (D/E = 53.47%, Debt/Capital = 34.84%) that Bookscape uses in the rest of the business. We will assume that Bookscape's tax rate (40%) and pretax cost of debt (6%) apply to this project.

<sup>&</sup>lt;sup>1</sup>The unlevered market beta for internet retailers is 1.70, and the average correlation of these stocks with the market is 0.40. The unlevered total beta is therefore 1.70/0.4 = 4.25.

Levered Beta <sub>Online Service</sub> = 4.25 [1 + (1 - 0.4) (0.5357)] = 5.61Cost of Equity <sub>Online Service</sub> = 3.5% + 5.61 (6%) = 37.18%

Cost of Capital<sub>Online Service</sub>= 37.18% (0.6516) + 6% (1 – 0.4) (0.3484) = 25.48%This is much higher than the cost of capital we computed for Bookscape in chapter 4, but it reflects the higher risk of the online retail venture.

• *Rio Disney*: We did estimate a cost of equity of 6.62% for the Disney theme park business in the last chapter, using a bottom-up levered beta of 0.7829 for the business. The only concern we would have with using this cost of equity for this project is that it may not adequately reflect the additional risk associated with the theme park being in an emerging market (Brazil). To account for this risk, we compute the US \$ cost of equity for the theme park using a risk premium that includes a country risk premium for Brazil:<sup>2</sup>

Cost of Equity in US\$= 3.5% + 0.7829 (6%+3.95%) = 11.29%

Using this estimate of the cost of equity, Disney's theme park debt ratio of 35.32% and its after-tax cost of debt of 3.72% (see chapter 4), we can estimate the cost of capital for the project:

Cost of Capital in US\$ = 11.29% (0.6468) + 3.72% (0.3532) = 8.62%

• *Aracruz Paper Plant*: We estimated the cost of equity and capital for Aracruz's paper business in Chapter 4 in real, U.S. dollar, and nominal BR terms. We reproduce those estimates in table 5.2:

	Cost of equity	Cost of capital
US \$	20.82%	12.84%
R\$	26.75%	18.37%
Real	18.45%	10.63%

Table 5.2: Costs of Equity and Capital: Aracruz

In analyzing projects, we will pick the appropriate discount rate based upon whether we are looking at cash flows prior to debt payments (cost of capital) or after debt payments (cost of equity) and the currency in which we are making our estimates.

<sup>&</sup>lt;sup>2</sup>We computed this country risk premium for Brazil in chapter 4, in the context of computing the cost of capital for Aracruz. We multiplied the default spread for Brazil (2.50%) by the relative volatility of Brazil's equity index to the Brazilian government bond. (34%/21.5%)

Country risk premium for Brazil = 2.50% (34/21.5) = 3.95%

- Sensient Technologies Acquisition: The costs of capital that we estimated for Tata Chemicals and its divisions in chapter 4 cannot be used in assessing the value of Sensient Technologies for four reasons:
  - a. <u>Currency</u>: The cost of capital for Tata Chemicals was estimated in rupee terms, whereas our assessment of Sensient will be done in US dollars.
  - b. <u>Country risk</u>: In estimating the cost of capital for Tata Chemicals, we incorporated an additional country risk premium for India, to reflect the fact that the operations are almost entirely in India. Sensient Technologies operates primarily in the United States and have very little emerging market exposure. Consequently, we should be using a mature market premium (of 6%) in estimating its cost of equity.
  - c. <u>Business risk</u>: To estimate the beta for Tata Chemicals, we looked at the betas of publicly traded emerging market companies in the diversified chemicals and fertilizers businesses. While Sensient Technologies is classified as a specialty chemical company, its revenues are derived almost entirely from the food processing business. Consequently, we feel that the unlevered beta of food processing companies in the United States is a better measure of risk; in January 2009, we estimated an unlevered beta of 0.65 for this sector.
  - d. <u>Cost of debt and debt ratio</u>: In this acquisition, Tata Chemicals plans to assume the existing debt of Sensient Technologies and to preserve Sensient's existing debt ratio. Sensient currently has a debt to capital ratio of 28.57% (translating into a debt to equity ratio of 40%) and faces a pre-tax cost of debt of 5.5%.

Using the US corporate tax rate of 37% (to reflect the fact that Sensient's income will be taxed in the US), we compute the cost of capital for Sensient in US dollar terms:

Levered Beta = 0.65 (1 + (1 - .37) (.40)) = 0.8138

Cost of Equity= 3.5% + 0.8138 (6%) = 8.38%

Cost of capital = 8.38% (1-.2857) + 5.5% (1-.37) (.2857) = 6.98%

#### In Practice: Exchange Rate Risk, Political Risk, and Foreign Projects

When computing the cost of capital for the Rio Disney project, we adjusted the cost of capital for the additional risk associated with investing in Brazil. Although it may

seem obvious that a Brazilian investment is more risky to Disney than an investment in the United States, the question of whether discount rates should be adjusted for country risk is not an easy one to answer. It is true that a Brazilian investment will carry more risk for Disney than an investment in the United States, both because of exchange rate risk (the cash flows will be in Brazilian Reais and not in U.S. dollars) and because of political risk (arising from Brazil's emerging market status). However, this risk should affect the discount rate only if it cannot be diversified away by the marginal investors in Disney.

To analyze whether the risk in Brazil is diversifiable to Disney, we went back to our assessment of the marginal investors in the company in Chapter 3, where we noted that they were primarily diversified institutional investors. Not only does exchange rate risk affect different companies in their portfolios very differently—some may be hurt by a strengthening dollar and others may be helped—but these investors can hedge exchange rate risk, if they so desire. If the only source of risk in the project were exchange rate, we would be inclined to treat it as diversifiable risk and not adjust the cost of capital. The issue of political risk is more confounding. To the extent that political risk is not only more difficult to hedge but is also more likely to carry a nondiversifiable component, especially when we are considering risky emerging markets, the cost of capital should be adjusted to reflect it.

In short, whether we adjust the cost of capital for foreign projects will depend both on the firm that is considering the project and the country in which the project is located. If the marginal investors in the firm are diversified and the project is in a country with relatively little or no political risk, we would be inclined not to add a risk premium on to the cost of capital. If the marginal investors in the firm are diversified and the project is in a country with significant political risk, we would add a political risk premium to the cost of capital. If the marginal investors in the firm are not diversified, we would adjust the discount rate for both exchange rate and political risk.

#### **Measuring Returns: The Choices**

On all of the investment decisions just described, we have to choose between alternative approaches to measuring returns on the investment made. We will present our argument for return measurement in three steps. First, we will contrast accounting earnings and cash flows and argue that cash flows are much better measures of true return on an investment. Second, we will note the differences between total and incremental cash flows and present the case for using incremental cash flows in measuring returns. Finally, we will argue that returns that occur earlier in a project life should be weighted more than returns that occur later in a project life and that the return on an investment should be measured using time-weighted returns.

#### A. Accounting Earnings versus Cash Flows

The first and most basic choice we have to make when it comes to measuring returns is the one between the accounting measure of income on a project—measured in accounting statements, using accounting principles and standards—and the cash flow generated by a project, measured as the difference between the cash inflows in each period and the cash outflows.

#### Why Are Accounting Earnings Different from Cash Flows?

Accountants have invested substantial time and resources in coming up with ways of measuring the income made by a project. In doing so, they subscribe to some generally accepted accounting principles. Generally accepted accounting principles require the recognition of revenues when the service for which the firm is getting paid has been performed in full or substantially and has received in return either cash or a receivable that is both observable and measurable. For expenses that are directly linked to the production of revenues (like labor and materials), expenses are recognized in the same period in which revenues are recognized. Any expenses that are not directly linked to the production of revenues are recognized in the period in which the firm consumes the services. Although the objective of distributing revenues and expenses fairly across time is worthy, the process of accrual accounting creates an accounting earnings number that can be very different from the cash flow generated by a project in any period. There are three significant factors that account for this difference.

#### 1. Operating versus Capital Expenditure

Accountants draw a distinction between expenditures that yield benefits only in the immediate period or periods (such as labor and material for a manufacturing firm) and those that yield benefits over multiple periods (such as land, buildings, and long-lived plant). The former are called *operating expenses* and are subtracted from revenues in computing the accounting income, whereas the latter are *capital expenditures* and are not subtracted from revenues in the period that they are made. Instead, the expenditure is spread over multiple periods and deducted as an expense in each period; these expenses are called depreciation (if the asset is a tangible asset like a building) or amortization (if the asset is an intangible asset, such as a patent or a trademark).

Although the capital expenditures made at the beginning of a project are often the largest part of investment, many projects require capital expenditures during their lifetime. These capital expenditures will reduce the cash available in each of these periods.

## 5.1. What Are Research and Development Expenses?

Research and development (R&D) expenses are generally considered to be operating expenses by accountants. Based on our categorization of capital and operating expenses, would you consider R&D expenses to be

a. operating expenses.

b. capital expenses.

c. operating or capital expenses, depending on the type of research being done.

Why?

#### 2. Noncash Charges

The distinction that accountants draw between operating and capital expenses leads to a number of accounting expenses, such as depreciation and amortization, which are not cash expenses. These noncash expenses, though depressing accounting income, do not reduce cash flows. In fact, they can have a significant positive impact on cash flows if they reduce the tax paid by the firm since some noncash charges reduce taxable income and the taxes paid by a business. The most important of such charges is depreciation, which, although reducing taxable and net income, does not cause a cash outflow. In efect, depreciation and amortization is added back to net income to arrive at the cash flows on a project. For projects that generate large depreciation charges, a significant portion of the cash flows can be attributed to the tax benefits of depreciation, which can be written as follows

Tax Benefit of Depreciation = Depreciation \* Marginal Tax Rate Although depreciation is similar to other tax-deductible expenses in terms of the tax benefit it generates, its impact is more positive because it does not generate a concurrent cash outflow.

Amortization is also a noncash charge, but the tax effects of amortization can vary depending on the nature of the amortization. Some amortization charges, such as the amortization of the price paid for a patent or a trademark, are tax-deductible and reduce both accounting income and taxes. Thus they provide tax benefits similar to depreciation. Other amortization, such as the amortization of the premium paid on an acquisition (called goodwill), reduces accounting income but not taxable income. This amortization does not provide a tax benefit.

Although there are a number of different depreciation methods used by firms, they can be classified broadly into two groups. The first is *straight line depreciation*, whereby equal amounts of depreciation are claimed each period for the life of the project. The second group includes *accelerated depreciation methods*, such as double-declining balance depreciation, which result in more depreciation early in the project life and less in the later years.

#### 3. Accrual versus Cash Revenues and Expenses

The accrual system of accounting leads to revenues being recognized when the sale is made, rather than when the customer pays for the good or service. Consequently, accrual revenues may be very different from cash revenues for three reasons. First, some customers, who bought their goods and services in prior periods, may pay in this period; second, some customers who buy their goods and services in this period (and are therefore shown as part of revenues in this period) may defer payment until the future. Finally, some customers who buy goods and services may never pay (bad debts). In some cases, customers may even pay in advance for products or services that will not be delivered until future periods.

A similar argument can be made on the expense side. Accrual expenses, relating to payments to third parties, will be different from cash expenses, because of payments made for material and services acquired in prior periods and because some materials and services acquired in current periods will not be paid for until future periods. Accrual taxes will be different from cash taxes for exactly the same reasons.

When material is used to produce a product or deliver a service, there is an added consideration. Some of the material used may have been acquired in previous periods and was brought in as inventory into this period, and some of the material that is acquired in this period may be taken into the next period as inventory.

Accountants define working capital as the difference between current assets (such as inventory and accounts receivable) and current liabilities (such as accounts payable and taxes payable). We will use a slight variant, and define non-cash working capital as the difference between non-cash current assets and non-debt current liabilities; debt is not considered part of working capital because it viewed as a source of capital. The reason we leave cash out of the working capital computation is different. We view cash, for the most part, to be a non-wasting asset, insofar as firms earn a fair rate of return on the cash. Put another way, cash that is invested in commercial paper or treasury bills is no longer a wasting asset and should not be considered part of working capital, even if it is viewed as an integral part of operations. Differences between accrual earnings and cash earnings, in the absence of noncash charges, can be captured by changes in the non-cash working capital. A decrease in non-cash working capital will increase cash flows, whereas an increase will decrease cash flows.

#### In Practice: The Payoff to Managing Working Capital

Firms that are more efficient in managing their working capital will see a direct payoff in terms of cash flows. Efficiency in working capital management implies that the firm has reduced its net working capital needs without adversely affecting its expected growth in revenues and earnings. Broadly defined, there are four ways net working capital can be reduced:

 Firms need to maintain an inventory of both produce goods and to meet customer demand, but minimizing this inventory while meeting these objectives can produce a lower net working capital. In fact, recent advances in technology that use information systems for just-in-time production have helped U.S. firms reduce their inventory needs significantly.

- Firms that sell goods and services on credit can reduce their net working capital needs by inducing customers to pay their bills faster and by improving their collection procedures.
- 3. Firms can also look for suppliers who offer more generous credit terms because accounts payable can be used to finance inventory and accounts receivable.

While lowering the amount invested in working capital will increase cash flows, that positive effect has to weighed off against any potential negative effects including lost sales (because of insufficient inventory or more stringent credit terms) and higher costs (because suppliers may demand higher prices if you take longer to pay).

#### From Accounting Earnings to Cash Flows

The three factors outlined can cause accounting earnings to deviate significantly from the cash flows. To get from after-tax operating earnings, which measures the earnings to the firm, to cash flows to all investors in the firm, we have to

- *Add back all noncash charges*, such as depreciation and amortization, to the operating earnings.
- Subtract out all cash outflows that represent capital expenditures.
- *Net out the effect of changes in noncash working capital*, that is, changes in accounts receivable, inventory, and accounts payable. If noncash working capital increased, the cash flows will be reduced by the change, whereas if it decreased, there is a cash inflow.

The first two adjustments change operating earnings to account for the distinction drawn by accountants between operating, financing and capital expenditures, whereas the last adjustment converts accrual revenues and expenses into cash revenues and expenses.

Cash Flow to Firm = Earnings before interest and taxes (1 - t) + Depreciation &

Amortization – Change in Noncash Working Capital – Capital Expenditures The cash flow to the firm is a pre-debt, after-tax cash flow that measures the cash generated by a project for all claim holders in the firm after reinvestment needs have been met. To get from net income, which measures the earnings of equity investors in the firm, to cash flows to equity investors requires the additional step of considering the net cash flow created by repaying old debt and taking on new debt. The difference between new debt issues and debt repayments is called the net debt, and it has to be added back to arrive at cash flows to equity. In addition, other cash flows to nonequity claim holders in the firm, such as preferred dividends, have to be netted from cash flows.

Cash Flow to Equity = Net Income + Depreciation & Amortization – Change in Noncash Working Capital – Capital Expenditures + (New Debt Issues – Debt Repayments) – Preferred Dividends

The cash flow to equity measures the cash flows generated by a project for equity investors in the firm, after taxes, debt payments, and reinvestment needs.

# 5.2. Earnings and Cash Flows

If the earnings for a firm are positive, the cash flows will also be positive.

a. True

b. False

Why or why not?



### Earnings Management: A Behavioral Perspective

Accounting standards allow some leeway for firms to move earnings across periods by deferring revenues or expenses or choosing a different accounting method for recording expenses. Companies not only work at holding down expectations on the part of analysts following them but also use their growth and accounting flexibility to move earnings across time to beat expectations and to smooth out earning. It should come as no surprise that firms such as Microsoft and Intel consistently beat analyst estimates of earnings. Studies indicate that the tools for accounting earnings management range the spectrum and include choices on when revenues get recognized, how inventory gets valued, how leases and option expenses are treated and how fair values get estimated for assets. Earnings can also be affected by decisions on when to invest in R&D and how acquisitions are structured.

In response to earnings management, FASB has created more stringent rules but the reasons why companies manage earnings may have behavioral roots. One study, for instance, finds that the performance anxiety created among managers by frequent internal auditing can lead to more earnings management. Thus, more rules and regulations may have the perverse impact of increasing earnings management. In addition, surveys indicate that managerial worries about personal reputation can induce them to try to meet earnings benchmarks set by external entities (such as equity research analysts) Finally, there is evidence that managers with 'short horizons' are more likely to manage earnings, with the intent of fooling investors.

The phenomenon of managing earnings has profound implications for a number of actions that firms may take, from how they sell their products and services to what kinds of projects they invest in or the firms they acquire and how they account for such investments. A survey of CFOs uncovers the troubling finding that more than 40% of them will reject an investment that will create value for a firm, if the investment will result in the firm reporting earnings that fall below analyst estimates.

#### The Case for Cash Flows

When earnings and cash flows are different, as they are for many projects, we must examine which one provides a more reliable measure of performance. Accounting earnings, especially at the equity level (net income), can be manipulated at least for individual periods, through the use of creative accounting techniques. A book titled *Accounting for Growth*, which garnered national headlines in the United Kingdom and cost the author, Terry Smith, his job as an analyst at UBS Phillips & Drew, examined twelve legal accounting techniques commonly used to mislead investors about the profitability of individual firms. To show how creative accounting techniques can increase reported profits, Smith highlighted such companies as Maxwell Communications and Polly Peck, both of which eventually succumbed to bankruptcy.

The second reason for using cash flow is much more direct. No business that we know off accepts earnings as payment for goods and services delivered; all of them require cash. Thus, a project with positive earnings and negative cash flows will drain

cash from the business undertaking it. Conversely, a project with negative earnings and positive cash flows might make the accounting bottom line look worse but will generate cash for the business undertaking it.

#### **B.** Total versus Incremental Cash Flows

The objective when analyzing a project is to answer the question: Will investing in this project make the entire firm or business more valuable? Consequently, the cash flows we should look at in investment analysis are the cash flows the project creates for the firm or business considering it. We will call these incremental cash flows.

#### Differences between Incremental and Total Cash Flows

The total and the incremental cash flows on a project will generally be different for two reasons. First, some of the cash flows on an investment may have occurred already and therefore are unaffected by whether we take the investment or not. Such cash flows are called sunk costs and should be removed from the analysis. The second is that some of the projected cash flows on an investment will be generated by the firm, whether this investment is accepted or rejected. Allocations of fixed expenses, such as general and administrative costs, usually fall into this category. These cash flows are not incremental, and the analysis needs to be cleansed of their impact.

#### 1. Sunk Costs

There are some expenses related to a project that are incurred before the project analysis is done. One example would be expenses associated with a test market done to assess the potential market for a product prior to conducting a full-blown investment analysis. Such expenses are called *sunk costs*. Because they will not be recovered if the project is rejected, sunk costs are not incremental and therefore should not be considered as part of the investment analysis. This contrasts with their treatment in accounting statements, which do not distinguish between expenses that have already been incurred and expenses that are still to be incurred.

One category of expenses that consistently falls into the sunk cost column in project analysis is research and development (R&D), which occurs well before a product is even considered for introduction. Firms that spend large amounts on R&D, such as

Merck and Intel, have struggled to come to terms with the fact that the analysis of these expenses generally occur after the fact, when little can be done about them.

Although sunk costs should not be treated as part of investment analysis, a firm does need to cover its sunk costs over time or it will cease to exist. Consider, for example, a firm like McDonald's, which expends considerable resources in test marketing products before introducing them. Assume, on the ill-fated McLean Deluxe (a low-fat hamburger introduced in 1990), that the test market expenses amounted to \$30 million and that the net present value of the project, analyzed after the test market, amounted to \$20 million. The project should be taken. If this is the pattern for every project McDonald's takes on, however, it will collapse under the weight of its test marketing expenses. To be successful, the *cumulative* net present value of its successful projects will have to exceed the *cumulative* test marketing expenses on both its successful and unsuccessful products.



## The Psychology of Sunk Costs

While the argument that sunk costs should not alter decisions is unassailable, studies indicate that ignoring sunk costs does not come easily to managers. In an experiment, Arkes and Blumer presented 48 people with a hypothetical scenario: Assume that you are investing \$10 million in research project to come up with a plane that cannot be detected by radar. When the project is 90% complete (\$ 9 million spent), another firm begins marketing a plane that cannot be detected by radar and is faster and cheaper than the one you are working on. Would you invest the last 10% to complete the project? Of the group, 40 individuals said they would go ahead. Another group of 60 was asked the question, with the same facts about the competing firm and its plane, but with the cost issue framed differently. Rather than mention that the firm had already spent \$ 9 million, they were asked whether they would spend an extra million to continue with this investment. Almost none of this group would fund the investment.<sup>3</sup> Other studies confirm this finding, which has been labeled the *Concorde fallacy*.

<sup>&</sup>lt;sup>3</sup> Arkes, H. R. & C. Blumer, 1985, The Psychology of Sunk Cost. Organizational Behavior and Human Decision Processes, 35, 124-140.

Rather than view this behavior as irrational, we should lecturing managers to ignore sunk costs in their decisions will accomplish little. The findings in these studies indicate one possible way of bridging the gap. If we can frame investment analysis primarily around incremental earnings and cash flows, with little emphasis on past costs and decisions (even if that is provided for historical perspective), we are far more likely to see good decisions and far less likely to see good money thrown after bad. It can be argued that conventional accounting, which mixes sunk costs and incremental costs, acts as an impediment in this process.

#### 2. Allocated Costs

An accounting device created to ensure that every part of a business bears its fair share of costs is *allocation*, whereby costs that are not directly traceable to revenues generated by individual products or divisions are allocated across these units, based on revenues, profits, or assets. Although the purpose of such allocations may be fairness, their effect on investment analyses have to be viewed in terms of whether they create incremental cash flows. An allocated cost that will exist with or without the project being analyzed does not belong in the investment analysis.

Any increase in administrative or staff costs that can be traced to the project is an incremental cost and belongs in the analysis. One way to estimate the incremental component of these costs is to break them down on the basis of whether they are fixed or variable and, if variable, what they are a function of. Thus, a portion of administrative costs may be related to revenue, and the revenue projections of a new project can be used to estimate the administrative costs to be assigned to it.

#### Illustration 5.3: Dealing with Allocated Costs

*Case 1*: Assume that you are analyzing a retail firm with general and administrative (G&A) costs currently of \$600,000 a year. The firm currently has five stores and the G&A costs are allocated evenly across the stores; the allocation to each store is \$120,000. The firm is considering opening a new store; with six stores, the allocation of G&A expenses to each store will be \$100,000.

In this case, assigning a cost of \$100,000 for G&A costs to the new store in the investment analysis would be a mistake, because it is not an incremental cost—the total G&A cost will be \$600,000, whether the project is taken or not.

*Case 2:* In the previous analysis, assume that all the facts remain unchanged except for one. The total G&A costs are expected to increase from 600,000 to 660,000 as a consequence of the new store. Each store is still allocated an equal amount; the new store will be allocated one-sixth of the total costs, or 110,000.

In this case, the allocated cost of 110,000 should not be considered in the investment analysis for the new store. The *incremental* cost of 60,000 (660,000 - 600,000), however, should be considered as part of the analysis.

#### In Practice: Who Will Pay for Headquarters?

As in the case of sunk costs, the right thing to do in project analysis (i.e., considering only direct incremental costs) may not add up to create a firm that is financially healthy. Thus, if a company like Disney does not require individual movies that it analyzes to cover the allocated costs of general administrative expenses of the movie division, it is difficult to see how these costs will be covered at the level of the firm.

In 2008, Disney's corporate shared costs amounted to \$471 million. Assuming that these general administrative costs serve a purpose, which otherwise would have to be borne by each of Disney's business, and that there is a positive relationship between the magnitude of these costs and revenues, it seems reasonable to argue that the firm should estimate a fixed charge for these costs that every new investment has to cover, even though this cost may not occur immediately or as a direct consequence of the new investment.

#### The Argument for Incremental Cash Flows

When analyzing investments it is easy to get tunnel vision and focus on the project or investment at hand, acting as if the objective of the exercise is to maximize the value of the individual investment. There is also the tendency, with perfect hindsight, to require projects to cover all costs that they have generated for the firm, even if such costs will not be recovered by rejecting the project. The objective in investment analysis is to maximize the value of the business or firm taking the investment. Consequently, it is the

cash flows that an investment will add on in the future to the business, that is, the incremental cash flows, that we should focus on.

#### Illustration 5.4: Estimating Cash Flows for an Online Book Ordering Service: Bookscape

As described in Illustration 5.1, Bookscape is considering investing in an online book ordering and information service, which will be staffed by two full-time employees. The following estimates relate to the costs of starting the service and the subsequent revenues from it.

- 1. The initial investment needed to start the service, including the installation of additional phone lines and computer equipment, will be \$1 million. These investments are expected to have a life of four years, at which point they will have no salvage value. The investments will be depreciated straight line over the four-year life.
- The revenues in the first year are expected to be \$1.5 million, growing 20% in year two, and 10% in the two years following.
- 3. The salaries and other benefits for the employees are estimated to be \$150,000 in year one, and grow 10% a year for the following three years.
- 4. The cost of the books is assumed to be 60% of the revenues in each of the four years.
- 5. The working capital, which includes the inventory of books needed for the service and the accounts receivable (associated with selling books on credit) is expected to amount to 10% of the revenues; the investments in working capital have to be made at the beginning of each year. At the end of year four, the entire working capital is assumed to be salvaged.
- The tax rate on income is expected to be 40%, which is also the marginal tax rate for Bookscape.

Based on this information, we estimate the operating income for Bookscape Online in Table 5.3:

	1	2	3	4
Revenues	\$1,500,000	\$1,800,000	\$1,980,000	\$2,178,000
Operating expenses				
Labor	\$150,000	\$165,000	\$181,500	\$199,650

Table 5.3 Expected Operating Income on Bookscape Online

Materials	\$900,000	\$1,080,000	\$1,188,000	\$1,306,800
Depreciation	\$250,000	\$250,000	\$250,000	\$250,000
Operating Income	\$200,000	\$305,000	\$360,500	\$421,550
Taxes	\$80,000	\$122,000	\$144,200	\$168,620
After-tax Operating Income	\$120,000	\$183,000	\$216,300	\$252,930

To get from operating income to cash flows, we add back the depreciation charges and subtract out the working capital requirements (which are the changes in working capital from year to year) in table 5.4. We also show the initial investment of \$1 million as a cash outflow right now (year zero) and the salvage value of the entire working capital investment in year four.

	0 (Now)	1	2	3	4
After-tax operating income		\$120,000	\$183,000	\$216,300	\$252,930
+ Depreciation		\$250,000	\$250,000	\$250,000	\$250,000
– Change in working capital	\$150,000	\$30,000	\$18,000	\$19,800	\$0
+ Salvage value					\$217,800
After-tax cash flows	-\$1,150,000	\$340,000	\$415,000	\$446,500	\$720,730

Table 5.4 From Operating Income to After-Tax Cash Flows

Note that there is an initial investment in working capital, which is 10% of the first year's revenues, invested at the beginning of the year. Each subsequent year has a change in working capital that represents 10% of the revenue change from that year to the next. In year 4, the cumulative investment in working capital over the four years (\$ 217,800) is salvaged, resulting in a positive cash flow.<sup>4</sup>

## 5.3. The Effects of Working Capital

In the analysis, we assumed that Bookscape would have to maintain additional inventory for its online book service. If, instead, we had assumed that Bookscape could use its existing inventory (i.e., from its regular bookstore), the cash flows on this project will

a. increase.

b. decrease.

c. remain unchanged.

<sup>&</sup>lt;sup>4</sup> Salvaging working capital is essentially the equivalent of having a going out of business sale, where all the inventory is sold at cost and all accounts receivable are collected.

Explain.

Illustration 5.5: Estimating Earnings, Incremental Earnings and Incremental Cash Flows: Disney Theme Park

The theme parks to be built near Rio, modeled on Disneyland Paris, will include a Magic Kingdom to be constructed, beginning immediately, and becoming operational at the beginning of the second year, and a second theme park modeled on Epcot at Orlando to be constructed in the second and third year and becoming operational at the beginning of the fifth year. The following is the set of assumptions that underlie the investment analysis.

- 1. The cash flows will be estimated in nominal dollars, even thought he actual cash flows will be in Brazilian Reals (R\$).
- 2. The cost of constructing Magic Kingdom will be \$3 billion, with \$2 billion to be spent right now and \$1 billion to be spent a year from now. Disney has already spent \$0.5 billion researching the proposal and getting the necessary licenses for the park; none of this investment can be recovered if the park is not built. This amount was capitalized and will be depreciated straight line over the next 10 years to a salvage value of zero.
- 3. The cost of constructing Epcot II will be \$1.5 billion, with \$1 billion spent at the end of the second year and \$0.5 billion at the end of the third year.
- 4. The revenues at the two parks and the resort properties at the parks are assumed to be the following, based on projected attendance figures until the tenth year and an expected inflation rate of 2% (in U.S. dollars). Starting in year ten, the revenues are expected to grow at the inflation rate. Table 5.5 summarizes the revenue projections:

Year	Magic Kingdom	Epcot II	Resort Properties	Total
1	\$0	\$0	\$0	\$0
2	\$1,000	\$0	\$250	\$1,250
3	\$1,400	\$0	\$350	\$1,750
4	\$1,700	\$300	\$500	\$2,500
5	\$2,000	\$500	\$625	\$3,125
6	\$2,200	\$550	\$688	\$3,438
7	\$2,420	\$605	\$756	\$3,781

Table 5.5 Revenue Projections: Rio Disney

8	\$2,662	\$666	\$832	\$4,159				
9	\$2,928	\$732	\$915	\$4,559				
10	\$2,987	\$747	\$933	\$4,667				
Beyond	Revenues grow 2% a year forever							

Note that the revenues at the resort properties are set at 25% of the revenues at the theme parks.

- The direct operating expenses are assumed to be 60% of the revenues at the parks and 75% of revenues at the resort properties.
- 6. The depreciation on fixed assets will be calculated as a percent of the remaining book value of these assets at the end of the previous year. In addition, the parks will require capital maintenance investments each year, specified as a percent of the depreciation that year. Table 5.6 lists both these statistics by year:<sup>5</sup>

Year	Depreciation as % of Book Value	Capital Maintenance as % of Depreciation
1	0.00%	0.00%
2	12.50%	50.00%
3	11.00%	60.00%
4	9.50%	70.00%
5	8.00%	80.00%
6	8.00%	90.00%
7	8.00%	100.00%
8	8.00%	105.00%
9	8.00%	110.00%
10	8.00%	110.00%

Table 5.6 Depreciation and Capital Maintenance Percentages

The capital maintenance expenditures are low in the early years, when the parks are still new but increase as the parks age since old attractions have to go through either major renovations or be replaced with new attractions. After year ten, both depreciation and capital expenditures are assumed to grow at the inflation rate (2%).

7. Disney will also allocate corporate G&A costs to this project, based on revenues; the G&A allocation will be 15% of the revenues each year. It is worth noting that a recent analysis of these expenses found that only one-third of these expenses are variable

<sup>&</sup>lt;sup>5</sup>Capital maintenance expenditures are capital expenditures to replace fixed assets that break down or become obsolete. This is in addition to the regular maintenance expenses that will be necessary to keep the parks going, which are included in operating expenses.

(and a function of total revenue) and that two-thirds are fixed. After year ten, these expenses are also assumed to grow at the inflation rate of 2%.

8. Disney will have to maintain noncash working capital (primarily consisting of inventory at the theme parks and the resort properties, netted against accounts payable) of 5% of revenues, with the investments being made at the *end of each year*.

9. The income from the investment will be taxed at Disney's marginal tax rate of 38%. The projected operating earnings at the theme parks, starting in the first year of operation (which is the second year) are summarized in Exhibit 5.1. Note that the project has no revenues until year two, when the first park becomes operational and that the project is expected to have an operating loss of \$150 million in that year. We have assumed that the firm will have enough income in its other businesses to claim the tax benefits from these losses (38% of the loss) in the same year. If this had been a stand-alone project, we would have had to carry the losses forward into future years and reduce taxes in those years.

The estimates of operating earnings in exhibit 5.1 are distorted because they do mix together expenses that are incremental with expenses that are not. In particular, there are two points of contention:

- a. <u>Pre-project investment</u>: We included the depreciation on the pre-project investment of \$ 500 million in the total depreciation for the project. This depreciation, however, can be claimed by Disney, irrespective of whether it goes ahead with the new theme park investment.
- b. <u>Allocated G&A Expenses</u>: While we considered the entire allocated expense in computing earnings, only one-third of this expense is incremental. Thus, we are understating the earnings on this project.

In exhibit 5.2a, we compute the incremental earnings for Rio Disney, using only the incremental depreciation and G&A expenses. Note that the incremental earnings are more positive than the unadjusted earnings in exhibit 5.1. In exhibit 5.2, we also estimate the incremental after-tax cash flow to Disney, prior to debt payments by:

- Adding back the incremental depreciation each year, because it is a noncash charge.
- Subtracting out the maintenance capital expenditures in addition to the primary capital expenditures because these are cash outflows.

• Subtracting out the incremental investment in working capital each year, which represent the change in working capital from the prior year. In this case, we have assumed that the working capital investments are made at the end of each year.

The investment of \$3 billion in Rio Magic Kingdom is shown at time 0 (as \$2 billion) and in year one (as \$1 billion). The expenditure of \$0.5 billion costing pre-project investments is not considered because it has already been made (sunk cost). Note that we could have arrived at the same estimates of incremental cash flows, starting with the unadjusted operating income and correcting for the non-incremental items (adding back the fixed portion of G&A costs and subtracting out the tax benefits from non-incremental depreciation). Exhibit 5.2b provides the proof.

# 5.4. Different Depreciation Methods for Tax Purposes and for Reporting

The depreciation that we used for the project is assumed to be the same for both tax and reporting purposes. Assume now that Disney uses more accelerated depreciation methods for tax purposes and straight-line depreciation for reporting purposes. In estimating cash flows, we should use the depreciation numbers from the

a. tax books.

b. reporting books.

Explain.

Capbudg.xls: This spreadsheet allows you to estimate the cash flows to the firm on a project.

	0	1	2	3	4	5	6	7	8	9	10
Magic Kingdom - Revenues		\$0	\$1,000	\$1,400	\$1,700	\$2,000	\$2,200	\$2,420	\$2,662	\$2,928	\$2,987
Epcot Rio - Revenues		\$0	\$0	\$0	\$300	\$500	\$550	\$605	\$666	\$732	\$747
Resort & Properties - Revenues		\$0	\$250	\$350	\$500	\$625	\$688	\$756	\$832	\$915	\$933
Total Revenues			\$1,250	\$1,750	\$2,500	\$3,125	\$3,438	\$3,781	\$4,159	\$4,575	\$4,667
Magic Kingdom – Direct Expenses		\$0	\$600	\$840	\$1,020	\$1,200	\$1,320	\$1,452	\$1,597	\$1,757	\$1,792
Epcot Rio – Direct Expenses		\$0	\$0	\$0	\$180	\$300	\$330	\$363	\$399	\$439	\$448
Resort & Property – Direct Expenses		\$0	\$188	\$263	\$375	\$469	\$516	\$567	\$624	\$686	\$700
Total Direct Expenses			\$788	\$1,103	\$1,575	\$1,969	\$2,166	\$2,382	\$2,620	\$2,882	\$2,940
Depreciation & Amortization		\$50	\$425	\$469	\$444	\$372	\$367	\$364	\$364	\$366	\$368
Allocated G&A Costs		\$0	\$188	\$263	\$375	\$469	\$516	\$567	\$624	\$686	\$700
Operating Income		-\$50	-\$150	-\$84	\$106	\$315	\$389	\$467	\$551	\$641	\$658
Taxes		-\$19	-\$57	-\$32	\$40	\$120	\$148	\$178	\$209	\$244	\$250
Operating Income after Taxes		-\$31	-\$93	-\$52	\$66	\$196	\$241	\$290	\$341	\$397	\$408
Capital Expenditures											
Pre-Project investments	\$500										
Depreciation: Pre-Project		\$50	\$50	\$50	\$50	\$50	\$50	\$50	\$50	\$50	\$50
Magic Kingdom: Construction	\$2,000	\$1,000	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Epcot Rio: Construction	\$0	\$0	\$1,000	\$500	\$0	\$0	\$0	\$0	\$0	\$0	\$0
Capital Maintenance		\$0	\$188	\$252	\$276	\$258	\$285	\$314	\$330	\$347	\$350
Depreciation on fixed assets		\$0	\$375	\$419	\$394	\$322	\$317	\$314	\$314	\$316	\$318
Book Value of New Fixed Assets	\$2,000	\$3,000	\$3,813	\$4,145	\$4,027	\$3,962	\$3,931	\$3,931	\$3,946	\$3,978	\$4,010
Book Value of Working Capital			\$63	\$88	\$125	\$156	\$172	\$189	\$208	\$229	\$233

Exhibit 5.1 Estimated Operating Earnings at Rio Disney (in millions of US dollars)

Book value of fixed assets<sub>t</sub>= Book value of fixed assets<sub>t-1</sub>+ New Investment<sub>t</sub> + Capital Maintenance<sub>t</sub> – Depreciation<sub>t</sub> Depreciation on fixed assets<sub>t</sub> = Book value of fixed assets<sub>t-1</sub>\* Depreciation as % of prior year's book value of fixed assets Depreciation & Amortization<sub>t</sub> = Depreciation: Pre-project investment<sub>t</sub> + Depreciation on fixed assets

Incremental Operating Income and Cash Flow											
	0	1	2	3	4	5	6	7	8	9	10
Revenues		\$0	\$1,250	\$1,750	\$2,500	\$3,125	\$3,438	\$3,781	\$4,159	\$4,575	\$4,667
-Direct Expenses		\$0	\$788	\$1,103	\$1,575	\$1,969	\$2,166	\$2,382	\$2,620	\$2,882	\$2,940
- Incremental Depreciation		\$0	\$375	\$419	\$394	\$322	\$317	\$314	\$314	\$316	\$318
- Incremental G&A		\$0	\$63	\$88	\$125	\$156	\$172	\$189	\$208	\$229	\$233
Incremental Operating Income		\$0	\$25	\$141	\$406	\$678	\$783	\$896	\$1,017	\$1,148	\$1,175
- Taxes		\$0	\$10	\$53	\$154	\$258	\$298	\$340	\$386	\$436	\$447
Incremental after-tax Operating income		\$0	\$16	\$87	\$252	\$420	\$485	\$555	\$630	\$712	\$729
+ Incremental Depreciation		\$0	\$375	\$419	\$394	\$322	\$317	\$314	\$314	\$316	\$318
- Capital Expenditures	\$2,000	\$1,000	\$1,188	\$752	\$276	\$258	\$285	\$314	\$330	\$347	\$350
- Change in non-cash Working Capital		\$0	\$63	\$25	\$38	\$31	\$16	\$17	\$19	\$21	\$5
Cashflow to firm	-\$2,000	-\$1,000	-\$860	-\$270	\$332	\$453	\$502	\$538	\$596	\$660	\$692

Exhibit 5.2a: Incremental Cash Flows at Rio Disney (in millions of US dollars)

Exhibit 5.2b: Another way of computing Incremental Cash Flows at Rio Disney

	0	1	2	3	4	5	6	7	8	9	10
Operating income (from Exhibit 5.1)		-\$50	-\$150	-\$84	\$106	\$315	\$389	\$467	\$551	\$641	\$658
- Taxes		-\$19	-\$57	-\$32	\$40	\$120	\$148	\$178	\$209	\$244	\$250
Operating Income after Taxes		-\$31	-\$93	-\$52	\$66	\$196	\$241	\$290	\$341	\$397	\$408
+ Depreciation & Amortization		\$50	\$425	\$469	\$444	\$372	\$367	\$364	\$364	\$366	\$368
- Pre-project Depreciation * tax rate		\$19	\$19	\$19	\$19	\$19	\$19	\$19	\$19	\$19	\$19
- Capital Expenditures	\$2,000	\$1,000	\$1,188	\$752	\$276	\$258	\$285	\$314	\$330	\$347	\$350
- Change in Working Capital	\$0	\$0	\$63	\$25	\$38	\$31	\$16	\$17	\$19	\$21	\$5
+ Non-incremental Allocated Expense (1-t)		\$0	\$78	\$109	\$155	\$194	\$213	\$234	\$258	\$284	\$289
Cashflow to Firm	-\$2,000	-\$1,000	-\$860	-\$270	\$332	\$453	\$502	\$538	\$596	\$660	\$692

Aracruz Celulose is considering a plan to build a state-of-the-art plant to manufacture linerboard. The plant is expected to have a capacity of 750,000 tons and will have the following characteristics:

- 1. It will require an initial investment of 250 million BR. At the end of the fifth year, an additional investment of 50 million BR will be needed to update the plant.
- 2. Aracruz plans to borrow 100 million BR at a real interest rate of 6.3725%, using a ten-year term loan (where the loan will be paid off in equal annual increments).
- 3. The plant will have a life of ten years. During that period, the depreciable portion of the plant (and the additional investment in year five), not including salvage value, will be depreciated using double declining balance depreciation, with a life of ten years.<sup>6</sup> At the end of the tenth year, the plant is expected to be sold for its salvage value of 75 million BR.
- 4. The plant will be partly in commission in a couple of months but will have a capacity of only 650,000 tons in the first year and 700,000 tons in the second year before getting to its full capacity of 750,000 tons in the third year.
- 5. The capacity utilization rate will be 90% for the first three years and rise to 95% after that.
- 6. The price per ton of linerboard is currently \$400 and is expected to keep pace with inflation for the life of the plant.
- 7. The variable cost of production, primarily labor and material, is expected to be 45% of total revenues; there is a fixed cost of 50 million BR, which will grow at the inflation rate.
- 8. The working capital requirements are estimated to be 15% of total revenues, and the investments have to be made at the beginning of each year. At the end of the tenth year, it is anticipated that the entire working capital will be salvaged.
- 9. Aracruz's corporate tax rate of 34% will apply to this project as well.

<sup>&</sup>lt;sup>6</sup>With double declining balance depreciation, we double the straight line rate (which would be 10 percent a year, in this case with a ten-year life) and apply that rate to the remaining depreciable book value. We apply this rate to the investment in year five as well. We switch to straight line depreciation in the 6<sup>th</sup> year because straight line depreciation yields a higher value (and depreciates down to salvage value).

Before we estimate the net income on this project, we have to consider the debt payments each year and break them down into interest and principal payments. Table 5.7 summarizes the results.

Year	Beginning Debt	Interest expense	Principal Repaid	Total Payment	Ending Debt
1	R\$ 100,000	R\$ 6,373	R\$ 7,455	R\$ 13,828	R\$ 92,545
2	R\$ 92,545	R\$ 5,897	R\$ 7,930	R\$ 13,828	R\$ 84,615
3	R\$ 84,615	R\$ 5,392	R\$ 8,436	R\$ 13,828	R\$ 76,179
4	R\$ 76,179	R\$ 4,855	R\$ 8,973	R\$ 13,828	R\$ 67,206
5	R\$ 67,206	R\$ 4,283	R\$ 9,545	R\$ 13,828	R\$ 57,661
6	R\$ 57,661	R\$ 3,674	R\$ 10,153	R\$ 13,828	R\$ 47,508
7	R\$ 47,508	R\$ 3,027	R\$ 10,800	R\$ 13,828	R\$ 36,708
8	R\$ 36,708	R\$ 2,339	R\$ 11,488	R\$ 13,828	R\$ 25,220
9	R\$ 25,220	R\$ 1,607	R\$ 12,220	R\$ 13,828	R\$ 12,999
10	R\$ 12,999	R\$ 828	R\$ 12,999	R\$ 13,828	R\$ 0

Table 5.7 Debt Payments: Aracruz Paper Plant

<sup>a</sup> Interest Expense = Beginning debt \* Pre-tax interest rate on debt

Note that although the total payment remains the same each year, the break down into interest and principal payments changes from year to year.

Exhibit 5.3 summarizes the net income from plant investment to Aracruz each year for the next ten years. Note that all of the projections are in real cash flows. Consequently, the price of paper (which grows at the same rate as inflation) is kept constant in real terms, as is any other item having this characteristic.

In Exhibit 5.4 we estimate the cash flows to equity from the plant to Aracruz. To arrive at these cash flows, we do the following:

- Subtract out the portion of the initial capital expenditures that comes from equity; of the initial investment of 250,000 BR, only 150,000 BR comes from equity. In year five, there is an additional investment of 50,000 BR.
- Add back depreciation and amortization, because they are noncash charges.
- Subtract the changes in working capital; because investments in working capital are made at the beginning of each period, the initial investment in working capital of 35.1 million BR is made at time 0 and is 15% of revenues in year one. The changes in working capital in the years that follow are 15% of the changes in revenue in those years. At the end of year ten, the entire investment in working capital is recovered as salvage.

- Subtract the principal payments that are made to the bank in each period, because these are cash outflows to the nonequity claimholders in the firm.
- Add the salvage value of the plant in year ten to the total cash flows, because this is a cash inflow to equity investors.

The cash flows to equity measure the cash flows that equity investors at Aracruz can expect to receive from investing in the plant.

# 5.5. The Effects of Debt Financing on Cash Flows to Equity

In the analysis, we assumed an additional capital expenditure of 50 million BR in year five, financed entirely with funds from equity; the cash flow to equity in year five (from Exhibit 5.4) is 12.95 million R\$. If, instead, we had assumed the 50 million R\$ had come from new borrowing, the cash flow to equity in year five will

- a. increase by 50 million BR.
- b. decrease by 50 million BR.
- c. remain unchanged.

Explain.

Capbudgeq.xls: This spreadsheet allows you to estimate the cash flows to equity on a project.

	1	2	3	4	5	6	7	8	9	10
Capacity (in '000s)	650	700	750	750	750	750	750	750	750	750
Utilization Rate	90%	90%	90%	95%	95%	95%	95%	95%	95%	95%
Production Rate (in '000s)	585	630	675	713	713	713	713	713	713	713
Price per ton	400	400	400	400	400	400	400	400	400	400
	R\$									
Revenues (in Real BR 000s)	234,000	252,000	270,000	285,000	285,000	285,000	285,000	285,000	285,000	285,000
	R\$									
- Direct Expenses	155,300	163,400	171,500	178,250	178,250	178,250	178,250	178,250	178,250	178,250
- Depreciation	R\$ 35,000	R\$ 28,000	R\$ 22,400	R\$ 17,920	R\$ 14,336	R\$ 21,469				
Operating Income	R\$ 43,700	R\$ 60,600	R\$ 76,100	R\$ 88,830	R\$ 92,414	R\$ 85,281				
- Interest Expenses	R\$ 6,373	R\$ 5,897	R\$ 5,392	R\$ 4,855	R\$ 4,283	R\$ 3,674	R\$ 3,027	R\$ 2,339	R\$ 1,607	R\$ 828
Taxable Income	R\$ 37,327	R\$ 54,703	R\$ 70,708	R\$ 83,975	R\$ 88,131	R\$ 81,607	R\$ 82,254	R\$ 82,942	R\$ 83,674	R\$ 84,453
- Taxes	R\$ 12,691	R\$ 18,599	R\$ 24,041	R\$ 28,552	R\$ 29,965	R\$ 27,746	R\$ 27,966	R\$ 28,200	R\$ 28,449	R\$ 28,714
Net Income	R\$ 24,636	R\$ 36,104	R\$ 46,667	R\$ 55,424	R\$ 58,167	R\$ 53,860	R\$ 54,287	R\$ 54,742	R\$ 55,225	R\$ 55,739
Beginning Book value: fixed	R\$									
assets	250,000	215,000	187,000	164,600	146,680	182,344	160,875	139,406	117,938	R\$ 96,469
- Depreciation	R\$ 35,000	R\$ 28,000	R\$ 22,400	R\$ 17,920	R\$ 14,336	R\$ 21,469				
+ Capital Exp.	R\$ 0	R\$ 0	R\$ 0	R\$ 0	R\$ 50,000	R\$ 0				
Ending Book Value: fixed	R\$									
assets	215,000	187,000	164,600	146,680	182,344	160,875	139,406	117,938	R\$ 96,469	R\$ 75,000

*Exhibit 5.3 Estimated Net Income from Paper Plant Investment: Aracruz Celulose (in '000s of R\$l – Real terms)* 

<sup>a</sup> Depreciation<sub>t</sub> = Higher of (20% (Beginning Book Value<sub>t</sub> – Salvage) or (Beginning Book Value – Salvage)/Remaining life). In year 1, for instance, 20% (250,000 – 75,000) = \$35,000, whereas (250,000-75,000)/10 = \$17,500. We use the former. We switch to straight line in year 6, right after the additional investment of 50 million R\$.

									· · · · · · · · · · · · · · · · · · ·		
	0	1	2	3	4	5	6	7	8	9	10
Net Income		24,636	36,104	46,667	55,424	58,167	53,860	54,287	54,742	55,225	55,739
+ Depreciation & Amortization		35,000	28,000	22,400	17,920	14,336	21,469	21,469	21,469	21,469	21,469
- Capital Expenditures	150,000	0	0	0	0	50,000	0	0	0	0	0
- Change in Working Capital	35,100	2,700	2,700	2,250	0	0	0	0	0	0	- 42,750
- Principal Repayments		7,455	7,930	8,436	8,973	9,545	10,153	10,800	11,488	12,220	12,999
+ Salvage Value of Plant											75,000
Cashflow to Equity	- 185,100	49,481	53,474	58,382	64,371	12,958	65,176	64,956	64,722	64,473	106,958

Exhibit 5.4 Cash Flows to Equity from Paper Plant: Aracruz Celulose (in '000s of real R\$)

#### Illustration 5.7: Estimating Cash flows from an acquisition: Sensient Technologies

To evaluate how much Tata Chemicals should pay for Sensient Technologies, we estimated the cash flows from the entire firm. As with the Disney analysis, we will estimate pre-debt cash flows, i.e., cash flow to the firm, using the same steps. We will begin with the after-tax operating income, add back depreciation and other non-cash charges and subtract out changes in non-cash working capital. There are two key differences between valuing a firm and valuing a project. The first is that a publicly traded firm, at least in theory, can have a perpetual life. Most projects have finite lives, though we will argue that projects such as theme parks may have lives so long that we could treat them as having infinite lives. The second is that a firm can be considered a portfolio of projects, current and future. As a consequence, to value a firm, we have to make judgments about the quantity and quality of future projects.

For Sensient Technologies, we started with the 2008 financial statements and obtained the following inputs for cash flow in 2008:

- a. <u>Operating Income</u>: The firm reported operating income of \$162 million on revenues of \$1.23 billion for the year. The firm paid 37% of its income as taxes in 2008, and we will use this as both the effective and marginal tax rate.
- b. Capital Expenditures and depreciation: Depreciation in 2008 amounted to \$44 million, whereas capital expenditures for the year was \$54 million. Non-cash working capital increased by approximately \$16 million during the year.

The cash flow to the firm for Sensient Technologies in 2008 can be estimated as follows:

Cash Flow to the firm = After-tax Operating Income + Depreciation – Capital Expenditures – Change in Non-cash Working Capital = 162 (1-.37) + 44 - 54 - 16 = \$76.06 million

We will assume that the firm is mature and that all of the inputs to this computation – earnings, capital expenditures, depreciation and working capital – will grow 2% a year in perpetuity.<sup>7</sup>

<sup>&</sup>lt;sup>7</sup> For the moment, this assumption seems to be an arbitrary one. Clearly, we need to give more thought to not only what a reasonable growth rate for a firm is but what may cause that growth rate to change. We will return to this issue in much more depth in chapter 12 and use this simplified example for this chapter.

#### In Practice: Estimating Expected Revenues and Cash Flows

How do we estimate a project's expected revenues and expenses? The key word in this question is *estimate*. No one, no matter what his or her skill at forecasting and degree of preparation, can forecast with certainty how a risky project will do. There are generally three ways in which we can make these forecasts:

- a. Experience and History: The process of estimating project revenues and expenses is simplest for firms that consider the same kind of projects repeatedly. These firms can use their experience from similar projects that are already in operation to estimate expected values for new projects. Disney, for instance, can use its experiences with its existing theme parks in making its estimates for Rio Disney.
- b. Market Testing: If the project being assessed is different from the firm's existing business, we may need a preliminary assessment of the market before actually investing in the project. In a market survey, potential customers are asked about the product or service being considered to gauge the interest they would have in acquiring it. The results usually are qualitative and indicate whether the interest is strong or weak, allowing the firm to decide whether to use optimistic forecasts for revenues (if the interest is strong) or pessimistic forecasts (if the interest is weak). Companies that need more information will often test market the concept on smaller markets, before introducing it on a larger scale. Test marketing not only allows firms to test out the product or service directly but also yields far more detailed information about the potential size of the market.
- *c. Scenario Analysis*: There are cases in which a firm is considering introducing a product to a market it knows well, but there is considerable uncertainty introduced by external factors that the firm cannot control. In such cases, a firm may decide to consider different scenarios, and the revenues and expenses on the project under each scenario. We will return to this approach later in this chapter.

We have laid out three ways of estimating revenues and expenses for projects, but none of these approaches yields perfect estimates. Although some project risk may come from estimation error, a large portion of risk comes from real uncertainty about the future. Improving estimation techniques, using more market testing, and performing scenario analysis may reduce estimation error but cannot eliminate real uncertainty. This is why we incorporate a risk premium into the discount rate.

#### C. Time-Weighted versus Nominal Cash Flows

Very few projects with long lifetimes generate earnings or cash flows evenly over their lives. In sectors with huge investments in infrastructure, such as telecommunications, the earnings and cash flows might be negative for an extended period (say, ten to twenty years) before they turn positive. In other sectors, the cashflows peak early and then gradually decrease over time. Whatever the reason for the unevenness of cash flows, a basic question that has to be addressed when measuring returns is whether they should reflect the timing of the earnings or cash flows. We will argue that they should, with earlier earnings and cash flows being weighted more when computing returns than earnings and cash flows later in a project life.

#### Why Cash Flows across Time Are Not Comparable

There are three reasons why cash flows across time are not comparable, and a cash flow in the future is worth less than a similar cash flow today:

- 1. Individuals *prefer present consumption to future consumption*. People would have to be offered more in the future to give up present consumption—this is called the *real rate of return*. The greater the real rate of return, the greater the difference in value between a cash flow today and an equal cash flow in the future.
- 2. When there is *monetary inflation*, the value of currency decreases over time. The greater the inflation, the greater the difference in value between a cash flow today and an equal cash flow in the future.
- 3. Any *uncertainty (risk)* associated with the cash flow in the future reduces the value of the cash flow. The greater the uncertainty associated with the cash flow, the greater the difference between receiving the cash flow today and receiving an equal amount in the future.

The process by which future cash flows are adjusted to reflect these factors is called *discounting*, and the magnitude of these factors is reflected in the *discount rate*. Thus the present value of a cash flow ( $CF_t$ ) at a point in time *t* in the future, when the discount rate is *r*, can be written as follows:

Present Value of Cash Flow = 
$$CF_t\left(\frac{1}{(1+r)^t}\right)$$

Note that the second term in the brackets, (1/[1 + r]'), is called the discount factor and effectively weights the cash flow by when it occurs. The differences in weights across time will depend entirely on the level of the discount rate. Consequently, when discount rates are high, which could be due to high real rates, high inflation, and/or high uncertainty, returns that occur further in the future will be weighted less. Appendix 3 includes a more complete discussion of the mechanics of present value.

#### The Case for Time-Weighted Returns

If we accept the arguments that cash flows measure returns more accurately than earnings and that the incremental cash flows more precisely estimate returns than total cash flows, we should logically follow up by using discounted cash flows (i.e., timeweighted returns) rather than nominal cash flows for two reasons.

- 1. Nominal cash flows at different points in time are not comparable and cannot be aggregated to arrive at returns. Discounted cash flows, on the other hand, convert all cash flows on a project to today's terms and allow us to compute returns more consistently.
- 2. If the objective in investment analysis is to maximize the value of the business taking the investments, we should be weighting cash flows that occur early more than cash flow that occur later, because investors in the business will also do so.

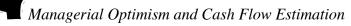
# 5.6. Time Horizons and Time Weighting

Calculating present values for cash flows leads to a greater weighting for cash flows that occur sooner and a lower weighting for cash flows that occur later. Does it necessarily follow that using present value (as opposed to nominal value) makes managers more likely to take short-term projects over long-term projects?

Yes

No

Why or why not?



There is substantial evidence that managers tend to be too optimistic when assessing outcomes from an investment, and systematically overestimate the cash flows on investments. From capital budgeting projects, where expected revenues are higher than expected and costs are lower than expected, to acquisitions, where the projected cash flows on target companies are much higher than actual cash flows, there is an "optimism bias" that leads firms to take many investments that should not be accepted.<sup>8</sup>

The literature on managerial optimism also has two key sub-findings. The first is that people are more optimistic about outcomes that they believe that they can control. Thus, managers often over estimate their capacity to deliver market share and profit margins, in the face of competition. The second is that optimism tends to increase with commitment; the more committed a manager is to an investment, the more he or she is likely to over estimate the cash flows from that investment. These findings suggests two possible solutions to the optimism bias. The first is to take away the project analysis duties away from the project advocates. In other words, managers should not be given the task of generating the expected cash flows from expansion opportunities that they have initiated. In the same vein, investment bankers touting potential target companies for acquisitions should not be generating the expected cash flows for the valuations of these companies. The second is a requirement that all investments, no matter what their pedigree and who advocates them, be put through stress tests, where key assumptions are questioned, changed and analyzed.

To those who believe that hiring more experienced or intelligent managers will solve this problem, there is substantial evidence that the optimism bias becomes worse as managers become more intelligent and with greater experience. In fact, it is to counter this bias that firms often set hurdle rates well above the cost of capital or require net present values to be much greater than zero for a project to pass muster.

<sup>&</sup>lt;sup>8</sup> Heaton, J.B., 2002, "Managerial optimism and corporate finance." Financial Management 33-45.

## **Investment Decision Rules**

Having estimated the accounting earnings, cash flows, and time-weighted cash flows on an investment, we are still faced with the crucial decision of whether we should take the investment. In this section, we will consider a series of investment decision rules and put them to the test.

#### What Is an Investment Decision Rule?

When faced with new investments and projects, firms have to decide whether to invest in them or not. We have been leading up to this decision over the last few chapters, but investment decision rules allow us to formalize the process and specify what conditions need to be met for a project to be acceptable. Although we will be looking at a variety of investment decision rules in this section, it is worth keeping in mind what characteristics we would like a good investment decision rule to have.

- First, a good investment decision rule has to maintain a fair balance between allowing a manager analyzing a project to bring in his or her *subjective assessments* into the decision and ensuring that different projects are judged *consistently*. Thus, an investment decision rule that is too mechanical (by not allowing for subjective inputs) or too malleable (where managers can bend the rule to match their biases) is not a good rule.
- Second, a good investment decision rule will allow the firm to further the stated objective in corporate finance, which is to *maximize the value of the firm*. Projects that are acceptable using the decision rule should increase the value of the firm accepting them, whereas projects that do not meet the requirements would destroy value if the firm invested in them.
- Third, a good investment decision rule should *work across a variety of investments*. Investments can be revenue-generating investments (such as Home Depot opening a new store) or they can be cost-saving investments (as would be the case if Boeing adopted a new system to manage inventory). Some projects have large up-front costs (as is the case with the Boeing Super Jumbo aircraft), whereas other projects may have costs spread out across time. A good investment rule will provide an answer on all of these different kinds of investments.

Does there have to be only one investment decision rule? Although many firms analyze projects using a number of different investment decision rules, one rule has to dominate. In other words, when the investment decision rules lead to different conclusions on whether the project should be accepted or rejected, one decision rule has to be the tie-breaker and can be viewed as the primary rule.

#### Accounting Income–Based Decision Rules

Many of the oldest and most established investment decision rules have been drawn from the accounting statements and, in particular, from accounting measures of income. Some of these rules are based on income to equity investors (i.e., net income), and others are based on operating income.

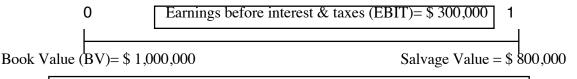
#### Return on Capital

The return on capital on a project measures the returns earned by the firm on it is total investment in the project. Consequently, it is a return to all claimholders in the firm on their collective investment in a project. Defined generally,

Return on Capital (Pretax) = <u>Earnings before interest and taxes</u> <u>Average Book Value of Capital Invested in Project</u>

Return on Capital (After-tax) =  $\frac{\text{Earnings before interest and taxes (1- tax rate)}}{\text{Average Book Value of Capital Invested in Project}}$ 

To illustrate, consider a one-year project, with an initial investment of \$1 million, and earnings before interest and taxes (EBIT) of \$300,000. Assume that the project has a salvage value at the end of the year of \$800,000, and that the tax rate is 40%. In terms of a time line, the project has the following parameters:



Average Book Value of Capital = (1,000,000+800,000)/2 = 900,000

The pretax and after-tax returns on capital can be estimated as follows:

Return on Capital (Pre-tax) = 
$$\frac{\$ 300,000}{\$ 900,000} = 33.33\%$$

Return on Capital (After-tax) = 
$$\frac{\$ 300,000 (1 - 0.40)}{\$ 900,000} = 20\%$$

Although this calculation is rather straightforward for a one-year project, it becomes more involved for multiyear projects, where both the operating income and the book value of the investment change over time. In these cases, the return on capital can either be estimated each year and then averaged over time or the average operating income over the life of the project can be used in conjunction with the average investment during the period to estimate the average return on capital.

The after-tax return on capital on a project has to be compared to a hurdle rate that is defined consistently. The return on capital is estimated using the earnings before debt payments and the total capital invested in a project. Consequently, it can be viewed as return to the firm, rather than just to equity investors. Consequently, the cost of capital should be used as the hurdle rate.

If the after-tax return on capital > Cost of Capital	$\rightarrow$	Accept the project
------------------------------------------------------	---------------	--------------------

If the after-tax return on capital < Cost of Capital  $\rightarrow$  Reject the project For instance, if the company considering this project had a cost of capital of 10%, it

would view the investment in the new project as a good one.

# Illustration 5.8: Estimating and Using Return on Capital in Decision Making: Disney and Bookscape projects

In Illustrations 5.4 and 5.5, we estimated the operating income from two projects—an investment by Bookscape in an online book ordering service and an investment in a theme park in Brazil by Disney. We will estimate the return on capital on each of these investments using our earlier estimates of operating income. Table 5.8 summarizes the estimates of operating income and the book value of capital at Bookscape.

	1	2	3	4	Average
After-tax Operating Income	\$120,000	\$183,000	\$216,300	\$252,930	\$193,058
BV of Capital: Beginning	\$1,150,000	\$930,000	\$698,000	\$467,800	
BV of Capital: Ending	\$930,000	\$698,000	\$467,800	\$0	
Average BV of Capital	\$1,040,000	\$814,000	\$582,900	\$233,900	\$667,700
Return on Capital	11.54%	22.48%	37.11%	108.14%	28.91%

Table 5.8 Return on Capital on Bookscape Online

The book value of capital each year includes the investment in fixed assets and the noncash working capital. If we average the year-specific returns on capital, the average return on capital is 44.82%, but this number is pushed up by the extremely high return in year four. A better estimate of the return on capital is obtained by dividing the average after-tax operating income (\$193,058) over the four years by the average capital invested (\$667,700) over this time, which yields a return on capital of 28.91%. Because this number exceeds the cost of capital of 25.42% that we estimated in Illustration 5.2 for this project, the return on capital approach would suggest that this is a good project.

In Table 5.9, we estimate operating income, book value of capital, and return on capital (ROC) for Rio Disney. The operating income estimates are from Exhibit 5.1.

			Average					
	After-tax					BV of	ROC	ROC
Year	Operating Income	Pre-project investment	Fixed assets	Working capital	Total Capital	Capital	(a)	(b)
0		\$500	\$2,000	\$0	\$2,500		NA	NA
1	-\$31	\$450	\$3,000	\$0	\$3,450	\$2,975	-1.04%	-1.24%
2	-\$93	\$400	\$3,813	\$63	\$4,275	\$3,863	-2.41%	-2.70%
3	-\$52	\$350	\$4,145	\$88	\$4,582	\$4,429	-1.18%	-1.22%
4	\$66	\$300	\$4,027	\$125	\$4,452	\$4,517	1.46%	1.44%
5	\$196	\$250	\$3,962	\$156	\$4,368	\$4,410	4.43%	4.39%
6	\$241	\$200	\$3,931	\$172	\$4,302	\$4,335	5.57%	5.52%
7	\$290	\$150	\$3,931	\$189	\$4,270	\$4,286	6.76%	6.74%
8	\$341	\$100	\$3,946	\$208	\$4,254	\$4,262	8.01%	8.00%
9	\$397	\$50	\$3,978	\$229	\$4,257	\$4,255	9.34%	9.34%
10	\$408	\$0	\$4,010	\$233	\$4,243	\$4,250	9.61%	9.59%
Average							4.05%	3.99%

Table 5.9 Return on Capital for Rio Disney (Income and capital in millions)

Average BV of  $Capital_t = (Capital_{t-1} + Capital_t)/2$ 

ROC (a) = After-tax Operating Income/ Average BV of Capital

ROC (b) = After-tax Operating Income/ BV of Capital at end of prior year

The book value of capital includes the investment in fixed assets (capital expenditures), net of depreciation, and the investment in working capital that year. It also includes the capitalized pre-project investment and the return on capital each year is computed based on the average book value of capital invested during the year. The average after-tax return on capital, computed using the average capital invested, over the ten-year period is 4.05%; it is slightly lower if we use capital at the end of the prior year. Here, the return

on capital is lower than the cost of capital that we estimated in Illustration 5.2 to be 8.62%, and this suggests that Disney should not make this investment.

# Return on Equity

The return on equity looks at the return to equity investors, using the accounting net income as a measure of this return. Again, defined generally,

Return on Equity =  $\frac{\text{Net Income}}{\text{Average Book Value of Equity Investment in Project}}$ To illustrate, consider a four-year project with an initial equity investment of \$800, and the following estimates of net income in each of the four years:

Net Income		\$ 140	\$ 170	\$ 210	\$ 250
	┢				
BV of Equity	\$ 800	\$ 700	\$ 600	\$ 500	\$ 400
Return on Equity		18.67%	26.15%	38.18%	55.56%

Like the return on capital, the return on equity tends to increase over the life of the project, as the book value of equity in the project is depreciated.

Just as the appropriate comparison for the return on capital is the cost of capital, the appropriate comparison for the return on equity is the *cost of equity*, which is the rate of return equity investors demand.

Decision Rule for ROE Measure for Independent Projects				
If the Return on Equity > Cost of Equity	$\rightarrow$	Accept the project		
If the Return on Equity < Cost of Equity	$\rightarrow$	Reject the project		

The cost of equity should reflect the riskiness of the project being considered and the financial leverage taken on by the firm. When choosing between mutually exclusive projects of similar risk, the project with the higher return on equity will be viewed as the better project.

#### Illustration 5.9: Estimating Return on Equity: Aracruz Celulose

Consider again the analysis of the paper plant for Aracruz Celulose that we started in Illustration 5.6. Table 5.10 summarizes the book value of equity and the estimated net income (from Exhibit 5.3) for each of the next ten years in thousands of real BR.

		Beg.			Ending	BV of			Average	
	Net	BV:		Capital	BV:	Working		BV:	BV:	
Year	Income	Assets	Depreciation	Exp.	Assets	Capital	Debt	Equity	Equity	ROE
				R\$	R\$	R\$	R\$	R\$		
0		R\$ 0	R\$ 0	250,000	250,000	35,100	100,000	185,100		
	R\$	R\$			R\$	R\$	R\$	R\$	R\$	
1	24,636	250,000	R\$ 35,000	R\$ 0	215,000	37,800	92,545	160,255	172,678	14.27%
	R\$	R\$			R\$	R\$	R\$	R\$	R\$	
2	36,104	215,000	R\$ 28,000	R\$ 0	187,000	40,500	84,615	142,885	151,570	23.82%
	R\$	R\$			R\$	R\$	R\$	R\$	R\$	
3	46,667	187,000	R\$ 22,400	R\$ 0	164,600	42,750	76,179	131,171	137,028	34.06%
	R\$	R\$			R\$	R\$	R\$	R\$	R\$	
4	55,424	164,600	R\$ 17,920	R\$ 0	146,680	42,750	67,206	122,224	126,697	43.75%
	R\$	R\$		R\$	R\$	R\$	R\$	R\$	R\$	
5	58,167	146,680	R\$ 14,336	50,000	182,344	42,750	57,661	167,433	144,828	40.16%
	R\$	R\$			R\$	R\$	R\$	R\$	R\$	
6	53,860	182,344	R\$ 21,469	R\$ 0	160,875	42,750	47,508	156,117	161,775	33.29%
	R\$	R\$			R\$	R\$	R\$	R\$	R\$	
7	54,287	160,875	R\$ 21,469	R\$ 0	139,406	42,750	36,708	145,448	150,783	36.00%
	R\$	R\$			R\$	R\$	R\$	R\$	R\$	
8	54,742	139,406	R\$ 21,469	R\$ 0	117,938	42,750	25,220	135,468	140,458	38.97%
	R\$	R\$			R\$	R\$	R\$	R\$	R\$	
9	55,225	117,938	R\$ 21,469	R\$ 0	96,469	42,750	12,999	126,220	130,844	42.21%
	R\$	R\$			R\$			R\$	R\$	
10	55,739	96,469	R\$ 21,469	R\$ 0	75,000	R\$ 0	R\$ 0	75,000	100,610	55.40%
								Average	e ROE =	36.19%
aDV I								Ŭ		

Table 5.10 Return on Equity: Aracruz Paper Plant

 $^{a}BV = Book Value$ 

<sup>b</sup>Ending BV = Beg BV + Capital Expenses - Depreciation

To compute the book value of equity in each year, we first compute the book value of the fixed assets (plant and equipment), add to it the book value of the working capital in that year, and subtract out the outstanding debt. The return on equity (ROE) each year is obtained by dividing the net income in that year by the average book value of equity invested in the plant in that year. The increase in the return on equity over time occurs because the net income rises while the book value of equity decreases. The average real return on equity of 36.19% on the paper plant project is compared to the real cost of equity for this plant, which is 18.45%, suggesting that this is a good investment.

#### Assessing Accounting Return Approaches

How well do accounting returns measure up to the three criteria we listed for a good investment decision rule? In terms of maintaining balance between allowing managers to bring into the analysis their judgments about the project and ensuring consistency between analysis, the accounting returns approach falls short. It fails because it is significantly affected by accounting choices. For instance, changing from straight-line to accelerated depreciation affects both the earnings and the book value over time, thus altering returns. Unless these decisions are taken out of the hands of individual managers assessing projects, there will be no consistency in the way returns are measured on different projects.

Does investing in projects that earn accounting returns exceeding their hurdle rates lead to an increase in firm value? The value of a firm is the present value of expected cash flows on the firm over its lifetime. Because accounting returns are based on earnings rather than cash flows and ignore the time value of money, investing in projects that earn a return greater than the hurdle rates will not necessarily increase firm value. Conversely, some projects that are rejected because their accounting returns fall short of the hurdle rate may have increased firm value. This problem is compounded by the fact that the returns are based on the book value of investments, rather than the cash invested in the assets.

Finally, the accounting return works better for projects that have a large up-front investments and generate level income over time. For projects that do not require a significant initial investment, the return on capital and equity has less meaning. For instance, a retail firm that leases store space for a new store will not have a significant initial investment and may have a very high return on capital as a consequence.

Note that all of the limitations of the accounting return measures are visible in the last two illustrations. First, the Disney example does not differentiate between money already spent and money still to be spent; rather, the sunk cost of \$0.5 billion is shown in the initial investment of \$3.5 billion. Second, in both the Bookscape and Aracruz analyses, as the book value of the assets decreases over time, largely as a consequence of depreciation, the operating income rises, leading to an increase in the return on capital. With the Disney analysis, there is one final and very important concern. The return on

capital was estimated over ten years, but the project life is likely to be much longer. After all, Disney's existing theme parks in the United States are more than three decades old and generate substantial cash flows for the firm even today. Extending the project life will push up the return on capital and may make this project viable.

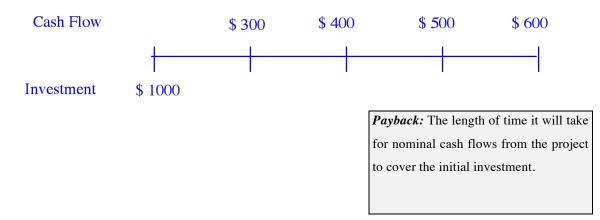
Notwithstanding these concerns, accounting measures of return endure in investment analysis. Although this fact can be partly attributed to the unwillingness of financial managers to abandon familiar measures, it also reflects the simplicity and intuitive appeal of these measures. More important, as long as accounting measures of return are used by investors and equity research analysts to assess to overall performance of firms, these same measures of return will be used in project analysis.

#### **Cash Flow-Based Decision Rules**

Measures of accounting return suffer from all of the problems that we noted with accounting profits. The simplest fix is to replace accounting earnings with cash flows. In this section, we will consider two simple variants: payback, where we examine the number of years it will take to get your money back on an investment and cash flows return on capital, where we modify the conventional return on capital by replacing earnings with cash flows.

#### Payback

The **payback** on a project is a measure of how quickly the cash flows generated by the project cover the initial investment. Consider a project that has the following cash flows:



The payback on this project is between two and three years and can be approximated, based on the cash flows to be 2.6 years.

As with the other measures, the payback can be estimated either for all investors in the project or just for the equity investors. To estimate the payback for the entire firm, the free cash flows to the firm are added up until they cover the total initial investment. To estimate payback just for the equity investors, the free cash flows to equity are cumulated until they cover the initial equity investment in the project.

#### Illustration 5.10: Estimating Payback for the Bookscape Online Service

This example estimates the payback from the viewpoint of the firm, using the Bookscape online service cash flows estimated in Illustration 5.4. Table 5.11 summarizes the annual cash flows and their cumulated value.

Year	Cash flow in year	Cumulated Cash flow
0	-\$1,150,000	
1	\$340,000	-\$810,000
2	\$415,000	-\$395,000
3	\$446,500	\$51,500
4	\$720,730	\$772,230

Table 5.11 Payback for Bookscape Online

The initial investment of \$1.15 million is covered sometime in the third year, leading to a payback of between two and three years. If we assume that cash flows occur uniformly over the course of the year:

Payback for Project = 2 + (\$395,000/\$446,500) = 2.88 years

#### Using Payback in Decision Making

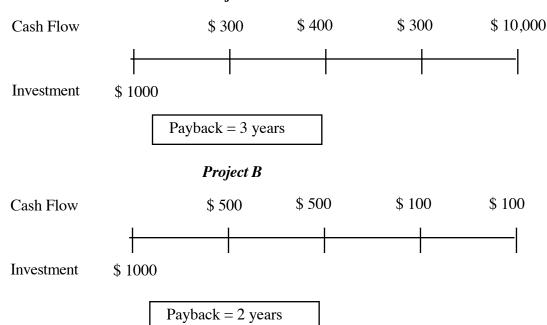
Although it is uncommon for firms to make investment decisions based solely on the payback, surveys suggest that some businesses do in fact use payback as their primary decision mechanism. In those situations where payback is used as the primary criterion for accepting or rejecting projects, a maximum acceptable payback period is typically set. Projects that pay back their initial investment sooner than this maximum are accepted, and projects that do not are rejected. Firms are much more likely to employ payback as a secondary investment decision rule and use it either as a constraint in decision making (e.g., accept projects that earn a return on capital of at least 15%, as long as the payback is less than ten years) or to choose between projects that score equally well on the primary decision rule (e.g., when two mutually exclusive projects have similar returns on equity, choose the one with the lower payback).

#### Biases, Limitations, and Caveats

The payback rule is a simple and intuitively appealing decision rule, but it does not use a significant proportion of the information that is available on a project.

• By restricting itself to answering the question, "When will this project make its initial investment?" it ignores what happens after the initial investment is recouped. This is a significant shortcoming when deciding between mutually exclusive projects. To provide a sense of the absurdities this can lead to, assume that you are picking between two mutually exclusive projects with the cash flows shown in Figure 5.2:





Project A

On the basis of the payback alone, project B is preferable to project A because it has a shorter payback period. Most decision makers would pick project A as the better

project, however, because of the high cash flows that result after the initial investment is paid back.

- The payback rule is designed to cover the conventional project that involves a large up-front investment followed by positive operating cash flows. It breaks down, however, when the investment is spread over time or when there is no initial investment.
- The payback rule uses nominal cash flows and counts cash flows in the early years the same as cash flows in the later years. Because money has time value, however, recouping the nominal initial investment does not make the business whole again, because that amount could have been invested elsewhere and earned a significant return.

# Cash Flow Returns

If the problem with the conventional return on capital and return on equity is the dependence on accounting earnings, there seems to be a simple fix in order. If we can replace earnings with cash flows, the return we should estimate should be a cash flow returns. The modification, though, can be tricky and many existing variants fail consistency tests. Table 5.12 summarizes some of the measures of cash flow returns in use and the measurement issues with each:

Measure	Measurement issues/biases			
EBITDA	Adding back depreciation without netting out capital			
BV of Capital Invested	expenditures and working capital changes will			
-	overstate returns, as will ignoring taxes.			
(EBIT(1-t) + Depreciation)	Same issue with depreciation being added back and			
BV of Capital Invested	capital expenditures not being subtracted out.			
&				
Net Income + Depreciation				
BV of Equity				
(EBIT(1-t) + Depreciation)	Gross capital invested is computed by adding back			
Gross Capital Invested	accumulated depreciation over time to the book value.			
1	It partially corrects for the failure to add back capital			
	expenditures.			

Table 5.12: Measures of Cash Flow Returns

The full estimate of cash flows, described earlier in the chapter, requires subtracting out capital expenditures and changes in non-cash working capital but it is far too volatile on a year-to-year basis to yield reliable measures of returns on equity or capital.

#### **Discounted Cash Flow Measures**

Investment decision rules based on discounted cash flows not only replace

*Net Present Value (NPV):* The sum of the present values of the expected cash flows on the project, net of the initial investment.

accounting income with cash flows but explicitly factor in the time value of money. The two most widely used discounted cash flows rules are *net present value* and the *internal rate of return*.

#### Net Present Value (NPV)

The *net present value* of a project is the sum of the present values of each of the cash flows—positive as well as negative—that occurs over the life of the project. The general formulation of the NPV rule is as follows:

NPV of Project = 
$$\sum_{t=1}^{t=N} \frac{CF_t}{(1+r)^t}$$
 - Initial Investment

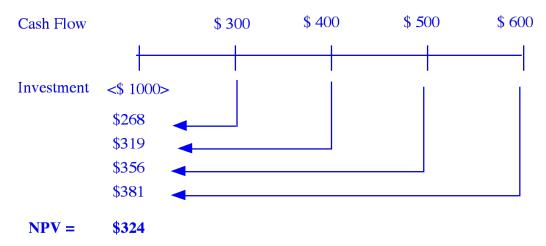
where

 $CF_t = Cash$  flow in period *t* 

r = Discount rate

N = Life of the project.

Consider a simple project, with an initial investment of \$ 1 billion and expected cash flows of \$300 million in year 1, \$ 400 million in year 2, \$ 500 million in year 3 and \$ 600 million in year 4. Assuming a discount rate of 12%, the NPV of a project is depicted in figure 5.3:



#### **Figure 5.3: NPV of a Project**

Once the NPV is computed, the decision rule is extremely simple because the hurdle rate is already factored in the present value.

Decision Rule for NPV for Independent Projects				
If the NPV $> 0$	$\rightarrow$	Accept the project		
If the NPV $< 0$	$\rightarrow$	Reject the project		

Note that an NPV that is greater than zero implies that the project makes a return greater than the hurdle rate.

# 5.7. The Significance of a Positive NPV

Assume that you have analyzed a \$100 million project using a cost of capital of 15% and come up with an NPV of \$1 million. The manager who has to decide on the project argues that this is too small an NPV for a project of this size and that this indicates a poor project. Is this true?

- a. Yes. The NPV is only 1% of the initial investment.
- b. No. A positive NPV indicates a good project.

Explain your answer.

# Illustration 5.11: NPV from the Firm's Standpoint: Bookscape Online

Table 5.13 calculates the present value of the cash flows to Bookscape as a firm from the proposed online book ordering service using the cost of capital of 25.48% as the

discount rate on the cash flows. (The cash flows are estimated in Illustration 5.4 and the cost of capital is estimated in Illustration 5.2.)

Year	Cash Flow	PV of Cash Flows @ 25.48%
0	(\$1,150,000)	\$(1,150,000)
1	\$340,000	\$270,957
2	\$415,000	\$263,568
3	\$446,500	\$225,989
4	\$720,730	\$290,710
NPV		\$(98,775)

Table 5.13 Cashflow to the Firm on Bookscape Online

This project has a net present value of -\$98,775, suggesting that it is a project that should not be accepted based on the projected cash flows and the cost of capital of 25.48%.

#### Illustration 5.12: NPV from the Firm's Standpoint: Rio Disney

In estimating the cash flows to discount for Disney's theme park in Rio, the first point to note when computing the NPV of the proposed theme park is the fact that it has a life far longer than the ten years shown in Exhibit 5.2. To bring in the cash flows that occur after year ten, when cash flows start growing at 2%, the inflation rate forever, we draw on a present value formula for a growing perpetuity (See Appendix 3):

Present Value of Cash Flows after Year 10 =  $\frac{\text{Cashflow}_{11}}{(\text{Cost of Capital} - \text{Perpetual growth rate})}$  $= \frac{\$692 (1.02)}{(.0862 - .02)} = \$10,669 \text{ million}$ 

The cost of capital of 8.62% is the cost of capital for Rio Disney that we estimated in Illustration 5.2. This present value is called the *terminal value* and occurs at the end of year ten.

Table 5.14 presents the NPV of the proposed park estimated using the cash flows in millions of U.S. dollars from Exhibit 5.2 and Disney's cost of capital, in dollar terms, of 8.62%.

Year	Annual Cashflow	Terminal Value	Present Value
0	-\$2,000		-\$2,000
1	-\$1,000		-\$921
2	-\$860		-\$729

Table 5.14 NPV of Rio Disney

3	-\$270		-\$211
4	\$332		\$239
5	\$453		\$300
6	\$502		\$305
7	\$538		\$302
8	\$596		\$307
9	\$660		\$313
10	\$692	\$10,669	\$4,970
	Net Present V	\$2,877	

The NPV of this project is positive. This suggests that it is a good project that will earn

\$2.877 billion in surplus value for Disney.

#### NPV and Currency Choices

When analyzing a project, the cash flows and discount rates can often be estimated in one of several currencies. For a project like the Disney theme park, the obvious choices are the project's local currency (Brazilian Reals- R\$) and the company's home currency (U.S. dollars), but we can in fact use any currency to evaluate the project. When switching from one currency to another, we have to go through the following steps:

Estimate the expected exchange rate for each period of the analysis: For some currencies (Euro, yen, or British pound), we can estimates of expected exchange rates from the financial markets in the form of forward rates. For other currencies, we have to estimate the exchange rate, and the soundest way to do so is to use the expected inflation rates in the two currencies in question. For instance, we can estimate the expected R\$/\$ exchange rate in n years:

Expected Rate (R\$/\$) = \$R/\$ (Today) \* 
$$\left[\frac{(1 + \text{Expected Inflation}_{\text{Brazil}})}{(1 + \text{Expected Inflation}_{\text{US}})}\right]^{T}$$

We are assuming that purchasing power ultimately drives exchange rates—this is called purchasing power parity.

- Convert the expected cash flows from one currency to another in future periods, using these exchange rates: Multiplying the expected cash flows in one currency to another will accomplish this.
- 3. Convert the discount rate from one currency to another: We cannot discount cash flows in one currency using discount rates estimated in another. To convert a

discount rate from one currency to another, we will again use expected inflation rates in the two currencies. A US dollar cost of capital can be converted into R\$ cost of capital as follows:

Cost of Capital(R\$) = 
$$(1 + \text{Cost of Capital ($)}) * \frac{(1 + \text{Exp Inflation}_{\text{Brazil}})}{(1 + \text{Exp Inflation}_{\text{US}})} - 1$$

*a*. Compute the NPV by discounting the converted cash flows (from step 2) at the converted discount rate (from step 3): The NPV should be identical in both currencies but only because the expected inflation rate was used to estimate the exchange rates. If the forecasted exchange rates diverge from purchasing power parity, we can get different NPVs, but our currency views are then contaminating our project analysis.

#### Illustration 5.13: NPV in R\$: Rio Disney

In Illustration 5.12, we computed the NPV for Rio Disney in dollar terms to be \$2,877 million. The entire analysis could have been done in Brazilian Reals (R\$) terms. To do this, the cash flows would have to be converted from dollars to R\$, and the discount rate would then have been a R\$ discount rate. To estimate the expected exchange rate, we will assume that the expected inflation rate will be 7% in Brazil and 2% in the United States and use the exchange rate is 2.04 R\$ per U.S. dollar in May 2009 as the current exchange rate. The projected exchange rate in one year will be:

Expected Exchange Rate in Year 1 = 2.04 R \* (1.07/1.02) = 2.14 R // Similar analyses will yield exchange rates for each of the next ten years.

The dollar cost of capital of 8.62%, estimated in illustration 5.1, is converted to a R\$ cost of capital using the expected inflation rates:

Cost of Capital (R\$) = 
$$(1 + \text{Cost of Capital ($)}) * \frac{(1 + \text{Exp Inflation}_{\text{Brazil}})}{(1 + \text{Exp Inflation}_{\text{US}})} - 1$$
  
=  $(1.0862) (1.07/1.02) - 1 = 13.94\%$ 

Table 5.15 summarizes exchange rates, cash flows, and the present value for the proposed Disney theme parks, with the analysis done entirely in Brazilian Reals.

Table 5.15 Expected Cash Flows from Disney Theme Park in R\$

Year	Cashflow (\$)	R\$/\$	Cashflow (R\$)	Present Value	
0	-\$ 2,000.00	R\$ 2.04	-R\$ 4,080.00	-R\$ 4,080.00	

1	-\$ 1,000.00	R\$ 2.14	-R\$ 2,140.00	-R\$ 1,878.14
2	-\$ 859.50	R\$ 2.24	-R\$ 1,929.49	-R\$ 1,486.19
3	-\$ 270.06	R\$ 2.35	-R\$ 635.98	-R\$ 429.92
4	\$ 332.50	R\$ 2.47	R\$ 821.40	R\$ 487.32
5	\$ 453.46	R\$ 2.59	R\$ 1,175.12	R\$ 611.87
6	\$ 501.55	R\$ 2.72	R\$ 1,363.46	R\$ 623.06
7	\$ 538.06	R\$ 2.85	R\$ 1,534.43	R\$ 615.39
8	\$ 595.64	R\$ 2.99	R\$ 1,781.89	R\$ 627.19
9	\$ 659.64	R\$ 3.14	R\$ 2,070.10	R\$ 639.48
10	\$ 11,360.86	R\$ 3.29	R\$ 37,400.49	R\$ 10,139.72
				R\$ 5,869.78

Note that the NPV of R\$ 5,870 million is exactly equal to the dollar NPV computed in Illustration 5.12, converted at the current exchange rate of 2.04 R\$ per dollar. NPV in dollars = NPV in R\$/Current Exchange Rate = 5,870/2.04 = \$2,877 million

#### In Practice: Terminal Value, Salvage Value, and Net Present Value

When estimating cash flows for an individual project, practicality constrains us to estimate cash flows for a finite period—three, five, or ten years, for instance. At the end of that finite period, we can make one of three assumptions.

- The most conservative one is that the project ceases to exist and its assets are worthless. In that case, the final year of operation will reflect only the operating cash flows from that year.
- We can assume that the project will end at the end of the analysis period and that the assets will be sold for salvage. Although we can try to estimate salvage value directly, a common assumption that is made is that salvage value is equal to the book value of the assets. For fixed assets, this will be the undepreciated portion of the initial investment, whereas for working capital, it will be the aggregate value of the investments made in working capital over the course of the project life.
- We can also assume that the project will not end at the end of the analysis period and try to estimate the value of the project on an ongoing basis—this is the terminal value. In the Disney theme park analysis, for instance, we assumed that the cash flows will continue forever and grow at the inflation rate each year. If that seems too optimistic, we can assume that the cash flows will continue with no growth for a finite period or even that they will drop by a constant rate each year.

The right approach to use will depend on the project being analyzed. For projects that are not expected to last for long periods, we can use either of the first two approaches; a zero salvage value should be used if the project assets are likely to become obsolete by the end of the project life (e.g., computer hardware), and salvage can be set to book value if the assets are likely to retain significant value (e.g., buildings).

For projects with long lives, the terminal value approach is likely to yield more reasonable results but with one caveat. The investment and maintenance assumptions made in the analysis should reflect its long life. In particular, capital maintenance expenditures will be much higher for projects with terminal value because the assets have to retain their earning power. For the Disney theme park, the capital maintenance expenditures climb over time and become larger than depreciation as we approach the terminal year.

# 5.8. Currency Choices and NPV

A company in a high-inflation economy has asked for your advice regarding which currency to use for investment analysis. The company believes that using the local currency to estimate the NPV will yield too low a value because domestic interest rates are very high—this, in turn, would push up the discount rate. Is this true?

a. Yes. A higher discount rate will lead to lower NPV.

b. No.

Explain your answer.

#### NPV: Firm versus Equity Analysis

In the previous analysis, the cash flows we discounted were prior to interest and principal payments, and the discount rate we used was the weighted average cost of capital. In NPV parlance, we were discounting cash flows to the entire firm (rather than just its equity investors) at a discount rate that reflected the costs to different claimholders in the firm to arrive at an NPV. There is an alternative. We could have discounted the cash flows left over after debt payments for equity investors at the cost of equity and arrived at an NPV to equity investors. Will the two approaches yield the same NPV? As a general rule, they will, but only if the following assumptions hold:

- The debt is correctly priced and the market interest rate to compute the cost of capital is the right one, given the default risk of the firm. If not, it is possible that equity investors can gain (if interest rates are set too low) or lose (if interest rates are set too high) to bondholders. This in turn can result in the NPV to equity being different from the NPV to the firm.
- The same assumptions are made about the financing mix used in both calculations. Note that the financing mix assumption affects the discount rate (cost of capital) in the firm approach and the cash flows (through the interest and principal payments) in the equity approach.

Given that the two approaches yield the same NPV, which one should we choose to use? Many practitioners prefer discounting cash flows to the firm at the cost of capital,; it is easier to do because the cash flows are before debt payments and therefore we do not have to estimate interest and principal payments explicitly. Cash flows to equity are more intuitive, though, because most of us think of cash flows left over after interest and principal payments as residual cash flows.

#### Illustration 5.14: NPV from the Equity Investors' Standpoint: Paper Plant for Aracruz

The NPV is computed from the equity investors' standpoint for the proposed linerboard plant for Aracruz using real cash flows to equity, estimated in Exhibit 5.4, and a real cost of equity of 18.45% (estimated earlier in illustration 5.2). Table 5.16 summarizes the cash flows and the present values.

Year	Cash flow to Equity	PV of Cashflow @ 18.45%
0	-R\$ 185,100	-R\$ 185,100
1	R\$ 49,481	R\$ 41,773
2	R\$ 53,474	R\$ 38,110
3	R\$ 58,382	R\$ 35,126
4	R\$ 64,371	R\$ 32,696
5	R\$ 12,958	R\$ 5,556
6	R\$ 65,176	R\$ 23,594
7	R\$ 64,956	R\$ 19,851
8	R\$ 64,722	R\$ 16,698

Table 5.16 Cashflow to Equity on Linerboard Plant (in Thousands)

9	R\$ 64,473	R\$ 14,043
10	R\$ 181,958	R\$ 33,458
Ne	et Present Value =	R\$ 75,806

The net present value of R\$ 75.806 million suggests that this is a good project for Aracruz to invest in.

The analysis was done entirely in real terms, but using nominal cash flows and discount rate would have had no impact on the NPV. The cash flows will be higher because of expected inflation, but the discount rate will increase by exactly the same magnitude, thus resulting in an identical NPV. The choice between nominal and real cash flows therefore boils down to one of convenience. When inflation rates are low, it is better to do the analysis in nominal terms because taxes are based on nominal income. When inflation rates are high and volatile, it is easier to do the analysis in real terms or in a different currency with a lower expected inflation rate.

# 5.9. Equity, Debt, and NPV

In the project just described, assume that Aracruz had used all equity to finance the project instead of its mix of debt and equity. Which of the following is likely to occur to the NPV?

- a. The NPV will go up, because the cash flows to equity will be much higher; there will be no interest and principal payments to make each year.
- b. The NPV will go down, because the initial investment in the project will much higher.
- c. The NPV will remain unchanged, because the financing mix should not affect the NPV.
- d. The NPV might go up or down, depending on . . .
- Explain your answer.

#### Illustration 5.15: Valuing a company for an acquisition: Sensient Technologies

Extending the net present value rule to cover an entire company is not complicated. Consider the proposed acquisition of Sensient Technologies by Tata Chemicals:

- In illustration 5.2, we estimated the cost of capital of 6.98% as the right discount rate to apply in valuing Sensient Technologies. This cost is estimated in US dollar terms and reflects the mature market exposure of the company.
- In illustration 5.7, we estimated the cash flow to the firm of \$76.06 million, in 2008, for Sensient Technologies. We also assumed that these cash flows would grow 2% a year in perpetuity.

We can estimate the value of the firm, based on these inputs:

Value of Operating Assets 
$$= \frac{\text{Expected Cashflow to the firm next year}}{(\text{Cost of Capital} - \text{Stable growth rate})}$$
$$= \frac{\$76.06 (1.02)}{(.0698 - .02)} = \$1,559 \text{ million}$$

Adding the cash balance of the firm (\$8 million) and subtracting out the existing debt (\$460 million) yields the value of equity in the firm:

Value of Equity = Value of Operating Assets + Cash – Debt = \$1,559 + \$8 - \$460 million = \$1,107 million

The market value of equity in Sensient Technologies in May 2009 was \$1,150 million. To the extent that Tata Chemicals pays a premium over this market price, it has to generate other benefits from the merger that will cover the difference.

#### Properties of the NPV Rule

The NPV has several important properties that make it an attractive decision rule and the preferred rule, at least if corporate finance theorist were doing the picking.

## 1. NPVs Are Additive

The NPVs of individual projects can be aggregated to arrive at a cumulative NPV for a business or a division. No other investment decision rule has this property. The property itself has a number of implications.

• The value of a firm can be written in terms of the present values of the cash flows of the projects it has already taken on as well as the expected NPVs of prospective future projects:

Value of firm = 
$$\sum$$
 Present Value of Projects in Place +  $\sum$  NPV of Future Projects

Assets in Place: The assets already owned by a firm or

projects that it has already

taken.

The first term in this equation captures the value of *assets in place*, whereas the second term measures the value of *expected future growth*. Note that the present value of projects in place is based on anticipated future cash flows on these projects.

- When a firm terminates an existing project that has a negative present value based on anticipated future cash flows, the value of the firm will increase by that amount. Similarly, when a invests in a new project, with an expected negative NPV, the value of the firm will decrease by that amount.
- When a firm divests itself of an existing asset, the price received for that asset will affect the value of the firm. If the price received exceeds the present value of the anticipated cash flows on that project to the firm, the value of the firm will increase with the divestiture; otherwise, it will decrease.
- When a firm invests in a new project with a positive NPV, the value of the firm will be affected depending on whether the NPV meets expectations. For example, a firm like Microsoft is expected to take on high positive NPV projects, and this expectation is built into value. Even if the new projects taken on by Microsoft have positive NPV, there may be a drop in value if the NPV does not meet the high expectations of financial markets.
- When a firm makes an acquisition and pays a price that exceeds the present value of the expected cash flows from the firm being acquired, it is the equivalent of taking on a negative NPV project and will lead to a drop in value.

# **5.10.** Firm Value and Overpayment on Acquisitions

Megatech Corporation, a large software firm with a market value for its equity of \$100 million, announces that it will be acquiring FastMail Corporation, a smaller software firm, for \$15 million. On the announcement, Megatech's stock price drops by 3%. Based on these facts, estimate the amount the market thinks Megatech should have paid for FastMail.

- a. \$15 million
- b. \$3 million
- c. \$12 million

How does NPV additivity enter into your answer?

#### 2. Intermediate Cash Flows Are Invested at the Hurdle Rate

Implicit in all present value calculations are assumptions about the rate at which

intermediate cash flows get reinvested. The NPV rule assumes that intermediate cash flows on a projects—that is, cash flows that occur between the initiation and the end of the project—get

*Hurdle Rate:* The minimum acceptable rate of return that a firm will accept for taking a given project.

reinvested at the **hurdle rate**, which is the cost of capital if the cash flows are to the firm and the cost of equity if the cash flows are to equity investors. Given that both the cost of equity and capital are based on the returns that can be made on alternative investments of equivalent risk, this assumption should be reasonable.

3. NPV Calculations Allow for Expected Term Structure and Interest Rate Shifts

In all the examples throughout in this chapter, we have assumed that the discount rate remains unchanged over time. This is not always the case, however; the NPV can be computed using time-varying discount rates. The general formulation for the NPV rule is as follows:

NPV of Project = 
$$\sum_{t=1}^{t=N} \frac{CF_t}{\prod_{j=1}^{j=t} (1 + r_t)}$$
 - Initial Investment

where

 $CF_t = Cash$  flow in period *t* 

 $r_t$  = One-period discount rate that applies to period t

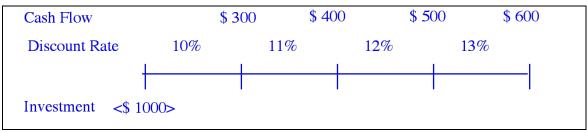
N = Life of the project.

The discount rates may change for three reasons:

- The level of interest rates may change over time, and the term structure may provide some insight on expected rates in the future.
- The risk characteristics of the project may be expected to change in a predictable way over time, resulting in changes in the discount rate.
- The financing mix on the project may change over time, resulting in changes in both the cost of equity and the cost of capital.

#### Illustration 5.16: NPV Calculation with Time-Varying Discount Rates

Assume that you are analyzing a four-year project investing in computer software development. Furthermore, assume that the technological uncertainty associated with the software industry leads to higher discount rates in future years.



The present value of each of the cash flows can be computed as follows.

PV of Cash Flow in year $2 = \frac{400}{(1.10 * 1.11)} = 327$	.72
	.60
PV of Cash Flow in year $3 = \frac{500}{(1.10 * 1.11 * 1.12)} = 3365$	.63
PV of Cash Flow in year $4 = \frac{600}{(1.10 * 1.11 * 1.12 * 1.13)} = 388$	.27
NPV of Project = $$272.72 + $327.60 + $365.63 + $388.27 - $1000.00 = $354$	.23

# 5.11. Changing Discount Rates and NPV

In the analysis just done, assume that you had been asked to use one discount rate for all of the cash flows. Is there a discount rate that would yield the same NPV as the one above?

a. Yes

b. No

If yes, how would you interpret this discount rate?

#### Biases, Limitations, and Caveats

In spite of its advantages and its linkage to the objective of value maximization, the NPV rule continues to have its detractors, who point out several limitations.

• The NPV is stated in absolute rather than relative terms and does not therefore factor in the scale of the projects. Thus, project A may have an NPV of \$200, whereas project B has an NPV of \$100, but project A may require an initial investment that is 10 or 100 times larger than project B. Proponents of the NPV rule argue that it is surplus value, over and above the hurdle rate, no matter what the investment.

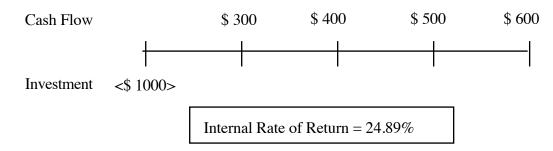
• The NPV rule does not control for the life of the project. Consequently, when comparing mutually exclusive projects with different lifetimes, the NPV rule is biased toward accepting longer-term projects.

#### Internal Rate of Return

The **internal rate of return (IRR)** is based on discounted cash flows. Unlike the NPV rule, however, it takes into account the project's scale. It is the discounted cash flow

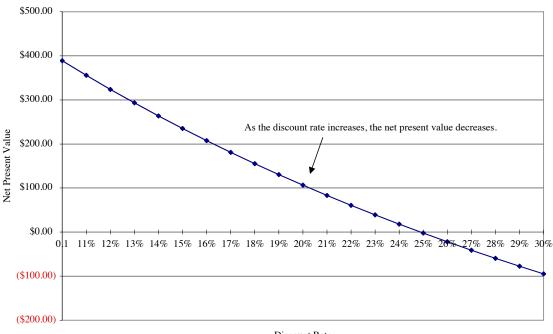
analog to the accounting rates of return. Again, in general terms, the IRR is that discount rate that makes the NPV of a project equal to zero. To illustrate, consider again the project described at the beginning of the NPV discussion.

Internal Rate of Return (IRR): The rate of return earned by the project based on cash flows, allowing for the time value of money.



At the internal rate of return, the NPV of this project is zero. The linkage between the NPV and the IRR is most obvious when the NPV is graphed as a function of the discount rate in a **net present value profile**. An NPV profile for the project described is illustrated in Figure 5.4.

Figure 5.4: NPV Profile



Discount Rate

The NPV profile provides several insights on the project's viability. First, the internal rate of return is clear from the graph—it is the point at which the profile crosses the *x*-axis. Second, it provides a measure of how sensitive the NPV—and, by extension, the

project decision—is to changes in the discount rate. The slope of the NPV profile is a measure of the discount rate sensitivity of the project. Third, when mutually

*NPV Profile:* This measures the sensitivity of the NPV to changes in the discount rate.

exclusive projects are being analyzed, graphing both NPV profiles together provides a measure of the break-even discount rate—the rate at which the decision maker will be indifferent between the two projects.

# 5.12. Discount Rates and NPV

In the project just described, the NPV decreased as the discount rate was increased. Is this always the case?

- a. Yes.
- b. No

## If no, when might the NPV go up as the discount rate is increased?

#### Using the IRR

One advantage of the IRR is that it can be used even in cases where the discount rate is unknown. While this is true for the calculation of the IRR, it is *not true* when the decision maker has to use the IRR to decide whether to take a project. At that stage in the process, the IRR has to be compared to the discount rate—f the IRR is greater than the discount rate, the project is a good one; alternatively, the project should be rejected.

Like the NPV, the IRR can be computed in one of two ways:

- The IRR can be calculated based on the free cash flows to the firm and the total investment in the project. In doing so, the IRR has to be compared to the cost of capital.
- The IRR can be calculated based on the free cash flows to equity and the equity investment in the project. If it is estimated with these cash flows, it has to be compared to the cost of equity, which should reflect the riskiness of the project.

Decision Rule for IRR for Independent Projects

A. IRR is computed on cash flows to the firm

If the IRR > Cost of Capital	$\rightarrow$	Accept the project
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If the IRR < Cost of Capital  $\rightarrow$  Reject the project

B. IRR is computed on cash flows to equity

If the IRR > Cost of Equity  $\rightarrow$  Accept the project

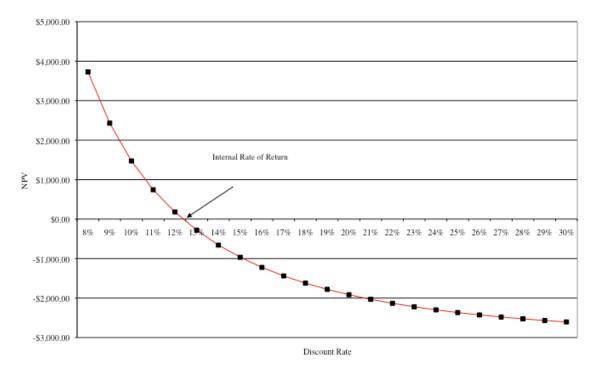
If the IRR < Cost of Equity  $\rightarrow$  Reject the project

When choosing between projects of equivalent risk, the project with the higher IRR is viewed as the better project.

#### Illustration 5.17: Estimating the IRR Based on FCFF: Rio Disney

The cash flows to the firm from Rio Disney, are used to arrive at a NPV profile for the project in Figure 5.5.





The IRR in dollar terms on this project is 12.35%, which is *higher* than the cost of capital of 8.62%. These results are consistent with the findings from the NPV rule, which also recommended investing in the theme parks.<sup>9</sup>

#### Illustration 5.18: Estimating IRR Based Upon FCFE - Aracruz Celulose

The net present value profile depicted in Figure 5.6 is based upon the equity investment and the free cash flows to equity estimated for the paper plant for Aracruz.

<sup>&</sup>lt;sup>9</sup>The terminal value of the project itself is a function of the discount rate used. That is why the IRR function in Excel will not yield the right answer. Instead, the NPV has to be recomputed at every discount rate and the IRR is the point at which the NPV = 0.

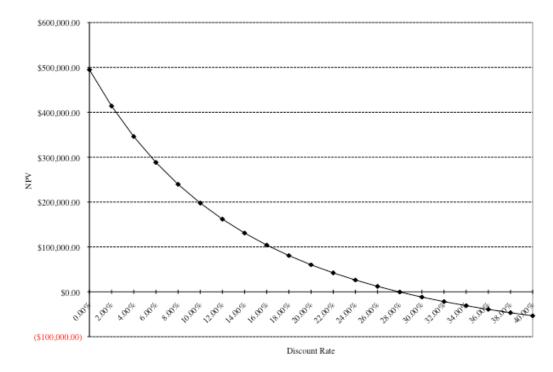


Figure 5.6: NPV Profile on Equity Investment in Paper Plant: Aracruz

The IRR (in real terms) on this project is 27.92%, which is *higher* than the real cost of equity of 18.45%. Again, these results are consistent with the findings from the NPV rule, which also recommended accepting this investment.

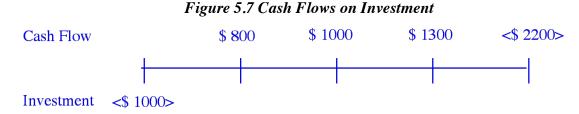
#### Biases, Limitations, and Caveats

The IRR is the most widely used discounted cash flow rule in investment analysis, but it does have some serious limitations.

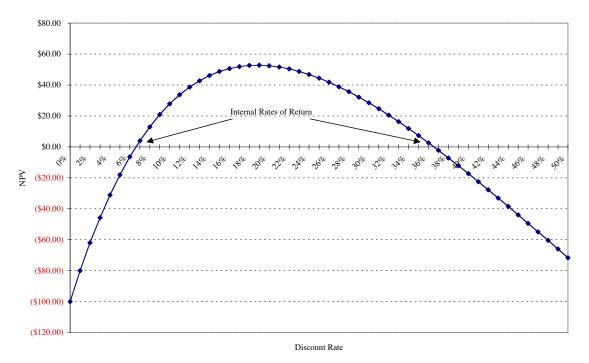
- Because the IRR is a scaled measure, it tends to bias decision makers toward smaller projects, which are much more likely to yield high%age returns, and away from larger ones.
- There are a number of scenarios in which the IRR cannot be computed or is not meaningful as a decision tool. The first is when there is no or only a very small initial investment and the investment is spread over time. In such cases, the IRR cannot be computed or, if computed, is likely to be meaningless. The second is when there is more than one internal rate of return for a project, and it is not clear which one the decision maker should use.

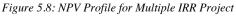
#### Illustration 5.19: Multiple IRR Projects

Consider a project to manufacture and sell a consumer product, with a hurdle rate of 12%, that has a four-year life and the following cash flows over those four years. The project, which requires the licensing of a trademark, requires a large payment at the end of the fourth year. Figure 5.7 shows the cash flows.



The NPV profile for this project, shown in Figure 5.8, reflects the problems that arise with the IRR measure.





As you can see, this project has two IRRs: 6.60% and 36.55%. Because the hurdle rate falls between these two IRRs, the decision on whether to take the project will change depending on which IRR is used. To make the right decision in this case, the decision maker would have to look at the NPV profile. If, as in this case, the NPV is positive at the

hurdle rate, the project should be accepted. If the NPV is negative at the hurdle rate, the project should be rejected.

#### In Practice: Multiple IRRs: Why They Exist and What to Do about Them

The IRR can be viewed mathematically as a root to the present value equation for cash flows. In the conventional project, where there is an initial investment and positive cash flows thereafter, there is only one sign change in the cash flows, and one root—that is, there is a unique IRR. When there is more than one sign change in the cash flows, there will be more than one IRR.<sup>10</sup> In Figure 5.7, for example, the cash flow changes sign from negative to positive in year one, and from positive to negative in year four, leading to two IRRs.

Lest this be viewed as some strange artifact that is unlikely to happen in the real world, note that many long-term projects require substantial reinvestment at intermediate points in the project and that these reinvestments may cause the cash flows in those years to become negative. When this happens, the IRR approach may run into trouble.

There are a number of solutions suggested to the multiple IRR problems. One is to use the hurdle rate to bring the negative cash flows from intermediate periods back to the present. Another is to construct an NPV profile. In either case, it is probably much simpler to estimate and use the NPV.

## **Probabilistic Approaches to Investment Analysis**

In all of the approaches that we described in the last section – accounting returns, payback, NPV and IRR – we used earnings or cash flows that were estimated for future years for the projects that we were analyzing. While we use expected values for revenues, margins and other key variables, the future is uncertain and the estimates will therefore reflect that uncertainty. While we cannot make this uncertainty disappear, we can consider ways in which we get a better handle on how a project's value will change as the inputs change. In this section, we will examine four approaches for dealing with uncertainty. The first and simplest is sensitivity analysis, where we ask what-if questions about key variables and to estimate how much room for error we have on each one. The

<sup>&</sup>lt;sup>10</sup>Athough the number of IRRs will be equal to the number of sign changes, some IRRs may be so far out of the realm of the ordinary (e.g. 10,000%) that they may not create the kinds of problems described here.

second is scenario analysis, where we develop a few possible scenarios, ranging from good to bad outcomes and compute the value of the project under each one. The third approach is decision trees, designed for multi-stage investments, where we evaluate the probabilities of success and failure at each stage and the consequences for the final value. The last approach is simulations, where we estimate probability distributions for each input variable rather than expected values. As a consequence, we will generate a distribution of values for a project, rather than a single number.

#### Sensitivity Analysis

The simplest way to deal with uncertainty is to ask "what if?" questions about key inputs into the analysis, with two objectives in mind. One is to get a sense of how much the value of the project and your decision about investing in the project change as you modfiy key assumptions. The other is to get a measure of how much margin for error you have on your estimates. Put another way, sensitivity analysis can be used to analyze how much you can afford to be off in your estimates of revenue growth and margins without altering your decision to accept or reject the investment. There are some dangers to sensitivity analysis:

- a. <u>Overdoing what if analyses</u>: There are often dozens of inputs that go into a project analysis, and we could do sensitivity analyses on each and every one of these inputs. In the process, though, we mix the variables that matter with those that do not and risk obscuring the importance of the former.
- b. Losing sight of the objective: The ultimate objective asking "What if?" is not to generate more tables, graphs and numbers but to make better decisions in the face of uncertainty. To help in decision-making, sensitivity analysis should be focused on key variables and the findings should be presented in ways that help decision makers better a grip on how outcomes will change as assumptions change.
- c. <u>Not considering how variables move together</u>: In most sensitivity analysis, we change one input at a time, keeping all other inputs at their base case values. While this makes computation simpler, it may be unrealistic, since input variables are often correlated with each other. Thus, assuming that margins will increase while keeping revenue growth fixed or that interest rates will go down while

inflation stays high may yield higher net present values for the project, but neither is likely to happen.

d. <u>Double counting risk</u>: In any sensitivity analysis, even good projects (with positive NPV and high IRR) will have negative net present values if key variables move adversely. Decision makers who use this as a rationale for rejecting these projects are potentially double counting risk, since the cash flows were discounted back at a risk-adjusted rate to estimate the base case NPV.

In general, there are two good uses for sensitivity analysis. The first is that it can be used as a tie-breaker when firms have to choose between two projects that are roughly equivalent in terms of base case net present value or IRR; the project that is less sensitive to changes in the key variables should be picked. The second is to use the output from sensitivity analysis to better manage both the operations and the risks of an investment, in the post-acceptance phase. Thus, knowing that the net present value of an investment is sensitive to labor costs may lead to entering into labor contracts that keep these costs under control. Similarly, the finding that a project's value fluctuates as exchange rates move may result in the firm using currency options and futures to hedge risk.

### Illustration 5.20: Aracruz Paper Plant: Sensitivity Analysis and Break Even

In illustration 5.14, we estimated a NPV of R\$ 75.8 million for Aracruz's proposed paper plant. While that value suggests that the plant would be a good investment, the conclusion is heavily dependent upon two variables – the price of paper and pulp and the R\$/\$ exchange rate. The pulp price affects revenues directly and a significant drop in paper prices will make the project an unattractive one; thus changing the assumption that the price per ton will remain at \$ 400 in real terms will affect the value of the project. The exchange rate matters because Aracruz sells a significant portion of its output into dollar-based markets but has most of its costs in Brazil (and in R\$). If the Brazilian Real strengthens relative to the US dollar, Aracruz will find itself squeezed, unable to raise prices but facing higher costs.

In the first part of the sensitivity analysis, we changed the price per ton, in real terms, of pulp from our base case value of \$ 400 and mapped out the effect on the NPV and IRR of the investment. Figure 5.9 presents the findings:

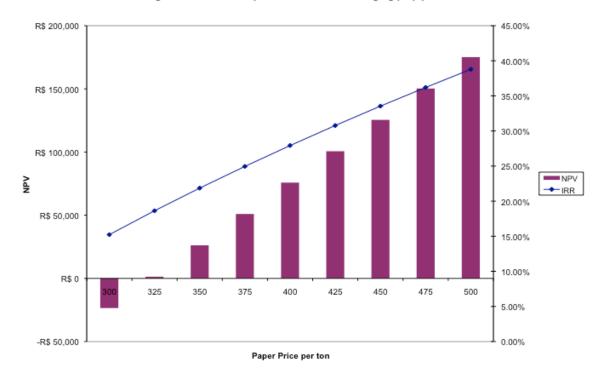


Figure 5.9: Aracruz Paper Plant: Effect of Changing pulp prices

Note that the NPV for the project drops below zero, if paper prices drop below \$325/ton and the IRR drops below the real cost of equity of 18.45%. In making these computations, we held fixed costs constant and kept variable costs at 45% of revenues.

In the second part of the analysis, we assessed the impact of unexpected changes in the exchange rate. While we have built in an expected devaluation into the R\$, based upon the inflation rates of 7% for Brazil and 2% for the US, it is entirely possible that the R\$ could become stronger or weaker, relative to the US dollar. Every 1% increase in the value of the R\$/\$, relative to our assessments, will increase the variable cost (which is entirely R\$ based), as a proportion of revenues, by 1%. Thus, if the R\$ is 5% stronger than expected, the variable costs will be 50% of revenues (instead of our base case estimate of 45%). Figure 5.10 presents the effects of exchange rate changes on NPV and IRR.

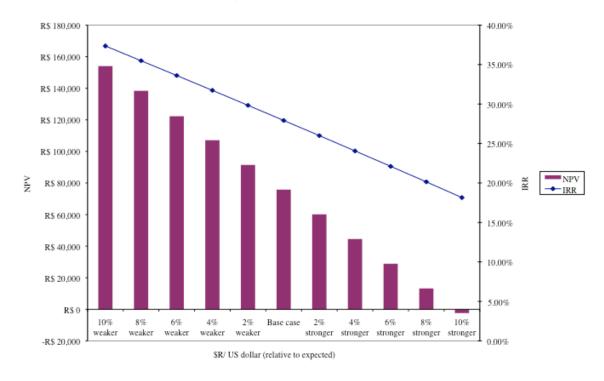


Figure 5.10: Aracruz Paper Plant: Effect of Changing Exchange Rates

If the Brazilian Real strengthens 10% of more, relative to our estimates, the associated jump in variable costs alters our assessment of the project, from positive to negative.

### In Practice: Should you hedge project risk?

Looking at the sensitivity analysis for the Aracruz paper plant, it is quite clear that the value of the plant will change significantly if paper prices change or if there are unexpected changes in exchange rates. Since there are derivatives markets on both the commodity (paper) and exchange rates, an open question then becomes whether Aracruz should hedge against these risks, using forwards, futures or options.

The answer is not clear-cut. While hedging risk makes the project's cash flows more predictable, there are two costs to consider. The first is that investors in the company may want to be exposed to the risk; investors in an oil, gold mining or paper company may be investing in the company because they believe that these commodities will go up in price and hedging that risk will undercut their rationale. The second is that hedging can be costly and it may be more efficient and cheaper for investors to hedge risk in their portfolios than it is for individual companies to each hedge risks. Thus, an investor who holds a large number of stocks exposed to exchange rate risk in the R\$/\$

rate may be able to diversify away a large component of that risk in his portfolio and then can choose to hedge or not hedge the remaining risk. These costs have to be weighed against two potential benefits. The first is that hedging against risks that can cause large losses, relative to the size of the firm, may reduce the chance of default, especially if a firm has significant debt obligations. The second is that hedging risk can sometimes yield tax benefits, both in the form of tax-deductible expenses for hedging and from smoothing out earnings.

Applying this trade off to Aracruz, we come to a mixed conclusion. The firm has significant debt obligations and cannot risk large losses. Consequently, we think it makes sense for the firm to hedge exchange rate risk, especially because it is relatively inexpensive to do so, using futures and forward contracts. Given that it is a commodity company, we are reluctant to suggest the same path for paper prices, since investors in the company may want that exposure. One compromise that will allow these investors to retain the upside, while protecting against very adverse moves in pulp prices, would be for Aracruz to buy put options on paper at a price of around \$325 (the breakeven point for NPV). Since the put options will be deep out of the money, the costs should be moderate and investors will still get most of the upside on paper prices.

### Scenario Analysis

In sensitivity analysis, we change one input variable at a time and examine the effect on the output variables – NPV, IRR and accounting returns. In scenario analysis, we outline scenarios that are different from the base case, where many or all of the inputs can have different values, and evaluate the project's value under these scenarios. In general, scenario analysis can take one of two forms: a best case/worst case analysis or an analysis of multiple possible scenarios.

#### Best Case, Worst Case

With risky projects, the actual cash flows can be very different from expectations. At the minimum, we can estimate the cash flows if everything works to perfection – a best case scenario – and if nothing does – a worse case scenario. In practice, there are two ways in which this analysis can be structured. In the first, each input into the project analysis is set to its best (or worst) possible outcome and the cash flows estimated with

those values. Thus, when analyzing a project, you may set the revenue growth rate and operating margin at the highest possible level while setting the discount rate at its lowest level, and compute the value as the best-case scenario. The problem with this approach is that it may not be feasible; after all, to get the high revenue growth, the firm may have to lower prices and accept lower margins. In the second, the best possible scenario is defined in terms of what is feasible while allowing for the relationship between the inputs. Thus, instead of assuming that revenue growth and margins will both be maximized, we will choose that combination of growth and margin that is feasible and yields the maximum value. While this approach is more realistic, it does require more work to put into practice.

There are two ways in which the results from this analysis can help decision makers. First, the difference between the best case and worst case value can be used as a measure of risk on an asset; the range in value (scaled to size) should be higher for riskier investments. Second, firms that are concerned about the potential spill over effects on their operations of an investment going bad may be able to gauge the effects by looking at the worst case outcome. Thus, a firm that has significant debt obligations may use the worst case outcome to make a judgment as to whether an investment has the potential to push them into default. In general, though, best case/worse case analyses are not very informative. After all, there should be no surprise in knowing that an investment is worth a great deal in the best case and does badly in the worst case.

### Multiple Scenario Analysis

Scenario analysis does not have to be restricted to the best and worst cases. In its most general form, the value of a risky investment can be computed under a number of different scenarios, varying the assumptions about both macro economic and asset-specific variables. While the concept of sensitivity analysis is a simple one, it has four critical components:

• The first is the determination of which factors the scenarios will be built around. These factors can range from the state of the economy for an automobile firm considering a new plant, to the response of competitors for a consumer product firm introducing a new product, to the behavior of regulatory authorities for a phone company, considering a new phone service.

- The second component is determining the number of scenarios to analyze for each factor. While more scenarios may be more realistic than fewer, it becomes more difficult to collect information and differentiate between the scenarios in terms of asset cash flows.. The question of how many scenarios to consider will depend then upon how different the scenarios are, and how well the analyst can forecast cash flows under each scenario.
- The third component is the estimation of asset cash flows under each scenario. It is to ease the estimation at this step that we focus on only two or three critical factors and build relatively few scenarios for each factor.
- The final component is the assignment of probabilities to each scenario. For some scenarios, involving macro-economic factors such as exchange rates, interest rates and overall economic growth, we can draw on the expertise of services that forecast these variables. For other scenarios, involving either the sector or competitors, we have to draw on our knowledge about the industry.

The output from a scenario analysis can be presented as values under each scenario and as an expected value across scenarios (if the probabilities can be estimated in the fourth step).

In general, scenario analysis is best suited for risks that are either discrete or can be categorized into discrete groups. Thus, it is better suited to deal with the risk that a competitor will introduce a product similar to your product (the competitor either will or will not) than it is to deal with the risk that interest rates may change in future periods.

### **Decision Trees**

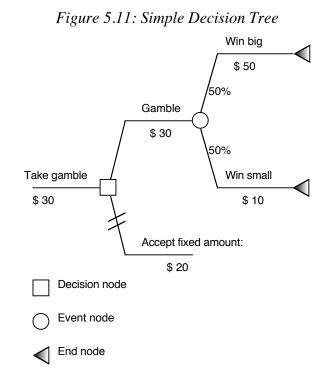
In some projects, risk is not only discrete but is sequential. In other words, for an investment to succeed, it has to pass through a series of tests, with failure at any point potentially translating into a complete loss of value. This is the case, for instance, with a pharmaceutical drug that is just being tested on human beings. The three-stage FDA approval process lays out the hurdles that have to be passed for this drug to be commercially sold, and failure at any of the three stages dooms the drug's chances. Decision trees allow us to not only consider the risk in stages but also to devise the right response to outcomes at each stage.

#### Steps in Decision Tree Analysis

The first step in understanding decision trees is to distinguish between root nodes, decision nodes, event nodes and end nodes.

- The root node represents the start of the decision tree, where a decision maker can be faced with a decision choice or an uncertain outcome. The objective of the exercise is to evaluate what a risky investment is worth at this node.
- Event nodes represent the possible outcomes on a risky gamble; whether a drug passes the first stage of the FDA approval process or not is a good example. We have to figure out the possible outcomes and the probabilities of the outcomes occurring, based upon the information we have available today.
- Decision nodes represent choices that can be made by the decision maker -to expand from a test market to a national market, after a test market's outcome is known.
- End nodes usually represent the final outcomes of earlier risky outcomes and decisions made in response.

Consider a very simple example. You are offered a choice where you can take a certain amount of \$ 20 or partake in a gamble, where you can win \$ 50 with probability 50% and \$10 with probability 50%. The decision tree for this offered gamble is shown in figure 5.11:



Note the key elements in the decision tree. First, only the event nodes represent uncertain outcomes and have probabilities attached to them. Second, the decision node represents a choice. On a pure expected value basis, the gamble is better (with an expected value of \$ 30) than the guaranteed amount of \$20; the double slash on the latter branch indicates that it would not be selected. While this example may be simplistic, the elements of building a decision tree are in it.

<u>Step 1: Divide analysis into risk phases</u>: The key to developing a decision tree is outlining the phases of risk that you will be exposed to in the future. In some cases, such as the FDA approval process, this will be easy to do since there are only two outcomes – the drug gets approved to move on to the next phase or it does not. In other cases, it will be more difficult. For instance, a test market of a new consumer product can yield hundreds of potential outcomes; here, you will have to create discrete categories for the success of the test market.

<u>Step 2: In each phase, estimate the probabilities of the outcomes</u>: Once the phases of risk have been put down and the outcomes at each phase are defined, the probabilities of the outcomes have to be computed. In addition to the obvious requirement that the probabilities across outcomes has to sum up to one, the analyst will also have to consider whether the probabilities of outcomes in one phase can be affected by outcomes in earlier phases. For example, how does the probability of a successful national product introduction change when the test market outcome is only average?

<u>Step 3: Define decision points</u>: Embedded in the decision tree will be decision points where you will get to determine, based upon observing the outcomes at earlier stages, and expectations of what will occur in the future, what your best course of action will be. With the test market example, for instance, you will get to determine, at the end of the test market, whether you want to conduct a second test market, abandon the product or move directly to a national product introduction.

<u>Step 4: Compute cash flows/value at end nodes</u>: The next step in the decision tree process is estimating what the final cash flow and value outcomes will be at each end node. In some cases, such as abandonment of a test market product, this will be easy to do and will represent the money spent on the test marketing of the product. In other cases, such as a national launch of the same product, this will be more difficult to do since you will

have to estimate expected cash flows over the life of the product and discount these cash flows to arrive at value.

<u>Step 5: Folding back the tree</u>: The last step in a decision tree analysis is termed "folding back' the tree, where the expected values are computed working backwards through the tree. If the node is a chance node, the expected value is computed as the probability weighted average of all of the possible outcomes. If it is a decision node, the expected value is computed for each branch, and the highest value is chosen (as the optimal decision). The process culminates in an expected value for the asset or investment today.<sup>11</sup>

There are two key pieces of output that emerge from a decision tree. The first is the expected value today of going through the entire decision tree. This expected value will incorporate the potential upside and downside from risk and the actions that you will take along the way in response to this risk. In effect, this is analogous to the risk adjusted value that we talked about in the last chapter. The second is the range of values at the end nodes, which should encapsulate the potential risk in the investment.

### Use in Decision Making

There are several benefits that accrue from using decision trees and it is surprising that they are not used more often in analysis.

- 1. <u>Dynamic response to Risk</u>: By linking actions and choices to outcomes of uncertain events, decision trees encourage firms to consider how they should act under different circumstances. As a consequence, firms will be prepared for whatever outcome may arise rather than be surprised. In the example in the last section, for instance, the firm will be ready with a plan of action, no matter what the outcome of phase 3 happens to be.
- <u>Value of Information</u>: Decision trees provide a useful perspective on the value of information in decision making. While it is not as obvious in the drug development example, it can be seen clearly when a firm considers whether to test market a product before commercially developing it. By test marketing a product, you acquire

<sup>&</sup>lt;sup>11</sup> There is a significant body of literature examining the assumptions that have to hold for this folding back process to yield consistent values. In particular, if a decision tree is used to portray concurrent risks, the

more information on the chances of eventual success. We can measure the expected value of this improved information in a decision tree and compare it to the test marketing cost.

3. <u>Risk Management</u>: Since decision trees provide a picture of how cash flows unfold over time, they are useful in deciding what risks should be protected against and the benefits of doing so. Consider a decision tree on an asset, where the worst-case scenario unfolds if the dollar is weak against the Euro. Since we can hedge against this risk, the cost of hedging the risk can be compared to the loss in cash flows in the worst-case scenario.

In summary, decision trees provide a flexible and powerful approach for dealing with risk that occurs in phases, with decisions in each phase depending upon outcomes in the previous one. In addition to providing us with measures of risk exposure, they also force to think through how we will react to both adverse and positive outcomes that may occur at each phase.

### Issues

There are some types of risk that decision trees are capable of handling and others that they are not. In particular, decision trees are best suited for risk that is sequential; the FDA process where approval occurs in phases is a good example. Risks that affect an asset concurrently cannot be easily modeled in a decision tree.<sup>12</sup> As with scenario analysis, decision trees generally look at risk in terms of discrete outcomes. Again, this is not a problem with the FDA approval process where there are only two outcomes – success or failure. There is a much wider range of outcomes with most other risks and we have to create discrete categories for the outcomes to stay within he decision tree framework. For instance, when looking at a market test, we may conclude that selling more than 100,000 units in a test market qualifies as a great success, between 60,000 ad 100,000 units as an average outcome and below 60,000 as a failure.

Assuming risk is sequential and can be categorized into discrete boxes, we are faced with estimation questions to which there may be no easy answers. In particular, we

risks should be independent of each other. See Sarin, R. and P.Wakker, 1994, Folding Back in Decision Tree Analysis, Management Science, v40, pg 625-628.

have to estimate the cash flows under each outcome and the associated probability. With the drug development example, we had to estimate the cost and the probability of success of each phase. The advantage that we have when it comes to these estimates is that we can draw on empirical data on how frequently drugs that enter each phase make it to the next one and historical costs associated with drug testing. To the extent that there may be wide differences across different phase 1 drugs in terms of success – some may be longer shots than others – there can still be errors that creep into decision trees.

The expected value of a decision tree is heavily dependent upon the assumption that we will stay disciplined at the decision points in the tree. In other words, if the optimal decision is to abandon if a test market fails and the expected value is computed, based on this assumption, the integrity of the process and the expected value will quickly fall apart, if managers decide to overlook the market testing failure and go with a full launch of the product anyway.

# Simulations

If scenario analysis and decision trees are techniques that help us to assess the effects of discrete risk, simulations provide a way of examining the consequences of continuous risk. To the extent that most risks that we face in the real world can generate hundreds of possible outcomes, a simulation will give us a fuller picture of the risk in an asset or investment.

### Steps in simulation

Unlike scenario analysis, where we look at the values under discrete scenarios, simulations allow for more flexibility in how we deal with uncertainty. In its classic form, distributions of values are estimated for each parameter in the valuation (growth, market share, operating margin, beta etc.). In each simulation, we draw one outcome from each distribution to generate a unique set of cashflows and value. Across a large number of simulations, we can derive a distribution for the value of investment or an asset that will reflect the underlying uncertainty we face in estimating the inputs to the valuation. The steps associated with running a simulation are as follows:

 $<sup>^{12}</sup>$  If we choose to model such risks in a decision tree, they have to be independent of each other. In other words, the sequencing should not matter.

1. <u>Determine "probabilistic" variables</u>: In any analysis, there are potentially dozens of inputs, some of which are predictable and some of which are not. Unlike scenario analysis and decision trees, where the number of variables that are changed and the potential outcomes have to be few in number, there is no constraint on how many variables can be allowed to vary in a simulation. At least in theory, we can define probability distributions for each and every input in a valuation. The reality, though, is that this will be time consuming and may not provide much of a payoff, especially for inputs that have only marginal impact on value. Consequently, it makes sense to focus attention on a few variables that have a significant impact on value.

2. Define probability distributions for these variables: This is a key and the most difficult step in the analysis. Generically, there are three ways in which we can go about defining probability distributions. One is to use historical data, especially for variables that have a long history and reliable data over that history. This approach works best for macro economic variables such as interest rates and inflation. The second is to use cross sectional data, from investments similar to the one that is being analyzed. Thus, a retail store like Target can look at the distribution of profit margins across its existing stores, when assessing what the margins will be on a new store. The third is to assume a reasonable statistical distribution for the variable, with parameters for that distribution.<sup>13</sup> Thus, we may conclude that operating margins will be distributed uniformly, with a minimum of 4% and a maximum of 8% and that revenue growth is normally distributed with an expected value of 8% and a standard deviation of 6%. The probability distributions can be discrete for some inputs and continuous for others, be based upon historical data for some and statistical distributions for others.

3. <u>Check for correlation across variables</u>: While it is tempting to jump to running simulations right after the distributions have been specified, it is important that we check for correlations across variables. Assume, for instance, that you are developing probability distributions for both interest rates and inflation. While both inputs may be critical in determining value, they are likely to be correlated with each other; high

<sup>&</sup>lt;sup>13</sup> For more details on the choices we face in terms of statistical distributions and how to pick the right one for a particular variable, see the paper I have on statistical distributions and simulations on http://www.damodaran/com , under research/papers.

inflation is usually accompanied by high interest rates. When there is strong correlation, positive or negative, across inputs, you have two choices. One is to pick only one of the two inputs to vary; it makes sense to focus on the input that has the bigger impact on value. The other is to build the correlation explicitly into the simulation; this does require more sophisticated simulation packages and adds more detail to the estimation process.

4. <u>Run the simulation</u>: For the first simulation, you draw one outcome from each distribution and compute the value based upon those outcomes. This process can be repeated as many times as desired, though the marginal contribution of each simulation drops off as the number of simulations increases. The number of simulations you run should be determined by the following:

a. <u>Number of probabilistic inputs</u>: The larger the number of inputs that have probability distributions attached to them, the greater will be the required number of simulations.

b. <u>Characteristics of probability distributions</u>: The greater the diversity of distributions in an analysis, the larger will be the number of required simulations. Thus, the number of required simulations will be smaller in a simulation where all of the inputs have normal distributions than in one where some have normal distributions, some are based upon historical data distributions and some are discrete.

c. <u>Range of outcomes</u>: The greater the potential range of outcomes on each input, the greater will be the number of simulations.

Most simulation packages allow users to run thousands of simulations, with little or no cost attached to increasing that number. Given that reality, it is better to err on the side of too many simulations rather than too few.

There have generally been two impediments to good simulations. The first is informational: estimating distributions of values for each input into a valuation is difficult to do. In other words, it is far easier to estimate an expected growth rate of 8% in revenues for the next 5 years than it is to specify the distribution of expected growth rates – the type of distribution, parameters of that distribution – for revenues. The second is computational; until the advent of personal computers, simulations tended to be too time

and resource intensive for the typical analyst. Both these constraints have eased in recent years and simulations have become more feasible.

### Use in decision making

A well-done simulation provides us with more than just an expected value for an asset or investment.

- a. <u>Better input estimation</u>: In an ideal simulation, analysts will examine both the historical and cross sectional data on each input variable before making a judgment on what distribution to use and the parameters of the distribution. In the process, they may be able to avoid the sloppiness that is associated with the use of point estimates; many discounted cash flow valuations are based upon expected growth rates that are obtained from services such Zack's or IBES, which report analysts' consensus estimates.
- b. <u>It yields a distribution for expected value rather than a point estimate</u>: Consider the valuation example that we completed in the last section. In addition to reporting an expected value of \$11.67 million for the store, we also estimated a standard deviation of \$5.96 million in that value and a break-down of the values, by percentile. The distribution reinforces the obvious but important point that valuation models yield estimates of value for risky assets that are imprecise and explains why different analysts valuing the same asset may arrive at different estimates of value.

Note that there are two claims about simulations that we are unwilling to make. The first is that simulations yield better estimates of expected value than conventional risk adjusted value models. In fact, the expected values from simulations should be fairly close to the expected value that we would obtain using the expected values for each of the inputs (rather than the entire distribution). The second is that simulations, by providing estimates of the expected value and the distribution in that value, lead to better decisions. This may not always be the case since the benefits that decision-makers get by getting a fuller picture of the uncertainty in value in a risky asset may be more than offset by misuse of that risk measure. As we will argue later in this chapter, it is all too common for risk to be double counted in simulations and for decisions to be based upon the wrong type of risk.

#### Illustration 5.21: Rio Disney – Simulation

In illustration 5.\*, we estimated a net present value of \$2.877 billion for the Rio Disney theme park, suggesting that Disney should make the investment. The analysis, though, rested on a few key assumptions about revenues, expenses and exchange rates that may put the value added to the test. We focused on four variables that we felt had the most uncertainty associated with them:

a. <u>Revenues</u>: In our base case, Rio Magic Kingdom starts generating revenues of # 1 billion in year 2 and revenues at that park grow to almost \$ 3 billion in year 10. Rio Epcot is expected to generate revenues of \$ 300 million in year 4 and grow to \$ 750 million in year 10. We assume that the actual revenues will be within 20% of the estimate in either direction, with a uniform distribution (in figure 5.12):

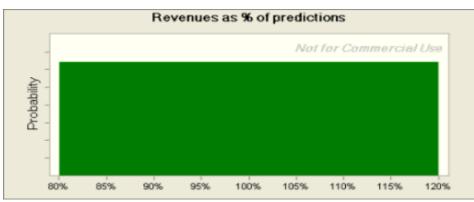
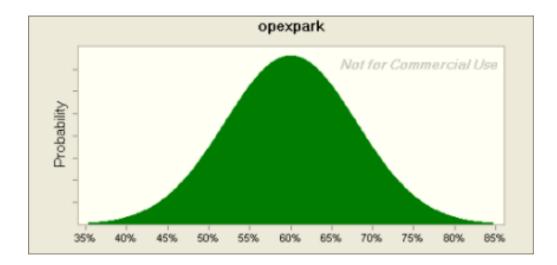


Figure 5.12: Revenues as % of Predictions: Rio Disney

b. <u>Direct Expenses</u>: In the base case analysis, we assumed that the direct expenses would be 60% of revenues, but we based those estimates on Disney's existing theme parks. To the extent that we are entering a new market (Latin America) and may be faced with unexpected surprises, we assume that direct expenses will be normally distributed with an average of 60% and a standard deviation of 6% (in figure 5.13):

Figure 5.13: Operating Expenses as % of Revenues – Rio Disney



c. <u>Country risk premium</u>: In our base case analysis, we used a country risk premium for Brazil of 3.95%, which when added to the mature market premium of 6% yielded a total risk premium of 9.95%. Given Brazil's volatile history, we examined the impact of changing this risk premium. Again, we assumed that the total equity risk premium would be normally distributed with an expected value of 9.95% but with a standard deviation of 1% (in figure 5.14):

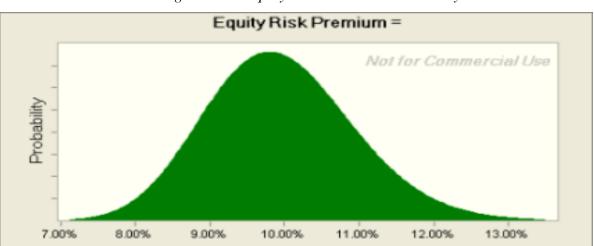


Figure 5.14: Equity Risk Premium: Rio Disney

d. <u>Correlation between assumptions</u>: We also recognize that our estimates of revenues will be tied to our assessments of country risk. In other words, if the risk in Brazil increases, it is likely to scare away potential visitors. To allow for this relationship, we assume that that the outcomes on revenues and total risk

premium have a correlation of -0.40; revenues are low when the country risk premium is high and revenues are high when the country risk premium is low.

e. With these assumptions in place, we ran 10,000 simulations and the resulting NPVs are graphed in figure 5.15:

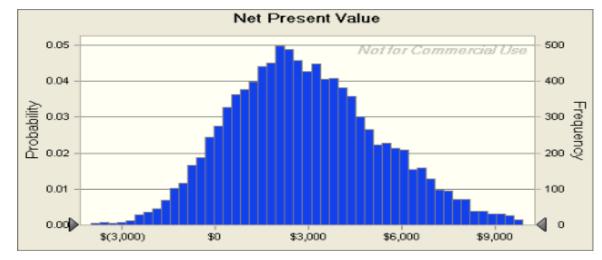


Figure 5.15: NPV of Rio Disney: Results of Simulations

There are three pieces of usable output. The first is that the average NPV across all 10,000 simulations is \$2.95 billion and the median value is \$2.73 billion, both close to our base case estimate of \$2.877 billion. The second is that the NPV is negative in about 12% of all the simulations, indicating again even why even the most lucrative investments come with risk premiums. The third is that net present values range from -\$4 billion as the worst case outcome to \$14.6 billion as the best case outcome.

While this simulation does not change our overall assessment of the project, it does provide the decision makers at Disney with a fuller sense of what the new theme park will generate as value for the firm.

#### An Overall Assessment of Probabilistic Risk Assessment Approaches

Assuming that we decide to use a probabilistic approach to assess risk and could choose between scenario analysis, decision trees and simulations, which one should we pick? The answer will depend upon how you plan to use the output and what types of risk you are facing:

1. <u>Selective versus Full Risk Analysis</u>: In the best-case/worst-case scenario analysis, we look at only three scenarios (the best case, the most likely case and the worst case) and

ignore all other scenarios. Even when we consider multiple scenarios, we will not have a complete assessment of all possible outcomes from risky investments or assets. With decision trees and simulations, we attempt to consider all possible outcomes. In decision trees, we try to accomplish this by converting continuous risk into a manageable set of possible outcomes. With simulations, we can use distributions to capture all possible outcomes. Put in terms of probability, the sum of the probabilities of the scenarios we examine in scenario analysis can be less than one, whereas the sum of the probabilities of outcomes in decision trees and simulations has to equal one. As a consequence, we can compute expected values across outcomes in the latter, using the probabilities as weights, and these expected values are comparable to the single estimate risk adjusted values that we talked about in the last chapter.

2. <u>Discrete versus Continuous Risk</u>: As noted above, scenario analysis and decision trees are generally built around discrete outcomes in risky events whereas simulations are better suited for continuous risks. Focusing on just scenario analysis and decision trees, the latter are better suited for sequential risks, since risk is considered in phases, whereas the former is easier to use when risks occur concurrently.

3. <u>Correlation across risks</u>: If the various risks that an investment is exposed to are correlated, simulations allow for explicitly modeling these correlations (assuming that you can estimate and forecast them). In scenario analysis, we can deal with correlations subjectively by creating scenarios that allow for them; the high (low) interest rate scenario will also include slower (higher) economic growth. Correlated risks are difficult to model in decision trees.

Table 5.17 summarizes the relationship between risk type and the probabilistic approach used:

Discrete/Continuous	Correlated/Independent	Sequential/Concurrent	
			Approach
Discrete	Independent	Sequential	Decision
			Tree
Discrete	Correlated	Concurrent	Scenario
			Analysis
Continuous	Either	Either	Simulations

Table 5.17: Risk Type and Probabilistic Approaches

Finally, the quality of the information will be a factor in your choice of approach. Since simulations are heavily dependent upon being able to assess probability distributions and parameters, they work best in cases where there is substantial historical and cross sectional data available that can be used to make these assessments. With decision trees, you need estimates of the probabilities of the outcomes at each chance node, making them best suited for risks where these risks can be assessed either using past data or population characteristics. Thus, it should come as no surprise that when confronted with new and unpredictable risks, analysts continue to fall back on scenario analysis, notwithstanding its slapdash and subjective ways of dealing with risk.

# Conclusion

Investment analysis is arguably the most important part of corporate financial analysis. In this chapter we defined the scope of investment analysis and examined a range of investment analysis techniques, ranging from accounting rate of return measures, such as return of equity and return on assets, to discounted cash flow techniques, such as NPV and IRR. In general, it can be argued that:

- Any decision that requires the use of resources is an investment decision; thus, investment decisions cover everything from broad strategic decisions at one extreme to narrower operating decisions such as how much inventory to carry at the other.
- There are two basic approaches to investment analysis; in the equity approach, the returns to equity investors from a project are measured against the cost of equity to decide on whether to take a project; in the firm approach, the returns to all investors in the firm are measured against the cost of capital to arrive at the same judgment.
- Accounting rate of return measures, such as return on equity or return on capital, generally work better for projects that have large initial investments, earnings that are roughly equal to the cash flows, and level earnings over time. For most projects, accounting returns will increase over time, as the book value of the assets is depreciated.
- Payback, which looks at how quickly a project returns its initial investment in nominal cash flow terms, is a useful secondary measure of project performance or a

measure of risk, but it is not a very effective primary technique because it does not consider cash flows after the initial investment is recouped.

- Discounted cash flow methods provide the best measures of true returns on projects because they are based on cash flows and consider the time value of money. Among discounted cash flow methods, NPV provides an unscaled measure, whereas IRR provides a scaled measure of project performance. Both methods require the same information, and for the most part they provide the same conclusions when used to analyze independent projects.
- Uncertainty is a given when analyzing risky projects and there are several techniques we can us to evaluate the consequences. In sensitivity analysis, we look at the consequences for value (and the investment decision) of changing one input at a time, holding all else constant. In scenario analysis, we examine the payoff to investing under the best and worst cases, as well as under specified scenarios. In decision trees, risk is assessed sequentically, where outcomes at one stage affect values at the next stage. Finally, in simulations, we use probability distributions for the inputs, rather than expected values, and derive probability distributions for the NPV and IRR (rather than one NPV and IRR).

## Live Case Study

# Estimating Earnings and Cash Flows only if feasible

Objective: To estimate earnings and cash flows on a typical project for the firm.

## Key Questions:

- 1. Does your firm have a typical investment?
- 2. If so, can you estimate the earnings and cash flows on a typical investment?

### Framework for Analysis:

- 1. Typical Investment
  - 1.1. Does your firm take a few or several investments each year?
  - 1.2. Do these investments have much in common?
  - 1.3. If so, what do they have in common and what are the differences?
- 2. Earnings and Cash Flows
  - 2.1. What is the typical life of an investment made by your firm?
  - 2.2. What is the pattern of earnings on such an investment?
  - 2.3. What is the pattern of cash flows on such an investment?
  - 2.4. Based upon the company's aggregate numbers, can you estimate the earnings and cash flows on a hypothetical investment?

# **Getting Information on Projects**

Firms do describe their investments, though not in significant detail, in their annual reports. The statement of cash flows will provide some breakdown, as will the footnotes to the financial statements.

Online sources of information:

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

### **Problems and Questions**

1. You have been given the following information on a project:

- It has a five-year lifetime
- The initial investment in the project will be \$25 million, and the investment will be depreciated straight line, down to a salvage value of \$10 million at the end of the fifth year.
- The revenues are expected to be \$20 million next year and to grow 10% a year after that for the remaining four years.
- The cost of goods sold, excluding depreciation, is expected to be 50% of revenues.
- The tax rate is 40%.
- a. Estimate the pretax return on capital, by year and on average, for the project.
- b. Estimate the after-tax return on capital, by year and on average, for the project.

c. If the firm faced a cost of capital of 12%, should it take this project?

2. Now assume that the facts in Problem 1 remain unchanged except for the depreciation method, which is switched to an accelerated method with the following depreciation schedule:

Year	% of Depreciable Asset
1	40%
2	20%
3	14.4%
4	13.3%
5	13.3%

Depreciable Asset = Initial Investment - Salvage Value

a. Estimate the pretax return on capital, by year and on average, for the project.

b. Estimate the after-tax return on capital, by year and on average, for the project.

c. If the firm faced a cost of capital of 12%, should it take this project?

3. Consider again the project described in Problem 1 (assume that the depreciation reverts to a straight line). Assume that 40% of the initial investment for the project will be financed with debt, with an annual interest rate of 10% and a balloon payment of the principal at the end of the fifth year.

a. Estimate the return on equity, by year and on average, for this project.

b. If the cost of equity is 15%, should the firm take this project?

4. Answer true or false to the following statements:

a. The return on equity for a project will always be higher than the return on capital on the same project.

b. If the return on capital is less than the cost of equity, the project should be rejected.

c. Projects with high financial leverage will have higher interest expenses and lower net income than projects with low financial leverage and thus end up with a lower return on equity.

d. Increasing the depreciation on an asset will increase the estimated return on capital and equity on the project.

e. The average return on equity on a project over its lifetime will increase if we switch from straight line to double declining balance depreciation.

5. Under what conditions will the return on equity on a project be equal to the IRR, estimated from cash flows to equity investors, on the same project?

Year	1	2	3	4
Revenues (\$)	\$10,000	\$11,000	\$12,000	\$13,000
- Cost of goods sold (\$)	\$4,000	\$4,400	\$4,800	\$5,200
- Depreciation	\$4,000	\$3,000	\$2,000	\$1,000
= EBIT	\$2,000	\$3,600	\$5,200	\$6,800

6. You are provided with the projected income statements for a project:

• The tax rate is 40%.

- The project required an initial investment of \$15,000 and an additional investment of \$2,000 at the end of year two.
- The working capital is anticipated to be 10% of revenues, and the working capital investment has to be made at the beginning of each period.

a. Estimate the free cash flow to the firm for each of the four years.

b. Estimate the payback period for investors in the firm.

c. Estimate the NPV to investors in the firm, if the cost of capital is 12%. Would you accept the project?

d. Estimate the IRR to investors in the firm. Would you accept the project?

7. Consider the project described in Problem 6. Assume that the firm plans to finance 40% of its net capital expenditure and working capital needs with debt.

- a. Estimate the free cash flow to equity for each of the four years.
- b. Estimate the payback period for equity investors in the firm.
- c. Estimate the NPV to equity investors if the cost of equity is 16%. Would you accept the project?

d. Estimate the IRR to equity investors in the firm. Would you accept the project?

8. You are provided with the following cash flows on a project:

Year	Cash Flow to Firm (\$)
0	-10,000,000
1	\$ 4,000,000
2	\$ 5,000,000
3	\$ 6,000,000

Plot the net present valueNPV profile for this project. What is the IRR? If this firm had a cost of capital of 10% and a cost of equity of 15%, would you accept this project?

9.	You have es	stimated the	following	cash flows on	a project:
----	-------------	--------------	-----------	---------------	------------

Year	Cash Flow to Equity (\$)
0	-\$ 5,000,000
1	\$4,000,000
2	\$ 4,000,000
3	-\$3,000,000

Plot the NPV profile for this project. What is the IRR? If the cost of equity is 16%, would you accept this project?

10. Estimate the MIRR for the project described in Problem 8. Does it change your decision on accepting this project?

11. You are analyzing two mutually exclusive projects with the following cash flows:

Year	А	В
0	-\$4,000,000	-\$4,000,000

1	\$2,000,000	\$1,000,000
2	\$1,500,000	\$1,500,000
3	\$ 1,250,000	\$1,700,000
4	\$1,000,000	\$2,400,000

a. Estimate the NPV of each project, assuming a cost of capital of 10%. Which is the better project?

b. Estimate the IRR for each project. Which is the better project?

c. What reinvestment rate assumptions are made by each of these rules? Can you show the effect on future cash flows of these assumptions?

d. What is the MIRR on each of these projects?

12. You have a project that does not require an initial investment but has its expenses spread over the life of the project. Can the IRR be estimated for this project? Why or why not?

Businesses with severe capital rationing constraints should use IRR more than NPV.
 Do you agree? Explain.

14. You have to pick between three mutually exclusive projects with the following cash flows to the firm:

Year	Project A	Project B	Project C
0	-\$10,000	\$5,000	-\$15,000
1	\$ 8,000	\$ 5,000	\$ 10,000
2	\$ 7,000	-\$8,000	\$10,000

The cost of capital is 12%.

a. Which project would you pick using the NPV rule?

b. Which project would you pick using the IRR rule?

c. How would you explain the differences between the two rules? Which one would you rely on to make your choice?

15. You are analyzing an investment decision, in which you will have to make an initial investment of \$10 million and you will be generating annual cash flows to the firm of \$2 million every year, growing at 5% a year, forever.

a. Estimate the NPV of this project, if the cost of capital is 10%.

16. You are analyzing a project with a thirty-year lifetime, with the following characteristics:

- The project will require an initial investment of \$20 million and additional investments of \$5 million in year ten and \$5 million in year twenty.
- The project will generate earnings before interest and taxes of \$3 million each year. (The tax rate is 40%.)
- The depreciation will amount to \$500,000 each year, and the salvage value of the equipment will be equal to the remaining book value at the end of year thirty.
- The cost of capital is 12.5%.

a. Estimate the NPV of this project.

b. Estimate the IRR on this project. What might be some of the problems in estimating the IRR for this project?

17. You are trying to estimate the NPV of a three-year project, where the discount rate is expected to change over time.

Year	Cash Flow to Firm	Discount Rate (%)
	(\$)	
0	\$15,000	9.5%
1	\$5,000	10.5%
2	\$ 5,000	11.5%
3	\$ 10,000	12.5%

a. Estimate the NPV of this project. Would you take this project?

b. Estimate the IRR of this project. How would you use the IRR to decide whether to take this project?

18. Barring the case of multiple IRRs, is it possible for the NPV of a project to be positive while the IRR is less than the discount rate? Explain.

19. You are helping a manufacturing firm decide whether it should invest in a new plant. The initial investment is expected to be \$50 million, and the plant is expected to generate after-tax cash flows of \$5 million a year for the next twenty years. There will be an additional investment of \$20 million needed to upgrade the plant in ten years. If the discount rate is 10%,

a. Estimate the NPV of the project.

b. Prepare an NPV Profile for this project.

c. Estimate the IRR for this project. Is there any aspect of the cash flows that may prove to be a problem for calculating IRR?

20. You have been asked to analyze a project where the analyst has estimated the return on capital to be 37% over the ten-year lifetime of the project. The cost of capital is only 12%, but you have concerns about using the return on capital as an investment decision rule. Would it make a difference if you knew that the project was employing an accelerated depreciation method to compute depreciation? Why?

21. Accounting rates of return are based on accounting income and book value of investment, whereas internal rates of return are based on cash flows and take into account the time value of money. Under what conditions will the two approaches give you similar estimates?

### **PROJECT INTERACTIONS, SIDE COSTS, AND SIDE BENEFITS**

In much of our discussion so far, we have assessed projects independently of other projects that the firm already has or might have in the future. Disney, for instance, was able to look at Rio Disney standing alone and analyze whether it was a good or bad investment. In reality, projects at most firms have interdependencies with and consequences for other projects. Disney may be able to increase both movie and merchandise revenues because of the new theme park in Brazil and may face higher advertising expenditures because of its Latin American expansion.

In this chapter, we examine a number of scenarios in which the consideration of one project affects other projects. We start with the most extreme case, whereby investing in one project leads to the rejection of one or more other projects; this is the case when firms have to choose between mutually exclusive investments. We then consider a less extreme scenario, in which a firm with constraints on how much capital it can raise considers a new project. Accepting this project reduces the capital available for other projects that the firm considers later in the period and thus can affect their acceptance; this is the case of capital rationing.

Projects can create costs for existing investments by using shared resources or excess capacity, and we consider these side costs next. Projects sometimes generate benefits for other projects, and we analyze how to bring these benefits into the analysis. In the third part of the chapter, we introduce the notion that projects often have options embedded in them, and ignoring these options can result in poor project decisions.

In the final part of the chapter, we turn from looking at new investments to the existing investments of the company. We consider how we can extend the techniques used to analyze new investments can be used to do post-mortems of existing investments as well as analyzing whether to continue or terminate an existing investment. We also look at how best to assess the portfolio of existing investments on a firm's books, using both cash flows and accounting earnings. Finally, we step away from investment and capital budgeting techniques and ask a more fundamental question. Where do good

investments come from? Put another way, what are the qualities that a company or its management possess that allow it to generate value from its investments.

# **Mutually Exclusive Projects**

Projects are mutually exclusive when accepting one investment means rejecting others, even though the latter standing alone may pass muster as good investments, i.e. have a positive NPV and a high IRR. There are two reasons for the loss of project independence. In the first, the firm may face a capital rationing constraint, where not all good projects can be accepted and choices have to be made across good investments. In the second, projects may be mutually exclusive because they serve the same purpose and choosing one makes the other redundant. This is the case when the owner of a commercial building is choosing among a number of different air conditioning or heating systems for the building. This is also the case when investments provide alternative approaches to the future; a firm that has to choose between a "high-margin, low volume" strategy and a "low-margin, high-volume" strategy for a product can choose only one of the two. We will begin this section by looking at why firms may face capital rationing and how to choose between investments, when faced with this constraint. We will then move on to look at projects that are mutually exclusive because they provide alternatives to the same ends.

#### **Project Dependence from Capital Rationing**

In chapter 5, in our analysis of independent projects, we assumed that investing capital in a good project has no effect on other concurrent or subsequent projects that the firm may consider. Implicitly, we assume that firms with good investment prospects (with positive NPV) can raise capital from financial markets, at a fair price, and without paying transaction costs. In reality, however, it is possible that the capital required to finance a project can cause managers to reject other good projects because the firm has limited access to capital. *Capital rationing* occurs when a firm is unable to invest in

projects that earn returns greater than the hurdle rates.<sup>1</sup> Firms may face capital rationing constraints because they do not have either the capital on hand or the capacity and willingness to raise the capital needed to finance these projects. This implies that the firm does not have the capital to accept the positive NPV projects available.

### **Reasons for Capital Rationing Constraints**

In theory, there will be no capital rationing constraint as long as a firm can follow this series of steps in locating and financing investments:

1. The firm identifies an attractive investment opportunity.

2. The firm goes to financial markets with a description of the project to seek financing.

3. Financial markets believe the firm's description of the project.

4. The firm issues securities—that is, stocks and bonds—to raise the capital needed to finance the project at fair market prices. Implicit here is the assumption that markets are efficient and that expectations of future earnings and growth are built into these prices.

5. The cost associated with issuing these securities is minimal.

If this were the case for every firm, then every worthwhile project would be financed and no good project would ever be rejected for lack of funds; in other words, there would be no capital rationing constraint.

The sequence described depends on a several assumptions, some of which are clearly unrealistic, at least for some firms. Let's consider each step even more closely.

<u>1. Project Discovery</u>: The implicit assumption that firms know when they have good projects on hand underestimates the uncertainty and the errors associated with project analysis. In very few cases can firms say with complete certainty that a prospective project will be a good one.

2. Credibility: Financial markets tend to be skeptical about announcements made by firms, especially when such announcements contain good news about future projects.

<sup>&</sup>lt;sup>1</sup> For discussions of the effect of capital rationing on the investment decision, see Lorie, J.H. and L.J. Savage, 1955, *Three Problems in Rationing Capital*, Journal of Business, v28, 229-239, Weingartner, H.M., 1977, *Capital Rationing: n Authors in Search of a Plot*, Journal of Finance, v32, 1403-1432.

Because it is easy for any firm to announce that its future projects are good, regardless of whether this is true or not, financial markets often require more substantial proof of the viability of projects.

<u>3. Market Efficiency:</u> If the securities issued by a firm are underpriced by markets, firms may be reluctant to issue stocks and bonds at these low prices to finance even good projects. In particular, the gains from investing in a project for existing stockholders may be overwhelmed by the loss from having to sell securities at or below their estimated true value. To illustrate, assume that a firm is considering a project that requires an initial investment of \$100 million and has an NPV of \$10 million. Also assume that the stock of this company, which management believes should be trading for \$100 per share, is actually trading at \$80 per share. If the company issues \$100 million of new stock to take on the new project, its existing stockholders will gain their share of the NPV of \$10 million, but they will lose \$20 million (\$100 million – \$80 million) to new investors in the company. There is an interesting converse to this problem. When securities are overpriced, there may be a temptation to overinvest, because existing stockholders gain from the very process of issuing equities to new investors.

<u>4, Flotation Costs:</u> These are costs associated with raising funds in financial markets, and they can be substantial. If these costs are larger than the NPV of the projects considered, it would not make sense to raise these funds and finance the projects.

# Sources of Capital Rationing

What are the sources of capital rationing? Going through the process described in the last section in Table 6.1, we can see the possible reasons for capital rationing at each step.

	In Theory	In Practice	Source of Rationing
1. Project discovery	A business uncovers	A business believes,	Uncertainty about
	a good investment	given the underlying	true value of
	opportunity.	uncertainty, that it	projects may cause
		has a good project.	rationing.
2. Information	The business	The business	Difficulty in
revelation	conveys information	attempts to convey	conveying

Table 6.1: Capital Rationing: Theory versus Practice

Lorie and Savage (1955) and Weingartner (1977).

<b></b>			
	about the project to	information to	information to
	financial markets.	financial markets.	markets may cause
			rationing.
3. Market response	Financial markets	Financial markets	The greater the
	believe the firm;	may not believe the	credibility gap, the
	i.e., the information	announcement.	greater the rationing
	is conveyed		problem.
	credibly.		
4. Market efficiency	The securities	The securities	With underpriced
	issued by the	issued by the	securities, firms will
	business (stocks and	business may not be	be unwilling to raise
	bonds) are fairly	correctly priced.	funds for projects.
	priced.		
5. Flotation costs	There are no costs	There are significant	The greater the
	associated with	costs associated	flotation costs, the
	raising funds for	with raising funds	larger will be the
	projects.	for projects.	capital rationing
			problem.

The three primary sources of capital rationing constraints, therefore, are a firm's lack of credibility with financial markets, market under pricing of securities, and flotation costs.

Researchers have collected data on firms to determine whether they face capital rationing constraints and, if so, to identify the sources of such constraints. One such survey was conducted by Scott and Martin and is summarized in Table 6.2.<sup>2</sup>

Table 6.2: The Causes of Capital Rationing

Cause	# firms	%
Debt limit imposed by outside agreement	10	10.7
Debt limit placed by management external to firm	3	3.2
Limit placed on borrowing by internal management	65	69.1
Restrictive policy imposed on retained earnings	-	2.1
Maintenance of target EPS or PE ratio	14	14.9

Source: Martin and Scott (1976)

This survey suggests that although some firms face capital rationing constraints as a result of external factors largely beyond their control, such as issuance costs and credibility problems, most firms face self-imposed constraints, such as restrictive policies to avoid overextending themselves by investing too much in any period. In some cases,

<sup>&</sup>lt;sup>2</sup> Martin, J.D. and D.F. Scott, 1976, *Debt Capacity and the Capital Budgeting Decision*, Financial Management, v5(2), 7-14.

managers are reluctant to issue additional equity because they fear that doing so will dilute the control they have over the company.

Looking at the sources of capital rationing, it seems clear that smaller firms with more limited access to capital markets are more likely to face capital rationing constraints than larger firms. Using similar reasoning, private businesses and emerging market companies are more likely to have limited capital than publicly traded and developed market companies.

### **Project Selection with Capital Rationing**

Whatever the reason, many firms have capital rationing constraints, limiting the funds available for investment. When there is a capital rationing constraint, the standard advice of investing in projects with positive NPV breaks down, because we can invest in a subset of projects. Put another way, we have to devise ranking systems for good investments that will help us direct the limited capital to where it can generate the biggest payoff. We will begin this section by evaluating how and why the two discounted cash flow techniques that we introduced in chapter 5 - NPV and IRR- yield different rankings and then consider modifying these techniques in the face of capital rationing.

### Project Rankings – NPV and IRR

The NPV and the IRR are both time-weighted, cash flow based measures of return for an investment and yield the same conclusion – accept or reject- for an independent, stand-alone investment. When comparing or ranking multiple projects, though, the two approaches can yield different rankings, either because of differences in scale or because of differences in the reinvestment rate assumption.

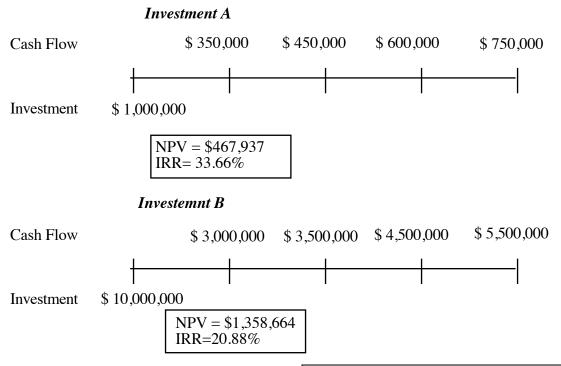
#### Differences in Scale

The NPV of a project is stated in dollar terms and does not factor in the scale of the project. The IRR, by contrast, is a percentage rate of return, which is standardized for the scale of the project. Not surprisingly, rankings based upon the former will rank the biggest projects (with large cash flows) highest, whereas rankings based upon IRR will tilt towards projects that require smaller investments.

The scale differences can be illustrated using a simple example. Assume that you are a firm and that you are comparing two projects. The first project requires an initial

investment of \$1 million and produces the cash flow revenues shown in Figure 6.1. The second project requires an investment of \$10 million and is likely to produce the much higher cash flows (shown in Figure 6.1) as well. The cost of capital is 15% for both projects.

Figure 6.1: NPV and IRR - Different Scale Projects



The two decision rules yield different results. The NPV rule suggests that project B is the better project, whereas the IRR rule leans toward project A. This is not surprising, given the differences in scale. *Capital Rationing:* The scenario where the firm does not have sufficient funds—either on hand or in terms of access to markets—to take on all of the good projects it might have.

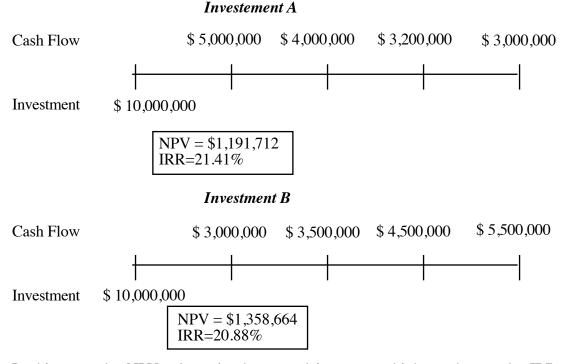
surprising, given the differences in scale. In fact, both projects generate positive net present values and high IRRs.

If a firm has easy access to capital markets, it would invest in both projects. However, if the firm has limited capital and has to apportion it across a number of good projects, however, then taking Project B may lead to the rejection of good projects later on. In those cases, the IRR rule may provide the better solution.

#### Differences in Reinvestment Rate Assumptions

Although the differences between the NPV rule and the IRR rules due to scale are fairly obvious, there is a subtler and much more significant difference between them relating to the reinvestment of intermediate cash flows. As pointed out earlier, the NPV rule assumes that intermediate cash flows are reinvested at the discount rate, whereas the IRR rule assumes that intermediate cash flows are reinvested at the IRR. As a consequence, the two rules can yield different conclusions, even for projects with the same scale, as illustrated in Figure 6.2.

Figure 6.2 NPV and IRR - Reinvestment Assumption



In this case, the NPV rule ranks the second investment higher, whereas the IRR rule ranks the first investment as the better project. The differences arise because the NPV rule assumes that intermediate cash flows get invested at the hurdle rate, which is 15%. The IRR rule assumes that intermediate cash flows get reinvested at the IRR of that project. Although both projects are affected by this assumption, it has a much greater effect for project A, which has higher cash flows earlier on. The reinvestment assumption is made clearer if the expected end balance is estimated under each rule.

End Balance for Investment A with IRR of  $21.41\% = $10,000,000*1.2141^4 = $21,730,887$ 

End Balance for Investment B with IRR of  $20.88\% = 10,000,000*1.2088^4 = 21,353,673$ To arrive at these end balances, however, the cash flows in years one, two, and three will have to be reinvested at the IRR. If they are reinvested at a lower rate, the end balance on these projects will be lower, and the actual return earned will be lower than the IRR even though the cash flows on the project came in as anticipated.

The reinvestment rate assumption made by the IRR rule creates more serious consequences the longer the term of the project and the higher the IRR, because it implicitly assumes that the firm has and will continue to have a fountain of projects yielding returns similar to that earned by the project under consideration.

### Project Rankings: Modified Rules

The conventional discounted cash flow rules, NPV or IRR, have limitations when it comes to ranking projects, in the presence of capital rationing. The NPV rule is biased towards larger investments and will not result in the best use of limited capital. The IRR rule is generally better suited for capital rationed firms, but the assumption that intermediate cash flows get reinvested at the IRR can skew investment choices. We consider three modifications to traditional investment rules that yield better choices than the traditional rules: a scaled version of NPV called the profitability index, a modified internal rate of return, with more reasonable reinvestment assumptions and a more complex linear programming approach, that allows capital constraints in multiples periods.

#### Profitability Index

The profitability index is the simplest method of including capital rationing in investment analysis. It is particularly useful for firms that have a constraint for the current period only and relatively few projects. A scaled version of the NPV, the profitability index is computed by dividing the NPV of the project by the initial investment in the project.<sup>3</sup>

 $Profitability Index = \frac{Net Present Value of Investment}{Initial Investment needed for Investment}$ 

<sup>&</sup>lt;sup>3</sup>There is another version of the profitability index, whereby the present value of all cash inflows is divided by the present value of cash outflows. The resulting ranking will be the same as with the profitability index as defined in this chapter.

The profitability index provides a rough measure of the NPV the firm gets for each dollar it invests. To use it in investment analysis, we first compute it for each investment the firm is considering, and then pick projects based on the profitability index, starting with the highest values and working down until we reach the capital constraint. When capital is limited and a firm cannot accept every positive NPV project, the profitability index identifies the highest cumulative NPV from the funds available for capital investment.

Although the profitability index is intuitively appealing, it has several limitations. First, it assumes that the capital rationing constraint applies to the current period only and does not include investment requirements in future periods. Thus, a firm may choose projects with a total initial investment that is less than the current period's capital constraint, but it may expose itself to capital rationing problems in future periods if these projects have outlays in those periods. A related problem is the classification of cash flows into an initial investment that occurs now and operating cash inflows that occur in future periods. If projects have investments spread over multiple periods and operating cash outflows, the profitability index may measure the project's contribution to value incorrectly. Finally, the profitability index does not guarantee that the total investment will add up to the capital rationing constraint. If it does not, we have to consider other combinations of projects, which may yield a higher NPV. Although this is feasible for firms with relatively few projects, it becomes increasing unwieldy as the number of projects increases.

#### Illustration 6.1: Using the Profitability Index to Select Projects

Assume that Bookscape, as a private firm, has limited access to capital, and a capital budget of \$100,000 in the current period. The projects available to the firm are listed in Table 6.3.

Project	Initial Investment (in 1000s)	NPV (000s)
А	\$25	\$10
В	40	20
С	5	5
D	100	25
Е	50	15
F	70	20

Table 6.3: Available Projects

G 35 20
---------

Note that all the projects have positive NPVs and would have been accepted by a firm not subject to a capital rationing constraint.

To choose among these projects, we compute the profitability index of each project in Table 6.4.

Project	Initial Investment	NPV	Profitability Index	Ranking
	(1000s)	(1000s)		
А	\$25	\$10	0.40	4
В	60	30	0.50	3
С	5	5	1.00	1
D	100	25	0.25	7
Е	50	15	0.30	5
F	70	20	0.29	6
G	35	20	0.57	2

Table 6.4: Profitability Index for Projects

The profitability index of 0.40 for project A means that the project earns an NPV of forty cents for every dollar of initial investment. Based on the profitability index, we should accept projects B, C, and G. This combination of projects would exhaust the capital budget of \$100,000 while maximizing the NPV of the projects accepted. This analysis also highlights the cost of the capital rationing constraint for this firm; the NPV of the projects rejected as a consequence of the constraint is \$70 million.

## 6.1. Mutually Exclusive Projects with Different Risk Levels

Assume in this illustration that the initial investment required for project B was \$40,000. Which of the following would be your best combination of projects given your capital rationing constraint of \$100,000?

- a. B, C, and G
- b. A, B, C, and G
- c. A, B, and G
- d. Other

#### Modified Internal Rate of Return (MIRR)

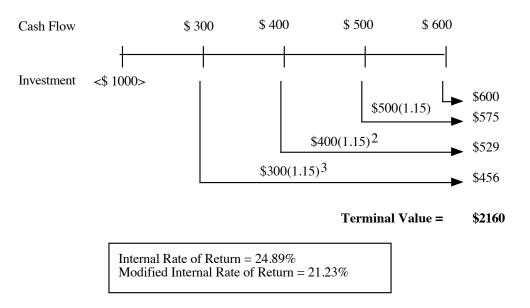
One solution that has been suggested for the reinvestment rate assumption is to assume that intermediate cash flows get reinvested at the hurdle rate—the cost of equity if the cash flows are to equity investors and the cost of

*Modified Internal Rate of Return (MIRR):* The IRR computed on the assumption that intermediate cash flows are reinvested at the hurdle rate.

capital if they are to the firm—and to calculate the IRR from the initial investment and the terminal value. This approach yields what is called the **modified internal rate of return (MIRR)**.

Consider a four-year project, with an initial investment of \$ 1 billion and expected cash flows of \$ 300 million in year 1, \$ 400 million in year 2, \$ 500 million in year 3 nd \$ 600 million in year 4. The conventional IRR of this investment is 24.89%, but that is premised on the assumption that the cashflows in years 1,2 and 3 are reinvested at that rate. If we assume a cost of capital of 15%, the modified internal rate of return computation is illustrated in Figure 6.3:

Figure 6.3: IRR versus Modified Internal Rate of Return



 $MIRR = (\$2160/\$1000)^{1/4} - 1 = 21.23\%$ 

The MIRR is lower than the IRR because the intermediate cash flows are invested at the hurdle rate of 15% instead of the IRR of 24.89%.

There are many who believe that the MIRR is neither fish nor fowl, because it is a mix of the NPV rule and the IRR rule. From a practical standpoint, the MIRR becomes a weighted average of the returns on individual projects and the hurdle rates the firm uses, with the weights on each depending on the magnitude and timing of the cash flows—the larger and earlier the cash flows on the project, the greater the weight attached to the hurdle rate. Furthermore, the MIRR approach will yield the same choices as the NPV approach for projects of the same scale and lives.

#### Multi-period Capital Rationing

All of the approaches that we have described so far are designed to deal with capital rationing in the current period. In some cases, capital rationing constraints apply not only to the current period but to future periods as well, with the amount of capital that is available for investment also varying across periods. If you combine these multi-period constraints with projects that require investments in many periods (and not just in the current one), the capital rationing problem becomes much more complex and project rankings cannot provide an optimal solution.

One solution is to use linear programming techniques, developed in operations research. In a linear program, we begin by specifying an objective, subject to specified constraints. In the context of capital rationing, that objective is to maximize the value added by new investments, subject to the capital constraints in each period. For example, the linear program for a firm. with capital constraints of \$ 1 billion for the current period, \$1.2 billion for next year and \$ 1.5 billion for year and trying to choose between k investments, can be written as follows:

Maximize 
$$\sum_{j=1}^{j=k} X_j NPV_j$$
 where  $X_j = 1$  if investment j is taken; 0 otherwise

Constraints:

$$\sum_{j=1}^{j=k} X_j Inv_{j,1} < \$1,000 \qquad \qquad \sum_{j=1}^{j=k} X_j Inv_{j,2} < \$1,200 \qquad \qquad \sum_{j=1}^{j=k} X_j Inv_{j,3} < \$1,500$$

where  $Inv_{i,t}$  = Investment needed on investment j in period t

The approach can be modified to allow for partial investments in projects and for other constraints (human capital) as well.

## In Practice: Using a Higher Hurdle Rate

Many firms choose what seems to be a more convenient way of selecting projects, when they face capital rationing— they raise the hurdle rate to reflect the severity of the constraint. If the definition of capital rationing is that a firm cannot take all the positive NPV projects it faces, raising the hurdle rate sufficiently will ensure that the problem is resolved or at least hidden. For instance, assume that a firm has a true cost of capital of 12 percent,<sup>4</sup> a capital rationing constraint of \$100 million, and positive NPV projects requiring an initial investment of \$250 million. At a higher cost of capital, fewer projects will have positive NPVs. At some cost of capital, say 18 percent, the positive NPV projects remaining will require an initial investment of \$100 million or less.

There are problems that result from building the capital rationing constraint into the hurdle rate. First, once the adjustment has been made, the firm may fail to correct it for shifts in the severity of the constraint. Thus, a small firm may adjust its cost of capital from 12 percent to 18 percent to reflect a severe capital rationing constraint. As the firm gets larger, the constraint will generally become less restrictive, but the firm may not decrease its cost of capital accordingly. Second, increasing the discount rate will yield NPVs that do not convey the same information as those computed using the correct discount rates. The NPV of a project, estimated using the right hurdle rate, is the value added to the firm by investing in that project; the present value estimated using an adjusted discount rate cannot be read the same way. Finally, adjusting the hurdle rate penalizes all projects equally, whether or not they are capital-intensive.

We recommend that firms separate the capital rationing constraint from traditional investment analysis so they can observe how much these constraints cost. In the simplest terms, the cost of a capital rationing constraint is the total NPV of the good projects that could not be taken for lack of funds. There are two reasons why this knowledge is useful. First, if the firm is faced with the opportunity to relax these constraints, knowing how much these constraints cost will be useful. For instance, the firm may be able to enter into a strategic partnership with a larger firm with excess funds and use the cash to take the good projects that would otherwise have been rejected, sharing the NPV of these projects.

Second, if the capital rationing is self-imposed, managers in the firm are forced to confront the cost of the constraint. In some cases, the sheer magnitude of this cost may be sufficient for them to drop or relax the constraint.

## **Project Dependence for Operating Reasons**

Even without capital rationing, choosing one project may require that we reject other projects. This is the case, for instance, when a firm is considering alternative ways, with different costs and cash flows, of delivering a needed service such as distribution or information technology. In choosing among mutually exclusive projects, we continue to use the same rules we developed for analyzing independent projects. The firm should choose the project that adds the most to its value. Although this concept is relatively straightforward when the projects are expected to generate cash flows for the same number of periods (have the same project life), as you will see, it can become more complicated when the projects have different lives.

## **Projects with Equal Lives**

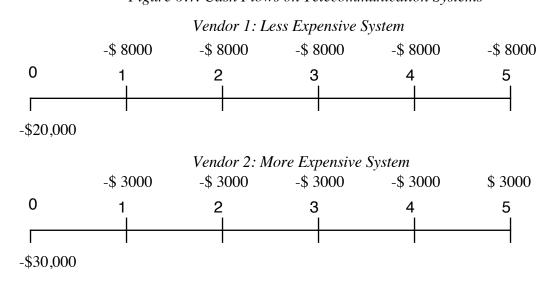
When comparing alternative investments with the same lives, a business can make its decision in one of two ways. It can compute the net present value (NPV) of each project and choose the one with the highest positive NPV (if the projects generate revenue) or the one with the lowest negative NPV (if the projects minimize costs). Alternatively, it can compute the differential cash flow between two projects and base its decision on the NPV or the internal rate of return (IRR) of the differential cash flow.

#### **Comparing NPVs**

The simplest way of choosing among mutually exclusive projects with equal lives is to compute the NPVs of the projects and choose the one with the highest NPV. This decision rule is consistent with firm value maximization. If the investments all generate costs (and hence only cash outflows), which is often the case when a service is being delivered, we will choose that alternative that has lowest negative NPV.

<sup>&</sup>lt;sup>4</sup>By true cost of capital, we mean a cost of capital that reflects the riskiness of the firm and its financing mix.

As an illustration, assume that Bookscape is choosing between alternative vendors who are offering telecommunications systems. Both systems have five-year lives, and the appropriate cost of capital is 10 percent for both projects. However the choice is between a more expensive system, with lower annual costs, with a cheaper system, with higher annual costs. Figure 6.4 summarizes the expected cash outflows on the two investments. *Figure 6.4: Cash Flows on Telecommunication Systems* 



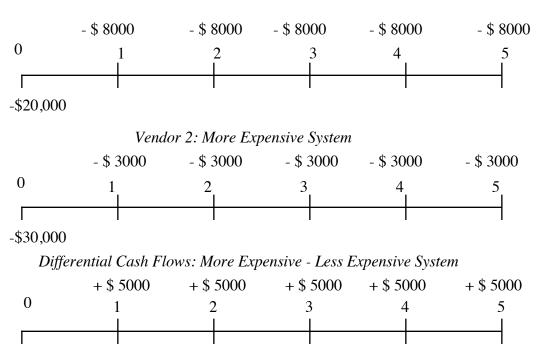
The more expensive system is also more efficient, resulting in lower annual costs. The NPVs of these two systems can be estimated as follows:

NPV of Less Expensive System =  $-\$20,000 - \$8,000 \frac{(1 - (1.10)^{-5})}{0.10}$ = -\$50,326NPV of More Expensive System =  $-\$30,000 - \$3,000 \frac{(1 - (1.10)^{-5})}{0.10}$ = -\$41,372

The NPV of all costs is much lower with the second system, making it the better choice.

#### Differential Cash Flows

An alternative approach for choosing between two mutually exclusive projects is to compute the difference in cash flows each period between the two investments. Using the telecommunications system from the last section as our illustrative example, we would compute the differential cash flow between the less expensive and the more expensive system in figure 6.5:



## Vendor 1: Less Expensive System

*Figure 6.5: Differential Cash Flows on Telecommunication Systems* 

-\$10,000

In computing the differential cash flows, the project with the larger initial investment becomes the project against which the comparison is made. In practical terms, the differential cash flow can be read thus: the more expensive system costs \$ 10,000 more up front, but saves \$ 5000 a year for the next five years.

The differential cash flows can be used to compute the NPV, and the decision rule can be summarized as follows:

If NPV<sub>B-A</sub> > 0: Project B is better than project A

 $NPV_{B-A} < 0$ : Project A is better than project B

Notice two points about the differential NPV. The first is that it provides the same result as would have been obtained if the business had computed NPVs of the individual projects and then taken the difference between them.

$$NPV_{B-A} = NPV_B - NPV_A$$

The second is that the differential cash flow approach works only when the two projects being compared have the same risk level and discount rates, because only one discount rate can be used on the differential cash flows. By contrast, computing project-specific NPVs allows for the use of different discount rates on each project. The differential cash flows can also be used to compute an IRR, which can guide us in selecting the better project.

If  $IRR_{B-A}$  > Hurdle Rate: Project B is better than project A

 $IRR_{B-A}$  < Hurdle Rate: Project A is better than project B

Again, this approach works only if the projects are of equivalent risk. Illustrating this process with the telecommunications example in figure 6.5, we estimate the NPV of the differential cash flows as follows:

Net Present Value of Differential Cash Flows =  $-\$10,000 + \$5,000 \frac{(1 - (1.10)^{-5})}{0.10}$ = +\$8.954

This NPV is equal to the difference between the NPVs of the individual projects that we computed in the last section, and it indicates that the system that costs more up front is also the better system from the viewpoint of NPV. The IRR of the differential cash flows is 41.04 percent, which is higher than the discount rate of 10 percent, once again suggesting that the more expensive system is the better one from a financial standpoint.

# 6.2. Mutually Exclusive Projects with Different Risk Levels

When comparing mutually exclusive projects with different risk levels and discount rates, what discount rate should we use to discount the differential cash flows?

- a. The higher of the two discount rates
- b. The lower of the two discount rates
- c. An average of the two discount rates
- d. None of the above

Explain your answer.

#### **Projects with Different Lives**

In many cases, firms have to choose among projects with different lives.<sup>5</sup> In doing so, they can no longer rely solely on the NPV. This is so because, as a non-scaled figure,

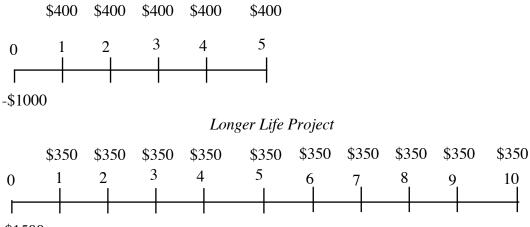
<sup>&</sup>lt;sup>5</sup>Emery, G.W., 1982, *Some Guidelines for Evaluating Capital Investment Alternatives with Unequal Lives*, Financial Management, v11, 14-19.

the NPV is likely to be higher for longer-term projects; the NPV of a project with only two years of cash flows is likely to be lower than one with thirty years of cash flows.

Assume that you are choosing between two projects: a five-year project, with an initial investment of \$ 1 billion and annual cash flows of \$ 400 million, each year for the next 5 years, and a ten-year project, with an initial investment of \$1.5 billion and annual cash flows of \$ 350 million for ten years. Figure 6.6 summarizes the cash flows and a discount rate of 12 percent applies for each.

Figure 6.6: Cash Flows on Projects with Unequal Lives

Shorter Life Project



-\$1500

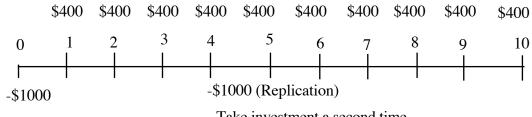
The NPV of the first project is \$442 million, whereas the NPV of the second project is \$478 million. On the basis on NPV alone, the second project is better, but this analysis fails to factor in the additional NPV that could be made by the firm from years six to ten in the project with a five-year life.

In comparing a project with a shorter life to one with a longer life, the firm must consider that it will be able to invest again with the shorter-term project. Two conventional approaches—project replication and equivalent annuities—assume that when the current project ends, the firm will be able to invest in the same project or a very similar one.

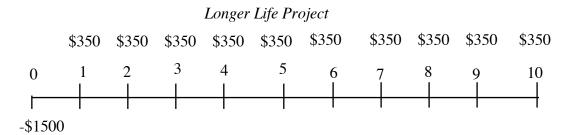
## Project Replication

One way of tackling the problem of different lives is to assume that projects can be replicated until they have the same lives. Thus, instead of comparing a five-year to a ten-year project, we can compute the NPV of investing in the five-year project twice and comparing it to the NPV of the ten-year project. Figure 6.7 presents the resulting cash flows.

Figure 6.7: Cash Flows on Projects with Unequal Lives: Replicated with poorer project Five-year Project: Replicated



Take investment a second time



The NPV of investing in the five-year project twice is \$693 million, whereas the net present value of the ten-year project remains at \$478 million. These NPVs now can be compared because they correspond to two investment choices that have the same life.

This approach has limitations. On a practical level, it can become tedious to use when the number of projects increases and the lives do not fit neatly into multiples of each other. For example, an analyst using this approach to compare a seven-year, a nineyear, and a thirteen-year project would have to replicate these projects to 819 years to arrive at an equivalent life for all three. It is also difficult to argue that a firm's project choice will essentially remain unchanged over time, especially if the projects being compared are very attractive in terms of NPV.

#### Illustration 6.2: Project Replication to Compare Projects with Different Lives

Suppose you are deciding whether to buy a used car, which is inexpensive but does not give very good mileage, or a new car, which costs more but gets better mileage. The two options are listed in Table 6.5.

	Used Car	New Car
Initial cost	\$3,000	\$8,000
Maintenance	\$1,500	\$1,000
costs/year		
Fuel costs/mile	\$0.20	\$0.05
Lifetime	4 years	5 years

Table 6.5: Expected Cash Flows on New versus Used Car

Assume that you drive 5,000 miles a year and that your cost of capital is 15 percent. This choice can be analyzed with replication.

Step 1: Replicate the projects until they have the same lifetime; in this case, that would mean buying used cars five consecutive times and new cars four consecutive times.

*a.* Buy a used car every four years for twenty years.

	l	I	_l		I	I
Year:	0	4	8	12	16	20
Investment	-\$3,000	-\$3,000	-\$3,000	-\$3,000	-\$3,000	

Maintenance costs: \$1,500 every year for twenty years

Fuel costs: \$1,000 every year for twenty years (5,000 miles at twenty cents a mile).

*b.* Buy a new car every five years for twenty years

	l		<u> </u>	I	I
Year:	0	5	10	15	20
Investment:	\$8,000	-\$8,000	-\$8,000	-\$8,000	

Maintenance costs: \$1000 every year for twenty years

Fuel costs: \$250 every year for twenty years (5,000 miles at five cents a mile) Step 2: Compute the NPV of each stream.

> NPV of replicating used cars for 20 years = -22,225.61NPV of replicating new cars for 20 years = -22,762.21

The NPV of the costs incurred by buying a used car every four years is less negative than the NPV of the costs incurred by buying a new car every five years, given that the cars will be driven 5,000 miles every year. As the mileage driven increases, however, the relative benefits of owning and driving the more efficient new car will also increase.

## Equivalent Annuities

We can compare projects with different lives by converting their net present values into *equivalent annuities*. These equivalent annuities can be compared legitimately across projects with different lives. The NPV of any project can be converted into an annuity using the following calculation.

Equivalent Annuity = Net Present Value \* 
$$\frac{r}{(1-(1+r)^{-n})}$$

where

r = project discount rate,

*n* = project lifetime

Note that the NPV of each project is converted into an annuity using that project's life and discount rate and that the second term in the equation is the annuity factor (see appendix 3).<sup>6</sup> Thus, this approach is flexible enough to use on projects with different discount rates and lifetimes. Consider again the example of the five-year and ten-year projects from the previous section. The NPVs of these projects can be converted into annuities as follows:

Equivalent Annuity for 5-year project = 
$$442 * \frac{0.12}{(1 - (1.12)^{-5})} = 122.62$$

Equivalent Annuity for 10-year project = 
$$478 * \frac{0.12}{(1 - (1.12)^{-10})} = 84.60$$

The NPV of the five-year project is lower than the NPV of the ten-year project, but using equivalent annuities, the five-year project yields \$37.98 more per year than the ten-year project.

Although this approach does not explicitly make an assumption of project replication, it does so implicitly. Consequently, it will always lead to the same decision rules as the replication method. The advantage is that the equivalent annuity method is less tedious and will continue to work even in the presence of projects with infinite lives.

Sequenxls: This spreadsheet allows you to compare projects with different lives, using the equivalent annuity approach.

<sup>&</sup>lt;sup>6</sup> This can be obtained just as easilty using the present value functions in a financial calculator or a present value factor table.

Consider again the choice between a new car and a used car described in Illustration 6.3. The equivalent annuities can be estimated for the two options as follows: *Step 1: Compute the NPV of each project individually (without replication)* 

NPV of buying a used car = 
$$-\$3,000 - \$2,500 * \frac{(1 - (1.15)^{-4})}{0.15}$$
  
=  $-\$10.137$ 

NPV of buying a new car =  $-\$8,000 - \$1,250 * \frac{(1 - (1.15)^{-5})}{0.15}$ 

= -\$12,190

Step 2: Convert the NPVs into equivalent annuities

Equivalent annuity of buying a used car =  $-\$10,137 * \frac{0.15}{(1-(1.15)^{-4})}$ 

= -\$3,551

Equivalent annuity of buying a new car =  $-12,190 * \frac{0.15}{(1 - (1.15)^{-5})}$ 

=-\$3,637

Based on the equivalent annuities of the two options, buying a used car is more economical than buying a new car.

## Calculating Break-Even

When an investment that costs more initially but is more efficient and economical on an annual basis is compared with a less expensive and less efficient investment, the choice between the two will depend on how much the investments get used. For instance, in Illustration 6.4, the less expensive used car is the more economical choice if the mileage is less than 5,000 miles in a year. The more efficient new car will be the better choice if the car is driven more than 5,000 miles. The *break-even* is the number of miles at which the two alternatives provide the same equivalent annual cost, as is illustrated in Figure 6.8.

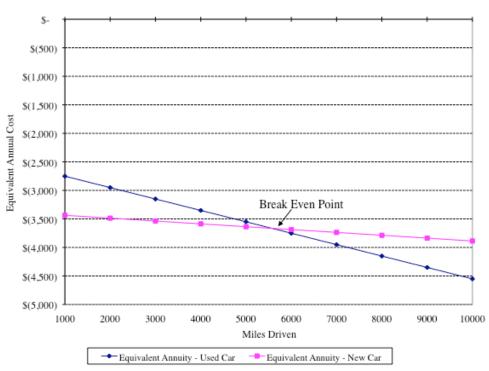


Figure 6.8: Equivalent Annual Costs as a function of Miles Driven

The break-even point occurs at roughly 5,500 miles; if there is a reasonable chance that the mileage driven will exceed this, the new car becomes the better option.

#### Illustration 6.4: Using Equivalent Annuities as a General Approach for Multiple Projects

The equivalent annuity approach can be used to compare multiple projects with different lifetimes. For instance, assume that Disney is considering three storage alternatives for its consumer products division:

Alternative	Initial Investment	Annual Cost	Project Life
Build own storage system	\$10 million	\$0.5 million	Infinite
Rent storage system	\$2 million	\$1.5 million	12 years
Use third-party storage	—	\$2.0 million	1 year

These projects have different lives; the equivalent annual costs have to be computed for the comparison. Since the cost of capital computed for the consumer products business in chapter 4 is 9.49%, the equivalent annual costs can be computed as follows:<sup>7</sup>

<sup>&</sup>lt;sup>7</sup> The cost of the first system is based upon a perpetuity of \$0.5 million a year. The net present value can be calculated as follows:

NPV = 10 + 0.5/.0949 =\$ 15.27 million

Alternative	NPV of costs	Equivalent Annual Cost
Build own storage system	\$15.27 million	\$1.45 million
Rent storage system	\$12.48 million	\$1.79 million
Use third-party storage	\$2.00 million	\$2.00 million

Based on the equivalent annual costs, Disney should build its own storage system, even though the initial costs are the highest for this option.

## 6.3. Equivalent Annuities with growing perpetuities

Assume that the cost of the third-party storage option will increase 2.5 percent a year forever. What would the equivalent annuity for this option be?

- a. \$2.05 million
- b. \$2.50 million
- c. \$2 million
- d. None of the above
- Explain your answer.

## Project Comparison Generalized

To compare projects with different lives, we can make specific assumptions about the types of projects that will be available when the shorter-term projects end. To illustrate this point, we can assume that the firm will have no positive NPV projects when its current projects end; this will lead to a decision rule whereby the NPVs of projects can be compared, even if they have different lives. Alternatively, we can make specific assumptions about the availability and the attractiveness of projects in the future, leading to cash flow estimates and present value computations. Going back to the five-year and ten-year projects, assume that future projects will not be as attractive as current projects. More specifically, assume that the annual cash flows on the second five-year project that will be taken when the first five-year project ends will be \$320 instead of \$400. The NPVs of these two investment streams can be computed as shown in Figure 6.9.

To convert it back to an annuity, all you need to do is multiply the NPV by the discount rate Equitvalent Annuity =  $15.62 \times .0889 = 1.39$  million

			Five	-year Pi	roject: K	Replicate	d			
	\$400	\$400	\$400	\$400	\$400	\$320	\$320	\$320	\$320	\$320
0	1	2 	3	4 	5	6	7	8	9	10
-\$100	0				-\$1000	) (Replic	cation)			
				Lon	iger Life	e Project	ţ			
	\$350	\$350	\$350	\$350	\$350	\$350	\$350	\$350	\$350	\$350
0	1	2	3	4	5	6	7	8	9	10
I										
-\$1500	)	•	•	•	·	•	•			•

Figure 6.9: Cash Flows on Projects with Unequal Lives: Replicated with poorer project Five-year Project: Replicated

The NPV of the first project, replicated to have a life of ten years, is \$529. This is still higher than the NPV of \$478 of the longer-life project. The firm will still pick the shorter-life project, though the margin in terms of NPV has shrunk.

This problem is not avoided by using IRRs. When the IRR of a short-term project is compared to the IRR of a long-term project, there is an implicit assumption that future projects will continue to have similar IRRs.

## The Replacement Decision: A Special Case of Mutually Exclusive Projects

In a *replacement decision*, we evaluate the replacement of an existing investment with a new one, generally because the existing investment has aged and become less efficient. In a typical replacement decision,

- the replacement of old equipment with new equipment will require an initial cash outflow, because the money spent on the new equipment will exceed any proceeds obtained from the sale of the old equipment.
- there will be cash savings (inflows) during the life of the new investment as a consequence of either the lower operating costs arising from the newer equipment or the higher revenues flowing from the investment. These cash inflows will be augmented by the tax benefits accruing from the greater depreciation that will arise from the new investment.
- the salvage value at the end of the life of the new equipment will be the differential salvage value—that is, the excess of the salvage value on the new equipment over the

salvage value that would have been obtained if the old equipment had been kept for the entire period and had not been replaced.

This approach has to be modified if the old equipment has a remaining life that is much shorter than the life of the new equipment replacing it.

Solution: This spreadsheet allows you to analyze a replacement decision.

#### Illustration 6.5: Analyzing a Replacement Decision

Bookscape would like to replace an antiquated packaging system with a new one. The old system has a book value of \$50,000 and a remaining life of ten years and could be sold for \$15,000, net of capital gains taxes, right now. It would be replaced with a new machine that costs \$150,000, has a depreciable life of ten years, and annual operating costs that are \$40,000 lower than with the old machine. Assuming straight-line depreciation for both the old and the new systems, a 40 percent tax rate, and no salvage value on either machine in ten years, the replacement decision cash flows can be estimated as follows:

Net Initial Investment in New Machine = -\$150,000 + \$15,000 = \$135,000

Depreciation on the old system = \$5,000

Depreciation on the new system = \$15,000

Annual Tax Savings from Additional Depreciation on New Machine = (Depreciation on Old Machine – Depreciation on New Machine) (Tax Rate) = (\$15,000 - \$5,000) \* 0.4 =

\$4,000

Annual After-Tax Savings in Operating Costs = 40,000(1 - 0.4) = 24,000The cost of capital for the company is 14.90% percent, resulting in an NPV from the replacement decision of

NPV of Replacement Decision = 
$$-\$135,000 + \$28,000 * \frac{(1 - (1.149)^{-10})}{0.149} = \$6063$$

This result would suggest that replacing the old packaging machine with a new one will increase the firm's value by \$6063 and would be a wise move to make.

## Side Costs from Projects

In much of the project analyses that we have presented in this chapter, we have assumed that the resources needed for a project are newly acquired; this includes not only the building and the equipment but also the personnel needed to get the project going. For most businesses considering new projects, this is an unrealistic assumption, however,

because many of the resources used on these projects are already part of the business and will just be transferred to the new project. When a business uses such resources, there is the potential for an

*Opportunity Cost:* The cost assigned to a project resource that is already owned by the firm. It is based on the next best alternative use.

**opportunity cost**—the cost created for the rest of the business as a consequence of this project. This opportunity cost may be a significant portion of the total investment needed on a project. Ignoring these costs because they are not explicit can lead to bad investments. In addition, a new product or service offered by a firm may hurt the profitability of its other products or services; this is generally termed **product cannibalization** and we will examine and whether and how to deal with the resulting costs.

### **Opportunity Costs of using Existing Resources**

The opportunity cost for a resource is simplest to estimate when there is a current alternative use for the resource, and we can estimate the cash flows lost by using the resource on the project. It becomes more complicated when the resource does not have a current use but does have potential future uses. In that case, we have to estimate the cash flows forgone on those future uses to estimate the opportunity costs.

## **Resource with a Current Alternative Use**

The general framework for analyzing opportunity costs begins by asking whether there is any other use for the resource right now. In other words, if the project that is considering using the resource is not accepted, what are the uses to which the resource will be put to and what cash flows will be generated as a result?

• The resource might be rented out, in which case the rental revenue lost is the opportunity cost of the resource. For example, if the project is considering the use of

a vacant building already owned by the business, the potential revenue from renting out this building will be the opportunity cost.

- The resource could be sold, in which case the sales price, net of any tax liability and lost depreciation tax benefits, would be the opportunity cost for the resource.
- The resource might be used elsewhere in the firm, in which case the cost of replacing it is the opportunity cost. Thus, the transfer of experienced employees from established divisions to a new project creates a cost to these divisions, which has to be factored into the decision making.

Sometimes, decision makers have to decide whether the opportunity cost will be estimated based on the lost rental revenue, the foregone sales price or the cost of replacing the resource. When such a choice has to be made, it is the highest of the costs—that is, the best alternative forgone—that should be considered as an opportunity cost.

## 6.4. Sunk Costs and Opportunity Costs

A colleague argues that resources that a firm owns already should not be considered in investment analysis because the cost is a sunk cost. Do you agree?

a. Yes

b. No

How would you reconcile the competing arguments of sunk and opportunity costs?

Illustration 6.6: Estimating the Opportunity Cost for a Resource with a Current Alternative Use

Working again with the Bookscape Online example, assume that the following additional information is provided:

Although Bookscape Online will employ only two full-time employees, it is estimated that the additional business associated with online ordering and the administration of the service itself will add to the workload for the current general manager of the bookstore. As a consequence, the salary of the general manager will be increased from \$100,000 to \$120,000 next year; it is expected to grow 5 percent a year after that for the remaining three years of the online venture. After the online

venture is ended in the fourth year, the manager's salary will revert back to its old levels.

• It is also estimated that Bookscape Online will utilize an office that is currently used to store financial records. The records will be moved to a bank vault, which will cost \$1000 a year to rent.

The opportunity cost of the addition to the general manager's workload lies in the additional salary expenditure that will be incurred as a consequence. Taking the present value of the after-tax costs (using a 40 percent tax rate) over the next four years, using the cost of capital of 25.48% estimated in Illustration 5.2, yields the values in Table 6.6.

	1	2	3	4
Increase in Salary	\$20,000	\$21,000	\$22,050	\$23,153
After-tax expense	\$12,000	\$12,600	\$13,230	\$13,892
Present Value @25.48%	\$9,563	\$8,002	\$6,696	\$5,603

 Table 6.6: Present Value of Additional Salary Expenses

The cumulative present value of the costs is \$29,865.

Turning to the second resource—a storage space originally used for the financial records—if this project is taken, the opportunity cost is the cost of the bank vault.

Additional Storage Expenses per Year = \$1,000

After-Tax Additional Storage Expenditure per Year = 1,000 (1 - 0.40) = 600

PV of After-Tax Storage Expenditures for 4 Years =  $600 * \frac{(1 - (1.2548)^{-4})}{0.2548}$ 

The opportunity costs estimated for the general manager's added workload (\$29,865) and the storage space (\$1,405) are in present value terms and can be added on to -\$98,775 that we computed as the NPV of Bookscape Online in Illustration 5.11.The NPV becomes more negative.

NPV with Opportunity Costs = NPV without Opportunity Costs + PV of Opportunity

Costs = -\$98,775 - \$29,865 - \$1,405 = -\$ 130,045

The cash flows associated with the opportunity costs could alternatively have been reflected in the years in which they occur. Thus, the additional salary and storage expenses could have been added to the operating expenses of the store in each of the four years. As table 6.7 indicates, this approach would yield the same NPV and would have clearly been the appropriate approach if the IRR were to be calculated.

	Cashflows from	Opportunity	Cashflow with	Present Value @
Year	Online venture	costs	opportunity costs	25.48%
0	-\$1,150,000		-\$1,150,000	-\$1,150,000
1	\$340,000	\$12,600	\$327,400	\$260,916
2	\$415,000	\$13,200	\$401,800	\$255,184
3	\$446,500	\$13,830	\$432,670	\$218,989
4	\$720,730	\$14,492	\$706,238	\$284,865
				-\$130,045

Table 6.7: NPV with Opportunity Costs: Alternate Approach

Note that this NPV is identical to our earlier computation —this project should not be taken.

## **Resources with No Current Alternative Use**

In some cases, a resource being considered for use in a project will have no current alternative use, but the business will have to forgo alternative uses in the future. One example would be excess capacity on a machine or a computer. Most firms cannot lease or sell excess capacity, but using that capacity now for a new product may cause the businesses to run out of capacity much earlier than they would otherwise, leading to one of two costs:

- They assume that excess capacity is free, because it is not being used currently and cannot be sold off or rented, in most cases.
- They allocate a portion of the book value of the plant or resource to the project. Thus, if the plant has a book value of \$100 million and the new project uses 40 percent of it, \$40 million will be allocated to the project.

We will argue that neither of these approaches considers the opportunity cost of using excess capacity, because the opportunity cost comes usually comes from costs that the firm will face in the future as a consequence of using up excess capacity today. By using up excess capacity on a new project, the firm will run out of capacity sooner than if it did not take the project. When it does run out of capacity, it has to take one of two paths:

• New capacity will have to be bought or built, in which case the opportunity cost will be the higher cost in present value terms of doing this earlier rather than later.

• Production will have to be cut back on one of the product lines, leading to a loss in cash flows that would have been generated by the lost sales.

Again, this choice is not random, because the logical action to take is the one that leads to the lower cost, in present value terms, for the firm. Thus, if it is cheaper to lose sales rather than build new capacity, the opportunity cost for the project being considered should be based on the lost sales.

A general framework for pricing excess capacity for purposes of investment analysis asks three questions:

1. If the new project is not taken, when will the firm run out of capacity on the equipment or space that is being evaluated?

2. If the new project is taken, when will the firm run out of capacity on the equipment or space that is being evaluated? Presumably, with the new project using up some of the excess capacity, the firm will run out of capacity sooner than it would have otherwise.

3. What will the firm do when it does run out of capacity? The firm has two choices: It can cut back on production of the least profitable product line and make less profits than it would have without a capacity constraint. In this case, the opportunity cost is the present value of the cash flows lost as a consequence. It can buy or build new capacity, in which case the opportunity cost is the difference in present value between investing earlier rather than later.

## **Product Cannibalization**

**Product cannibalization** refers to the phenomenon whereby a new product introduced by a firm competes with and reduces sales of the

**Product Cannibalization:** Sales generated by one product that come at the expense of other products manufactured by the same firm.

firm's existing products. On one level, it can be argued that this is a negative incremental effect of the new product, and the lost cash flows or profits from the existing products should be treated as costs in analyzing whether to introduce the product. Doing so introduces the possibility that of the new product will be rejected, however. If this happens, and a competitor then exploits the opening to introduce a product that fills the niche that the new product would have and consequently erodes the sales of the firm's

existing products, the worst of all scenarios is created—the firm loses sales to a competitor rather than to itself.

Thus, the decision on whether to build in the lost sales created by product cannibalization will depend on the potential for a competitor to introduce a close substitute to the new product being considered. Two extreme possibilities exist: The first is that close substitutes will be offered almost instantaneously by competitors; the second is that substitutes cannot be offered.

- If the business in which the firm operates is extremely competitive and there are no barriers to entry, it can be assumed that the product cannibalization will occur anyway, and the costs associated with it have no place in an incremental cash flow analysis. For example, in considering whether to introduce a new brand of cereal, a company like Kellogg's can reasonably ignore the expected product cannibalization that will occur because of the competitive nature of the cereal business and the ease with which Post or General Mills could introduce a close substitute. Similarly, it would not make sense for Compaq to consider the product cannibalization that will occur as a consequence of introducing an updated notebook computer because it can be reasonably assumed that a competitor, say, IBM or Dell, would create the lost sales anyway with their versions of the same product if Compaq does not introduce the product.
- If a competitor cannot introduce a substitute—because of legal restrictions such as patents, for example—the cash flows lost as a consequence of product cannibalization belong in the investment analysis at least for the period of the patent protection. For example, a pharmaceutical company, which has the only patented drug available to treat ulcers, may hold back on introducing a potentially better, new ulcer drug because of fears of product cannibalization.<sup>8</sup>

In most cases, there will be some barriers to entry, ensuring that a competitor will either introduce an imperfect substitute, leading to much smaller erosion in existing product sales, or that a competitor will not introduce a substitute for some period of time, leading

<sup>&</sup>lt;sup>8</sup> Even the patent system does not offer complete protection against competition. It is entirely possible that another pharmaceutical company may come into the market with its own ulcer treating drug and cause the lost sales anyway.

to a much later erosion in existing product sales. In this case, an intermediate solution whereby some of the product cannibalization costs are considered may be appropriate. Note that brand name loyalty is one potential barrier to entry. Firms with stronger brand loyalty should therefore factor into their investment analysis more of the cost of lost sales from existing products as a consequence of a new product introduction.

## 6.5. Product Cannibalization at Disney

In coming up with revenues on its proposed theme park in Thailand, Disney estimates that 15 percent of the revenues at these parks will be generated from people who would have gone to Disneyland in California if these parks did not exist. When analyzing the project in Thailand, would you use

a. the total revenues expected at the park?

- b. only 85 percent of the revenues, because 15 percent of the revenues would have come to Disney anyway?
- c. a compromise estimated that lies between the first two numbers?

Explain.

## Side Benefits from Projects

A proposed investment may benefit other investments that a firm already has. In assessing this investment, we should **Project Synergy:** The increase in cash flows that accrue to other projects, as a consequence of the project under consideration.

therefore consider these side benefits. We will begin this section with a consideration of synergies between individual projects and then follow up by extending the discussion to cover acquisitions, where synergy between two companies is often offered as the reason for large acquisition premiums.

#### **Project Synergies**

When a project under consideration creates positive benefits (in the form of cash flows) for other projects that a firm may have, **project synergies** are created. For instance, assume that you are a clothing retailer considering whether to open an upscale clothing store for children in the same shopping center where you already own a store that caters to an adult clientele. In addition to generating revenues and cash flows on its

own, the children's store might increase the traffic to the adult store and increase profits there. That additional profit, and its ensuing cash flow, must be factored into the analysis of the new store.

Sometimes the project synergies are not with existing projects but with other projects being considered contemporaneously. In such cases, the best way to analyze the projects is jointly, because examining each separately will lead to a much lower NPV. Thus, a proposal to open a children's clothing store and an adult clothing store in the same shopping center will have to be treated as a joint investment analysis, and the NPV will have to be calculated for both stores together. A positive NPV would suggest opening both stores, whereas a negative NPV would indicate that neither should be opened.

## Illustration 6.7: Cash Flow Synergies with Existing Projects

Assume that Bookscape is considering adding a café to its bookstore. The café, it is hoped, will make the bookstore a more attractive destination for would-be shoppers. The following information relates to the proposed café:

- The initial cost of remodeling a portion of the store to make it a café and of buying equipment is expected to be \$150,000. This investment is expected to have a life of five years, during which period it will be depreciated using straight-line depreciation. None of the cost is expected to be recoverable at the end of the five years.
- The revenues in the first year are expected to be \$60,000, growing at 10 percent a year for the next four years.
- There will be one employee, and the total cost for this employee in year one is expected to be \$30,000 growing at 5 percent a year for the next four years.
- The cost of the material (food, drinks, etc.) needed to run the café is expected to be 40 percent of revenues in each of the five years.
- An inventory amounting to 5 percent of the revenues has to be maintained; investments in the inventory are made at the beginning of each year.
- The tax rate for Bookscape as a business is 40 percent.

Based on this information, the estimated cash flows on the cafe are shown in Table 6.8.

	Year 0	1	2	3	4	5
Investment	-\$150,000					
Revenues		\$60,000	\$66,000	\$72,600	\$79,860	\$87,846
Labor		\$30,000	\$31,500	\$33,075	\$34,729	\$36,465
Materials		\$24,000	\$26,400	\$29,040	\$31,944	\$35,138
Depreciation		\$30,000	\$30,000	\$30,000	\$30,000	\$30,000
Operating Income		-\$24,000	-\$21,900	-\$19,515	-\$16,813	-\$13,758
Taxes		-\$9,600	-\$8,760	-\$7,806	-\$6,725	-\$5,503
After-tax operating						
income		-\$14,400	-\$13,140	-\$11,709	-\$10,088	-\$8,255
+ Depreciation		\$30,000	\$30,000	\$30,000	\$30,000	\$30,000
$-\Delta$ Working capital	\$3,000	\$300	\$330	\$363	\$399	-\$4,392
Cash flow to firm	-\$153,000	\$15,300	\$16,530	\$17,928	\$19,513	\$26,138
PV at 14.90%	-\$153,000	\$13,644	\$13,146	\$12,714	\$12,341	\$14,742
Working capital		\$3,000	\$3,300	\$3,630	\$3,993	\$4,392

Table 6.8: Estimating Cash Flows from Opening Bookscape Café

Note that the working capital is fully salvaged at the end of year five, resulting in a cash inflow of \$4,392.

To compute the NPV, we will use Bookscape's cost of capital of 14.90 percent (from Chapter 4). In doing so, we recognize that this is the cost of capital for a bookstore and that this is an investment in a café. It is, however, a café whose good fortunes rest with how well the bookstore is doing and whose risk is therefore the risk associated with the bookstore. The present value of the cash inflows is reduced by the initial investment of \$150,000, resulting in an NPV of -\$89,760. This suggests that this is not a good investment based on the cash flows it would generate.

Note, however, that this analysis is based on looking at the café as a stand-alone entity and that one of the benefits of the café is that is that it might attract more customers to the store and get them to buy more books. For purposes of our analysis, assume that the café will increase revenues at the store by \$500,000 in year one, growing at 10 percent a year for the following four years. In addition, assume that the pretax operating margin on these sales is 10 percent. The incremental cash flows from the synergy are shown in Table 6.9.

	Year 1	2	3	4	5
Increased revenues	\$500,000	\$550,000	\$605,000	\$665,500	\$732,050
Operating margin (%)	10.00%	10.00%	10.00%	10.00%	10.00%
Operating income	\$50,000	\$55,000	\$60,500	\$66,550	\$73,205
Operating income after					
taxes	\$29,000	\$31,900	\$35,090	\$38,599	\$42,459
PV of cash flows at 12.14%	\$25,861	\$25,369	\$24,886	\$24,412	\$23,947

Table 6.9: Incremental Cash Flows from Synergy

The present value of the incremental cash flows generated for the bookstore as a consequence of the café is \$115,882. Incorporating this into the present value analysis yields the following:

NPV of Cafe = -\$89,670 + \$115,882 = \$26,122

By incorporating the cash flows from the synergy into the analysis, we can see that the café is a good investment for Bookscape.

## 6.6. Synergy Benefits

In the analysis, the cost of capital for both the café and the bookstore was identical at 14.90 percent. Assume that the cost of capital for the cafe had been 18 percent, whereas the cost of capital for the bookstore had stayed at 14.90 percent. Which discount rate would you use for estimating the present value of synergy benefits?

- a. 18 percent
- b. 14.90 percent
- c. An average of the two discount rates
- d. Could be 14.90 percent or 18 percent depending on . . .
- Explain.

## In Practice: The Value of Synergy: Disney's Animated Movies

Disney has a well-deserved reputation for finding synergy in its movie operations, especially its animated movies. Consider, for instance, some of the spin-offs from its recent movies:

- 1. Plastic action figures and stuffed toys are produced and sold at the time the movies are released, producing profits for Disney both from its own stores and from royalties from sales of the merchandise at other stores.
- Joint promotions of the movies with fast-food chains, such as McDonald's and Burger King, where the chains give away movie merchandise with their kid's meals and reduce Disney's own advertising costs for the movie by promoting it.
- With its acquisition of Capital Cities, Disney now has a broadcasting outlet for cartoons based on successful movies (*Aladdin*, Lion King, Little Mermaid(, which generate production and advertising revenues for Disney.
- 4. Disney has also made successful Broadway musicals of its hit movies, *Beauty and the Beast*, *The Little Mermaid* and *The Lion King*, and plans to use the theater that it now owns on Broadway to produce more such shows.
- 5. Disney's theme parks all over the world benefit indirectly as these movies attract more people to the parks.
- Disney produces computer software and video games based on its animated movie characters.
- Finally, Disney has been extremely successful in promoting the video and DVD releases of its movies as must-have items for video collections.

In fact, on its best-known classics, such as *Snow White*, Disney released the movie in theaters dozens of times between the original release in 1937 and the eventual video release in 1985, making substantial profits each time. More recently, the company has released its masterworks on DVD, with special features added and a premium price.

## **Synergy in Acquisitions**

Synergy is often a motive in acquisitions, but it is used as a way of justifying huge premiums and is seldom analyzed objectively. The framework we developed for valuing synergy in projects can be applied to valuing synergy in acquisitions. The key to the existence of synergy is that the target firm controls a specialized resource that becomes more valuable when combined with the bidding firm's resources. The specialized resource will vary depending on the merger. Horizontal mergers occur when two firms in the same line of business merge. In that case, the synergy must come from some form of economies of scale, which reduce costs, or from increased market power, which increases profit margins and sales. Vertical integration occurs when a firm acquires a supplier of inputs into its production process or a distributor or retailer for the product it produces. The primary source of synergy in this case comes from more complete control of the chain of production. This benefit has to be weighed against the loss of efficiency from having a captive supplier who does not have any incentive to keep costs low and compete with other suppliers.

When a firm with strengths in one functional area acquires another firm with strengths in a different functional area (functional integration), synergy may be gained by exploiting the strengths in these areas. Thus, when a firm with a good distribution network acquires a firm with a promising product line, value is gained by combining these two strengths. The argument is that both firms will be better off after the merger.

Most reasonable observers agree that there is a potential for operating synergy, in one form or the other, in many takeovers. Some disagreement exists, however, over whether synergy can be valued and, if so, how much that value should be. One school of thought argues that synergy is too nebulous to be valued and that any systematic attempt to do so requires so many assumptions that it is pointless. We disagree. It is true that valuing synergy requires assumptions about future cash flows and growth, but the lack of precision in the process does not mean that an unbiased estimate of value cannot be made. Thus we maintain that synergy can be valued by answering two fundamental questions:

1. *What form is the synergy expected to take?* The benefits of synergy have to show up in one of the inputs into value, as higher revenues, a healthier operating margin, more investment opportunities or higher growth in the future. To value synergy, we need to identify which of these inputs will most likely be affected and by how much.

2. When can the synergy be expected to start affecting cash flows? Even if there are good reasons for believing that synergy exists in a particular merger, it is unlikely that these benefits will accrue instantaneously after the merger is completed. It often takes time to integrate the operations of two firms, and the difficulty of doing so increases with the sizes of the firms. If we have to wait for the higher cash flows that arise as a result of synergy, the value of synergy decreases, an

Once these questions are answered, the value of synergy can be estimated using an extension of investment analysis techniques. First, the firms involved in the merger are valued independently by discounting expected cash flows to each firm at the weighted average cost of capital for that firm. Second, the value of the combined firm, with no synergy, is obtained by adding the values obtained for each firm in the first step. Third, the effects of synergy are built into expected growth rates and cash flows, and the combined firm is revalued with synergy. The difference between the value of the combined firm with synergy and the value of the combined firm without synergy provides a value for synergy.

### Illustration 6.8: Valuing Synergy in Tata-Sensient Merger

In chapter 5, we valued Sensient Technologies for an acquisition by Tata Chemicals and estimated a value of \$ 1,559 million for the operating assets and \$ 1,107 million for the equity in the firm. In estimating this value, though, we treated Sensient Technologies as a stand-alone firm. Assume that Tata Chemicals foresees potential synergies in the combination of the two firms, primarily from using its distribution and marketing facilities in India to market Sensient's food additive products to India's rapidly growing processed food industry. To value this synergy, let us assume the following:

- a. It will take Tata Chemicals approximately 3 years to adapt Sensient's products to match the needs of the Indian processed food sector more spice, less color.
- b. Tata Chemicals will be able to generate Rs 1,500 million in after-tax operating income in year 4 from Sensient's Indian sales, growing at a rate of 4% a year after that in perpetuity from Sensient's products in India.

To value synergy, we first estimate the cost of capital that we should be using in this computation. In this case, there are two aspects to the synergy that focus our estimation. The first is that all the perceived synergies flow from Sensient's products and the risks therefore relate to those products; we will begin with the levered beta of 0.8138, that we estimated for Sensient in chapter 5, in estimating the cost of equity. The second is that the synergies are expected to come from India; consequently, we will add the country risk premium of 4.51% for India, estimated in chapter 4 (for Tata Chemicals). Finally, we will

assume that Sensient will maintain its existing debt to capital ratio of 28.57%, its current dollar cost of debt of 5.5% and its marginal tax rate of 37%.

Cost of equity in US \$ = 3.5% + 0.8138(6% + 4.51%) = 12.05%

Cost of debt in US \$=5.5% (1-.37) = 3.47%

Cost of capital in US \$ = 12.05% (1-.2857) + 5.5% (1-.37)= 9.60%

Since our cashflows are in rupees, we will convert this cost of capital to a rupee rate by using expected inflation rates of 3% for India and 2% for the United States.

Cost of capital in Rs =  $(1 + \text{Cost of Capital}_{\text{US}\,\$}) \frac{(1 + \text{Inflation Rate}_{\text{Rs}})}{(1 + \text{Inflation Rate}_{\text{US}\,\$})} - 1$ 

$$= (1.096)\frac{(1.03)}{(1.02)} - 1 = 10.67\%$$

We can now discount the expected cash flows a this estimated cost of capital to value synergy, starting in year 4:

Value of synergy<sub>Year 3</sub> = 
$$\frac{\text{Expected Cash Flow}_{\text{Year 4}}}{(\text{Cost of Capital - g})} = \frac{1500}{(.1067 - .04)} = \text{Rs } 22,476 \text{ million}$$
  
Value of synergy today =  $\frac{\text{Value of Synergy}_{\text{year 3}}}{(1 + \text{Cost of Capital})^3} = \frac{22,476}{(1.1067)^3} = \text{Rs } 16,580 \text{ million}$ 

In illustration 5.15, we estimated the value of equity in Sensient Technologies, with no synergy, to be \$1,107 million. Converting the synergy value into dollar terms at the current exchange rate of Rs 47.50/\$, we can estimate a total value that Tata Chemicals can pay for Sensient's equity:

Value of synergy in US = Rs 16,580/47.50 = 349 million

Value of Sensient Technologies = \$1,107 million + \$349 million = \$1,456 million Since Sensient's equity trades at \$1,150 million, Tata Chemicals can afford to pay a premium of up to \$306 million and still gain in value from the acquisition.

## Why do acquirers pay too much? A Behavioral Perspective

There is substantial evidence that acquirers pay too much for target companies and that the value of synergy is overstated in the process. In addition to academic studies of mergers that indicate that acquiring firms' stock prices go down in about 40-45% of all acquisitions, on the announcement of the merger, both KPMG and McKinsey have studies that follow up acquisitions and indicate that there is little evidence of synergy gains in the years after.

The persistence and the magnitude of the overpayment suggest two problems. The first is that the process of analyzing acquisitions is flawed, with those that are richly compensated by the deal (investment bankers) also being responsible for analyzing whether the deal should be done. However, that does not mitigate the responsibility of the acquiring company's managers, who seem to be cavalier about spending stockholders' money, nor does it explain their behavior. There are three reasons that have been presented for this phenomenon:

- a. <u>Hubris:</u> Roll (1986) argues that it is managerial hubris that best explains acquisition over payments. The managers in acquiring firms make mistakes in assessing target company values and their pride prevents them from admitting these mistakes.<sup>9</sup>
- b. Over confidence: The same over confidence that leads managers to over estimate cash flows on conventional capital budgeting projects manifests itself in acquisitions, perhaps in a more virulent form.<sup>10</sup> Studies seem to indicate that the managers in acquiring firms are among the most over-confident of the entire group.
- c. Anchoring and framing: When negotiating a price for a target firm, both the acquiring firm's managers and the target firm's stockholders compare the price being offered to "reference points", often unrelated to intrinsic value. Wurgler, Pan and Baker (2008) argue that while the current stock price is one reference point, the highest price over the previous 52 weeks seems to be an even stronger one.<sup>11</sup> In fact, they present evidence that the price paid on acquisitions has less to do with fair value and more to do with matching this 52-week high.

How can we reduce the problem of overpayment? First, we need to reform the acquisition process and separate the deal making from the deal analysis. Second, we have to give stockholders a much bigger say in the process. If the board of directors cannot perform their oversight role, the largest investors in the acquiring company should be allowed

<sup>&</sup>lt;sup>9</sup> Roll, Richard, 1986, "The hubris hypothesis of corporate takeovers," Journal of Business 59, 197-216.

<sup>&</sup>lt;sup>10</sup> Graham, J., C. Harvey, and M. Puri, 2008, "Managerial attitudes and corporate actions," Duke University working paper.

<sup>&</sup>lt;sup>11</sup> Baker, M., X. Pan and J. Wurgler, 2009, The Psychology of Pricing in Mergers and Acquisitions, Working Paper, ssrn.com.

representation during the negotiation, and the representative will be given the responsibility of questioning key assumptions and forecasts. Third, the managers who are most intent on pushing the acquisition through should be given the responsibility of delivering the projected cash flows.

## **Options Embedded in Projects**

In Chapter 5, we examined the process for analyzing a project and deciding whether to accept the project. In particular, we noted *Real Option*: An option on a nontraded asset, such as an investment project or a gold mine.

that a project should be accepted only if the returns on the project exceed the hurdle rate; in the context of cash flows and discount rates, this translates into projects with positive NPVs. The limitation with traditional investment analysis, which analyzes projects on the basis of expected cash flows and discount rates, is that it fails to consider fully the myriad options that are usually associated with many projects.

In this section, we will begin by first describing what an option is why they matter, and then analyze three options that are embedded in many capital budgeting projects. The first is the option to delay a project, especially when the firm has exclusive rights to the project. The second is the option to expand a project to cover new products or markets some time in the future. The third is the option to abandon a project if the cash flows do not measure up to expectations. These are generically called real options since the underlying asset is a real asset (a project) rather than a financial asset. With each of these options, we will present both the intuitive implications of valuing them as options as well as the details of using option pricing models to value them. Appendix 4 contains more detail on these models.

### **Options: Description and Determinants of Value**

An option is an asset that derives its value from another asset, called an underlying asset, and has a cash payoff that is contingent on what happens to the value of the underlying asset. There are two types of options. With a call option, you get the right to buy the underlying asset at a fixed price, called a strike price, whereas with put options, you get the right to sell the underlying asset at a fixed price. Since you have the right, as the holder of the option, to buy or sell the underlying asset, and not an obligation, you will exercise an option only if it makes sense for you to do so. With a call option, that will occur when the value of the underlying asset is greater than your strike price, whereas with a put, it is when the value is lower.

As explained in appendix 4, the value of an option ultimately rests of six variables – the value, volatility and expected dividends of the underlying asset, the strike price and the life of the option and the level of interest rates. Without delving into the minutiae of option pricing models, it is still worth noting the differences between valuing conventional assets or projects on the one hand and options on the other. The first is that conventional assets can be valued by discounting expected cash flows at a risk-adjusted discount rate, whereas options are valued at a premium over their exercise value. The premium can be attributed to the choice that the holder of the option as to when and whether to exercise. The second is that increasing risk and uncertainty reduce the value of conventional assets, but they increase the value of options. This is because the holders of options can never be forced to exercise an option, which protects them against downside risk but preserves upside potential.

It is because of these two differences that this section is necessitated. If an investment has options embedded in it, conventional net present value will miss the option premium and understate the value of the investment. In addition, the option portion of the investment may benefit as the investment becomes more risky, even as the rest of the investment becomes more valuable.

## The Option to Delay a Project

Projects are typically analyzed based on their expected cash flows and discount rates at the time of the analysis; the NPV computed on that basis is a measure of its value and acceptability at that time. Expected cash flows and discount rates change over time, however, and so does the NPV. Thus, a project that has a negative NPV now may have a positive NPV in the future. In a competitive environment, in which individual firms have no special advantages over their competitors in taking projects, this may not seem significant. In an environment where a project can be taken by only one firm (because of legal restrictions or other barriers to entry to competitors), however, the changes in the project's value over time give it the characteristics of a call option.

## Describing the Option to Delay

In the abstract, assume that a project requires an initial investment of X and that the present value of expected cash inflows computed right now is PV. The NPV of this project is the difference between the two:

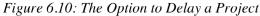
$$NPV = PV - X$$

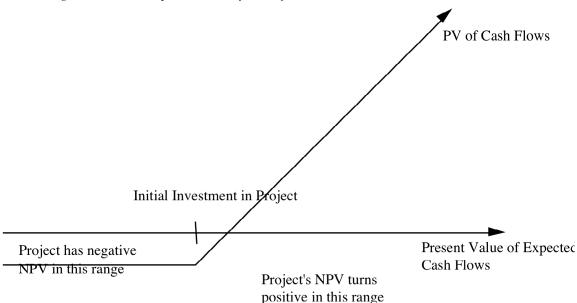
Now assume that the firm has exclusive rights to this project for the next n years, and that the present value of the cash inflows may change over that time because of changes in either the cash flows or the discount rate. Thus, the project may have a negative NPV right now, but it may still become a good project if the firm waits. Defining V as the present value of the cash flows, the firm's decision rule on this project can be summarized as follows:

If V > X project has positive NPV

V < X project has negative NPV

This relationship can be presented in a payoff diagram of cash flows on this project, as shown in Figure 6.10, assuming that the firm holds out until the end of the period for which it has exclusive rights to the project.





Note that this payoff diagram is that of a call option—the underlying asset is the project; the strike price of the option is the investment needed to take the project; and the life of the option is the period for which the firm has rights to the project. The present value of

the cash flows on this project and the expected variance in this present value represent the value and variance of the underlying asset.

#### Valuing the Option to Delay

On the surface, the inputs needed to apply option pricing models to valuing the option to delay are the same as those needed for any application: the value of the underlying asset, the variance in the value, the time to expiration on the option, the strike price, the riskless rate, and the equivalent of the dividend yield. Actually estimating these inputs for valuing real options can be difficult, however.

#### Value of the Underlying Asset

In the case of product options, the underlying asset is the project itself. The current value of this asset is the present value of expected cash flows from initiating the project now, which can be obtained by doing a standard capital budgeting analysis. There is likely to be a substantial amount of estimation error in the cash flow estimates and the present value, however. Rather than being viewed as a problem, this uncertainty should be viewed as the reason why the project delay option has value. If the expected cash flows on the project were known with certainty and were not expected to change, there would be no need to adopt an option pricing framework, because there would be no value to the option.

#### Variance in the Value of the Asset

As noted in the previous section, there is likely to be considerable uncertainty associated with the cash flow estimates and the present value that measures the value of the asset now, partly because the potential market size for the product may be unknown and partly because technological shifts can change the cost structure and profitability of the product. The variance in the present value of cash flows from the project can be estimated in one of three ways. First, if similar projects have been introduced in the past, the variance in the cash flows from those projects can be used as an estimate. Second, probabilities can be assigned to various market scenarios, cash flows estimated under each scenario, and the variance estimated across present values. Finally, the average variance in firm value of publicly traded companies that are in the business that the project will be in can be used. Thus, the average variance in firm value of biotechnology companies can be used as the variance for the option to delay a biotechnology project.

The value of the option is largely derived from the variance in cash flows—the higher the variance, the higher the value of the project delay option. Thus, the value of an option to invest in a project in a stable business will be less than the value of one in an environment in which technology, competition, and markets are all changing rapidly.

There is a data set online that summarizes, by sector, the variances in firm value and equity value for companies in each sector in the United States.

#### Exercise Price on Option

A project delay option is exercised when the firm owning the rights to the project decides to invest in it. The cost of making this investment is equivalent to the exercise price of the option. For simplicity, it is best to assume that this cost remains constant (in present value dollars) and that any uncertainty associated with the product is reflected in the present value of cash flows on the product.

# Expiration of the Option and the Riskless Rate

The project delay option expires when the rights to the project lapse; investments made after the project rights expire are assumed to deliver an NPV of zero as competition drives returns down to the required rate. The riskless rate to use in pricing the option should be the rate that corresponds to the expiration of the option.

#### Dividend Yield

Once the NPV turns positive, there is a cost borne in delaying making an investment. Because the project rights expire after a fixed period, and excess profits (which are the source of positive present value) are assumed to disappear after that time as new competitors emerge, each year of delay translates into one less year of valuecreating cash flows.<sup>12</sup> If the cash flows are evenly distributed over time, and the life of the option is n years, the cost of delay can be written as:

<sup>&</sup>lt;sup>12</sup>A value-creating cash flow is one that adds to the NPV because it is in excess of the required return for investments of equivalent risk.

Annual cost of delay 
$$= \frac{1}{n}$$

Thus, if the project rights are for 20 years, the annual cost of delay works out to 5 percent a year.

# 6.7. Cost of Delay and Early Exercise

For typical listed options on financial assets, it is argued that early exercise is almost never optimal. Is this true for real options as well? Explain.

a. Yes

b. No

# Illustration 6.9: Valuing a Patent

Assume that a pharmaceutical company has been approached by an entrepreneur who has patented a new drug to treat ulcers. The entrepreneur has obtained FDA approval and has the patent rights for the next seventeen years. Although the drug shows promise, it is still very expensive to manufacture and has a relatively small market. Assume that the initial investment to produce the drug is \$500 million and the present value of the cash flows from introducing the drug now is only \$350 million. The technology and the market is volatile, and the annualized standard deviation in the present value, estimated from a simulation is 25 percent.<sup>13</sup>

Although the NPV of introducing the drug is negative, the rights to this drug may still be valuable because of the variance in the present value of the cash flow. In other words, it is entirely possible that this drug may not only be viable but extremely profitable a year or two from now. To value this right, we first define the inputs to the option pricing model:

Value of the Underlying Asset (S) = PV of Cash Flows from Project if Introduced Now = \$350 million

Strike Price (K) = Initial Investment Needed to Introduce the Product = \$500 million Variance in Underlying Asset's Value =  $(0.25)^2 = 0.0625$ 

<sup>&</sup>lt;sup>13</sup>This simulation would yield an expected value for the project of \$350 million and the standard deviation in that value of 25 percent.

#### Time to Expiration = Life of the Patent = 17 years

Cost of delay (Dividend yield in option model) = 1/Life of the patent = 1/17 = 5.88%Assume that the seventeen-year riskless rate is 4 percent. The value of the option can be estimated as follows:

Call Value=  $350 \exp(-0.0588)(17) (0.5285) - 500 \exp(-0.04)(17) (0.1219) = $37.12 million$ Thus, this ulcer drug, which has a negative NPV if introduced now, is still valuable to its owner.

# 6.8. How Much Would You Pay for This Option?

Assume that you are negotiating for a pharmaceutical company that is trying to buy this patent. What would you pay?

a. \$37.12 million

b. more than \$37.12 million

c. less than \$37.12 million

Explain.

#### Intuitive Implications

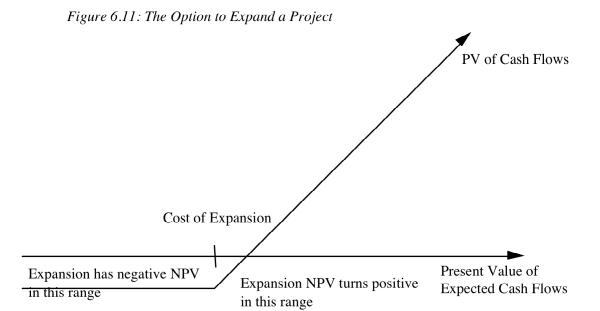
Several interesting implications emerge from the analysis of the option to delay a project. First, a project may have a negative NPV based on expected cash flows currently, but the rights to this project can still be valuable because of the option characteristics. Thus, although a negative NPV should encourage a firm to reject an investment or technology, it should not lead it to conclude that the rights to it are worthless. Second, a project may have a positive NPV but still not be accepted right away because the firm may gain by waiting and accepting the project in a future period, for the same reasons that investors do not always exercise an option just because it has the money. This is more likely to happen if the firm has the rights to the project for a long time and the variance in project inflows is high. To illustrate, assume that a firm has the patent rights to produce a new type of disk drive for computer systems and that building a new plant will yield a positive NPV right now. If the technology for manufacturing the disk drive is in flux, however, the firm may delay taking the project in the hopes that the improved technology will increase the expected cash flows and consequently the value of the project.

#### The Option to Expand a Project

In some cases, firms invest in projects because doing so allows them to either take on other investments or enter other markets in the future. In such cases, it can be argued that the initial projects yield expansion options for a firm, and that the firm should therefore be willing to pay a price for such options. It is easiest to understand this option if you consider the projects in sequence. The initial project is not an option and may very well have a negative net present value. However, investing in the initial investment gives the firm the opportunity to make a second investment – expanding into a new market or introducing a new product – later in time. The firm can choose to exploit this opportunity or ignore it but the choice that it has gives the second investment the characteristics of an option.

# Describing the Option to Expand

To examine the option to expand using the same framework developed earlier, assume that the present value of the expected cash flows from expanding into the new market or taking the new project is V, and the total investment needed to enter this market or take this project is X. Furthermore, assume that the firm has a fixed time horizon, at the end of which it has to make the final decision on whether to take advantage of this expansion opportunity. Finally, assume that the firm cannot move forward on this opportunity if it does not take the initial project. This scenario implies the option payoffs shown in Figure 6.11.



As you can see, at the expiration of the fixed time horizon, the firm will expand into the new market or take the new project if the present value of the expected cash flows at that point in time exceeds the cost of entering the market.

# Valuing the Option to Expand

To understand how to estimate the value of the option to expand, let us begin by recognizing that there are two projects usually that drive this option. The first project generally has a negative net present value and is recognized as a poor investment, even by the firm investing in it. The second project is the potential to expand that comes with the first project. It is the second project that represents the underlying asset for the option. The inputs have to be defined accordingly.

- The present value of the cash flows that you would generate if you were to invest in the second project today (the expansion option) is the value of the underlying asset – S in the option pricing model.
- If there is substantial uncertainty about the expansion potential, the present value is likely to be volatile and change over time as circumstances change. It is the variance in this present value that you would want to use to value the expansion option. Since projects are not traded, you have to either estimate this variance from simulations or use the variance in values of publicly traded firms in the business.

- The cost that you would incur up front, if you invest in the expansion today, is the equivalent of the strike price.
- The life of the option is fairly difficult to define, since there is usually no externally imposed exercise period. When valuing the option to expand, the life of the option will be an internal constraint imposed by the firm on itself. For instance, a firm that invests on a small scale in China might impose a constraint that it either will expand within 5 years or pull out of the market. Why might it do so? There may be considerable costs associated with maintaining the small presence or the firm may have scarce resources that have to be committed elsewhere.

As with other real options, there may be a cost to waiting, once the expansion option becomes viable. That cost may take the form of cash flows that will be lost on the expansion project if it is not taken or a cost imposed on the firm until it makes its final decision. For instance, the firm may have to pay a fee every year until it makes its final decision.

# Illustration 6.10: Valuing an Option to Expand: Disney Entertainment

Assume that Disney is considering investing \$100 million to create a Spanish version of the Disney Channel to serve the growing Mexican market. Assume also that a financial analysis of the cash flows from this investment suggests that the present value of the cash flows from this investment to Disney will be only \$80 million. Thus, by itself, the new channel has a negative NPV of \$20 million.

One factor that does have to be considered in this analysis is that if the market in Mexico turns out to be more lucrative than currently anticipated, Disney could expand its reach to all of Latin America with an additional investment of \$150 million any time over the next ten years. Although the current expectation is that the cash flows from having a Disney channel in Latin America will have a present value of only \$100 million, there is considerable uncertainty about both the potential for such an channel and the shape of the market itself, leading to significant variance in this estimate.

The value of the option to expand can now be estimated, by defining the inputs to the option pricing model as follows:

Value of the Underlying Asset (S) = PV of Cash Flows from Expansion to Latin America, if Done Now = \$100 million

Strike Price (K) = Cost of Expansion into Latin America = \$150 million

We estimate the standard deviation in the estimate of the project value by using the annualized standard deviation in firm value of publicly traded entertainment firms in the Latin American markets, which is approximately 30 percent.

Variance in Underlying Asset's Value =  $0.30^2 = 0.09$ 

Time to Expiration = Period for which Expansion Option Applies = 10 years Assume that the ten-year riskless rate is 4 percent. The value of the option can be estimated as follows:

Call Value =  $100 (0.6803) - 150 \exp(-0.04)(10) (0.3156) = $36.30$  million

In other words, even though this expansion opportunity has a negative net present value today of -\$50 million, the option to take it is worth \$36.30 million. Since this option is dependent upon making the initial investment in the Spanish channel, this value can be added on to the NPV of -\$20 million on the initial investment.

NPV of Disney Channel in Mexico = \$80 Million - \$100 million = -\$20 million Value of Option to Expand = \$36.30 million NPV of Project with Option to Expand = -\$20 million + \$36.3 million

= \$16.3 million

Considered as a package, Disney should invest in the Mexican project because the option to expand into the Latin American market more than compensates for the negative NPV of the Mexican project.

# Tests for Expansion Option to Have Value

Not all investments have options embedded in them, and not all options, even if they do exist, have value. To assess whether an investment creates valuable options that need to be analyzed and valued, we need to understand three key questions.

1. Is the first investment a pre-requisite for the later investment/expansion? If not, how necessary is the first investment for the later investment/expansion? Consider our earlier analysis of the value of a patent or the value of an undeveloped oil reserve as options. A firm cannot generate patents without investing in research or paying another firm for the patents, and it cannot get rights to an undeveloped oil reserve

without bidding on it at a government auction or buying it from another oil company. Clearly, the initial investment here (spending on R&D, bidding at the auction) is required for the firm to have the second investment. Now consider the Disney investment in a Spanish-language channel, without which presumably it cannot expand into the larger Latin American market. Unlike the patent and undeveloped reserves examples, the initial investment is not a prerequisite for the second, though management might view it as such. The connection gets even weaker, and the option value lower, when we look at one firm acquiring another to have the option to be able to enter a large market. Acquiring an Internet service provider to have a foothold in the online retailing market or buying a Chinese brewery to preserve the option to enter the Chinese beer market would be examples of less valuable options.

- 2. Does the firm have an exclusive right to the later investment/expansion? If not, does the initial investment provide the firm with significant competitive advantages on subsequent investments? The value of the option ultimately derives not from the cash flows generated by the second and subsequent investments but from the excess returns generated by these cash flows. The greater the potential for excess returns on the second investment, the greater the value of the expansion option. The potential for excess returns is closely tied to how much of a competitive advantage the first investment provides the firm when it takes subsequent investments. At one extreme, again, consider investing in R&D to acquire a patent. The patent gives the firm that owns it the exclusive rights to produce that product, and if the market potential is large, the right to the excess returns from the project. At the other extreme, the firm might get no competitive advantages on subsequent investments, in which case it is questionable whether there can be any excess returns on these investments. In reality, most investments will fall in the continuum between these two extremes, with greater competitive advantages being associated with higher excess returns and larger option values.
- 3. *How sustainable are the competitive advantages?* In a competitive marketplace, excess returns attract competitors, and competition drives out excess returns. The more sustainable the competitive advantages possessed by a firm, the greater the value of the options embedded in the initial investment. The sustainability of

competitive advantages is a function of two forces. The first is the *nature of the competition*; other things remaining equal, competitive advantages fade much more quickly in sectors where there are aggressive competitors. The second is the *nature of the competitive advantage*. If the resource controlled by the firm is finite and scarce (as is the case with natural resource reserves and vacant land), the competitive advantage is likely to be sustainable for longer periods. Alternatively, if the competitive advantage comes from being the first mover in a market or from having technological expertise, it will come under assault far sooner. The most direct way of reflecting this competitive advantage in the value of the option is its life; the life of the option can be set to the period of competitive advantage and only the excess returns earned over this period counts towards the value of the option.

#### **Practical Considerations**

The practical considerations associated with estimating the value of the option to expand are similar to those associated with valuing the option to delay. In most cases, firms with options to expand have no specific time horizon by which they have to make an expansion decision, making these open-ended options or at best options with arbitrary lives. Even in those cases where a life can be estimated for the option, neither the size nor the potential market for the product may be known, and estimating either can be problematic. To illustrate, consider the Disney expansion example. We adopted a period of ten years, at the end of Disney has to decide one way or another on its future expansion in Latin America, but it is entirely possible that this time frame is not specified at the time the store is opened. Furthermore, we have assumed that both the cost and the present value of expansion are known initially. In reality, the firm may not have good estimates for either before starting its Spanish cable channel, because it does not have much information on the underlying market.

# Intuitive Implications

The option to expand is implicitly used by firms to rationalize taking projects that may have negative NPV but provide significant opportunities to tap into new markets or sell new products. Although the option pricing approach adds rigor to this argument by estimating the value of this option, it also provides insight into those occasions when it is most valuable. In general, the option to expand is clearly more valuable for more volatile businesses with higher returns on projects (such as biotechnology or computer software) than in stable businesses with lower returns (such as housing, chemicals or automobiles).

It can also be argued that R&D provides one immediate application for this methodology. Investing in R&D is justified by noting that it provides the basis for new products for the future. In recent years, however, more firms have stopped accepting this explanation at face value as a rationale for spending more money on R&D and have started demanding better returns from their investments.

Firms that spend considerable amounts of money on R&D or test marketing are often stymied when they try to evaluate these expenses, because the payoffs are often in terms of future projects. At the same time, there is the very real possibility that after the money has been spent, the products or projects may turn out not to be viable; consequently, the expenditure is treated as a sunk cost. In fact, it can be argued that what emerges from R&D – patents or technological expertise -- has the characteristics of a call option. If this is true, the amount spent on the R&D is the cost of the call option, and the patents that might emerge from the research provide the options.

Several logical implications emerge from this view of R&D. First, research expenditures should provide much higher value for firms that are in volatile technologies or businesses, because the higher variance in product or project cash flows creates more valuable call options. It follows then that R&D at pharmaceutical firms should be redirected to areas where little is known and there is substantial uncertainty – gene therapy, for example – and away from areas where there is more stability. Second, the value of research and the optimal amount to be spent on research will change over time as businesses mature. The best example example is the pharmaceutical industry—drug companies spent most of the 1980s investing substantial amounts in research and earning high returns on new products, as the health care business matured. In the 1990s, however, as health care costs started leveling off and the business matured, many of these companies found that they were not getting the same payoffs on research and started cutting back.

If we perceive R&D expenses as the price of acquiring options (product patents), R&D expenditures will have most value if directed to

- a. areas where the technology is stable and the likelihood of success is high.
- b. areas where the technology is volatile, though the likelihood of success is low.
- c. Neither

Explain.

#### In Practice: Are Strategic Considerations Really Options?

Many firms faced with projects that do not meet their financial benchmarks use the argument that these projects should be taken anyway because of strategic considerations. In other words, it is argued that these projects will accomplish other goals for the firm or allow the firm to enter into other markets. Although we are wary of how this argument is used to justify poor projects, there are cases where these strategic considerations are really referring to options embedded in projects—options to produce new products or expand into new markets.

Take the example of the Disney Channel expansion into Mexico and Latin America project. The project, based on conventional capital budgeting, has a negative NPV, but it should be taken nevertheless because it gives Disney the option to enter a potentially lucrative market. Disney might well use the strategic considerations argument to accept the project anyway.

The differences between using option pricing and the strategic considerations argument are the following:

- 1. Option pricing assigns value to only some of the strategic considerations that firms may have. For instance, the option to enter the Latin American market has value because of the variance in the estimates of the value of entering the market and the fact that Disney has to take the smaller project (the Mexican venture) first to get the option. However, strategic considerations that are not clearly defined and have little exclusivity, such as "corporate image" or "growth potential," may not have any value from an option pricing standpoint.
- 2. Option pricing attempts to put a dollar value on the strategic consideration. As a consequence, the existence of strategic considerations does not guarantee that the

project will be taken. In the Disney example, the Mexican venture should not be taken if the value of the option to enter the Latin American market is less than \$20 million.

# The Option to Abandon a Project

The final option to consider here is the option to abandon a project when its cash flows do not measure up to expectations. Generally, the option to abandon a project later will make that project more attractive to investors now.

#### Describing the Option to Abandon

To illustrate the option to abandon, assume that you have invested in a project and that V is the remaining value on a project if your continue it to the end of its life. Now, assume that you can abandon the project today and that L is the liquidation or abandonment value for the same project. If the project has a life of n years, the value of continuing the project can be compared to the liquidation (abandonment) value—if it is higher, the project should be continued; if it is lower, the holder of the abandonment option could consider abandoning the project .

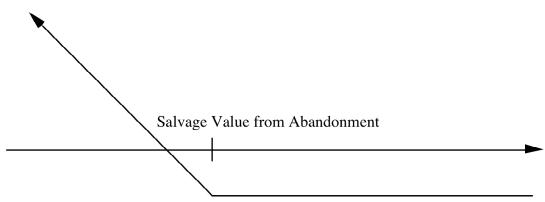
Payoff from owning an abandonment option = 0 if V > L

$$=$$
 L if V  $\leq$  L

These payoffs are graphed in Figure 6.12, as a function of the expected stock price.

#### Figure 6.12: The Option to Abandon a Project

PV of Cash Flows from project



Unlike the prior two cases, the option to abandon takes on the characteristics of a put option.

#### Illustration 6.11: Valuing Disney's Option to Abandon: A Real Estate Investment

Assume that Disney is considering taking a twenty-five-year project that requires an initial investment of \$250 million in a real estate partnership to develop time-share properties with a south Florida real estate developer and where the present value of expected cash flows is \$254 million. Although the NPV of \$4 million is small for a project of this size, assume that Disney has the option to abandon this project at any time by selling its share back to the developer in the next five years for \$150 million. A simulation of the cash flows on this time-share investment yields a standard deviation in the present value of the cash flows from being in the partnership of 20 percent.

The value of the abandonment option can be estimated by determining the characteristics of the put option:

Value of the Underlying Asset (S) = PV of Cash Flows from Project = \$254 million

Strike Price (K) = Salvage Value from Abandonment = \$150 million

Variance in Underlying Asset's Value =  $0.20^2 = 0.04$ 

Time to Expiration = Life of the Project =5 years

Dividend Yield = 1/Life of the Project = 1/25 = 0.04 (We are assuming that the

project's present value will drop by roughly 1/n each year into the project)

Assume that the five-year riskless rate is 4 percent. The value of the put option can be estimated as follows:

Call Value =  $254 \exp^{(0.04)(5)}(0.9194) - 150 \exp^{(-0.04)(5)}(0.8300) = \$89.27$  million

Put Value =  $\$89.27 - 254 \exp(0.04)(5) + 150 \exp(-0.04)(5) = \$4.13$  million

The value of this abandonment option has to be added on to the NPV of the project of \$4 million, yielding a total NPV with the abandonment option of \$8.13 million.

# 6.10. Abandonment Value and Project Life

Consider the project just described. Assume that three years into the project, the cash flows are coming in 20 percent below expectations. What will happen to the value of the option to abandon?

It will increase.

It will decrease.

It may increase or decrease, depending on . . . Explain.

#### Intuitive Implications

The fact that the option to abandon has value provides a rationale for firms to build the flexibility to scale back or terminate projects if they do not measure up to expectations. Firms can do this in a number of ways. The first and most direct way is to build in the option contractually with those parties that are involved in the project. Thus, contracts with suppliers may be written on an annual basis, rather than long-term, and employees may be hired on a temporary basis rather than permanently. The physical plant used for a project may be leased on a short-term basis, rather than bought, and the financial investment may be made in stages rather than as an initial lump sum. Although there is a cost to building in this flexibility, the gains may be much larger, especially in volatile businesses. The option to abandon is particularly valuable for smaller companies investing in large projects, where the investment in the project may represent a significant percentage of the firm's capital.

# Measuring the quality of existing investments

A firm is composed of assets in place, i.e., investments already made, and growth assets, i.e., new investments. Much of the last two chapters has been spent talking about the latter, but the techniques we used to examine and analyze new investments can also be used to assess existing investments. In doing so, there is one area where we have to exercise care. Some of the cash flows on existing investments will be in the past and some will be in the future. While we can use past cash flows to learn about these investments, they are sunk costs and should not drive decisions on whether to continue or abandon these investments. In this section, we will begin by looking at cash flow techniques for assessing existing investments and then move on to how accounting returns – return on equity and capital – can also be useful. We will close the section, by linking returns on investments to the competitive advantages and the quality of management in a firm.

#### Analyzing a past investment

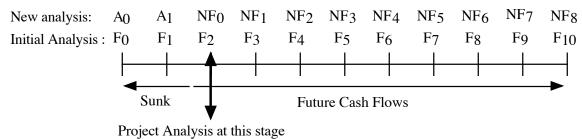
We could analyze a past project's performance by looking at the actual cash flows generated by the investment and measuring the return relative to the original investment in the project. We could measure the returns on the project on an accounting basis, or we could estimate a net present value and internal rate of return for this project.

While the way in which we estimate these measures is similar to what we would do for a new project, the numbers have to be interpreted differently. First, unlike the net present value on a new project, which measures the value that will be added to the firm by investing in the project today, the net present value on an old project is a historic number. It is, in a sense, a post-mortem. If the net present value is negative, the firm cannot reverse its investment in the project, but it might be able to learn from its mistakes. If the net present value is positive, the project's effect on firm value is in the past. Second, unlike the net present value of a project that is based on expected numbers, the net present value on an existing project is based on actual numbers.

#### Analyzing an ongoing investment

An ongoing investment is one, where some of the cash flows on the investment have already occurred but some are still to come in the future. Unlike an assessment of a past investment, which is post-mortem, the assessment of an ongoing investment can help us answer the question of whether the investment should be continued or terminated. Tin making this assessment, the cash flows on an existing project have to be evaluated entirely on an incremental basis. Thus, if the firm is considering terminating the project, the incremental cash flow is the difference between the cash flow the firm can expect from continuing the project and the cash flow it could lose if the project is terminated. If the firm has already committed to the expenses on the project, for contractual or legal reasons, it may not save much by terminating the project.

If the incremental cash flows on the existing project are estimated and discounted at an appropriate rate, the firm is in a position to decide whether the project should be continued, liquidated or divested. For example, assume that you are analyzing a 10-year project 2 years into its life and that the cash flows are as shown in Figure 6.13. Cashflow estimates from



 $F_n = \text{Forecast of cash flows in period n in initial analysis} \\ A_n = \text{Actual Cash Flow in period n} \\ NF_n = \text{New forecast of cash flows in period n at end of period 2} \\ \end{cases}$ 

In particular, the following general decision rules should apply:

• If the present value of the expected future cash flows is negative, and there are no offers from third parties to acquire the project, the project should be liquidated.



..... Liquidated the project

where r is the discount rate that applies to the cash flows, based on perceived risk at the time of the analysis.

• If the present value of the expected future cash flows is positive but it is less than the salvage value that can be obtained by liquidating the project, the project should be liquidated.

$$\sum_{t=0}^{t=n} \frac{NF_n}{(1+r)^n} < \text{Salvage Value} \qquad \qquad \text{Terminate the project}$$

where r is the discount rate that applies to the cash flows, based on perceived risk at the time of the analysis.

• If the present value of the expected future cash flows is positive but there is an offer from a third party to buy the project for a higher price, the project should be divested .

$$\sum_{t=0}^{t=n} \frac{NF_n}{(1+r)^n}$$
 < Divest the project ......

• If the present value of the expected future cash flows is positive (even though it may be well below expectations and below the initial investment) and there are no better offers from third parties, the project should be continued.

$$\sum_{t=0}^{t=n} \frac{NF_n}{(1+r)^n} > 0 > Divestiture Value \qquad \dots \qquad Continue the project$$

Firms should not liquidate or divest existing projects simply because the actual returns do not measure up to either the forecasts or the original investment. They should be liquidated or divested if, and only if, the present value of the forecasted incremental cash flows from continuing with the project is less than the salvage value or divestiture value.

#### Illustration 6.12: Disney's California Adventure: Terminate, continue or expand?

Disney opened the Disney California Adventure (DCA) Park in 2001, just across from Disneyland in Anaheim. The firm spent approximately \$1.5 billion in creating the park, with a mix of roller coaster rides, California history and movie nostalgia. Disney initially expected about 60% of its visitors to Disneyland to come across to DCA and generate about \$100 million in after-cash flows for the firm on an annual basis.

By 2008, it was clear that DCA had not performed up to expectations. Of the 15 million people who came to Disneyland in 2007, only 6 million (about 40%) visited California Adventure, and the incremental after-tax cash flow averaged out to only \$ 50 million between 2001 and 2007. In early 2008, Disney faced three choices:

- a. Shut down California Adventure and try to recover whatever it can of its initial investment. It is estimated that Disney can, at best, recover about \$ 500 million of its it's initial investment (either by selling the park or shutting it down).
- b. Continue with the status quo, recognizing that future cash flows will be closer to the actual values (\$ 50 million) than the original projections.
- c. Expand and modify the park, with the intent of making it more attractive to visitors to Disneyland. Investing about \$ 600 million, with the intent of increasing the number of attractions for families with children, is expected to increase the percentage of Disneyland visitors who come to DCA from 40% to 60% and increase the annual after tax cash flow by 60% (from \$ 50 million to \$ 80 million) at the park.

The first step in assessing this investment is to estimate the cash flows from DCA as a continuing operation. To make this estimate, we assume that the current after-tax cash flow of \$ 50 million will continue in perpetuity, growing at the inflation rate of 2%. Discounting back at the theme park cost of capital of 6.62% (from chapter 4), yields a value for continuing with the status quo

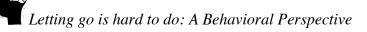
Value of DCA = 
$$\frac{\text{Expected Cash Flow next year}}{(\text{Cost of capital - g})} = \frac{50(1.02)}{(.0662 - .02)} = \$1.103 \text{ billion}$$

Note that this status quo value is well below the original investment of \$ 1.5 billion, suggesting that Disney should never had opened this park, at least in hindsight. Abandoning this investment currently would do little to remedy this mistake since Disney can recover only \$ 500 million of its original investment. Since the value of the cash flows, disappointing though they might be, is still higher than the divestiture/salvage value, continuing with the park adds more value than shutting it down.

As a final piece, let us consider whether Disney should make the additional investment in the park. The up-front cost of \$ 600 million will lead to more visitors in the park and an increase in the existing cash flows from \$ 50 to \$ 80 million. Using the same inflation rate and cost of capital, we can assess the present value of the cash flows from expansion:

Value of CF from expansion = 
$$\frac{\text{Increase in CF next year}}{(\text{Cost of capital - g})} = \frac{30(1.02)}{(.0662 - .02)} = $662 \text{ million}$$
  
Since the present value of the cash flows exceeds the cost of expansion, we would

recommend that Disney not only continue with its investment in DCA, but expand it.



The principles of when to continue, expand and terminate projects are fairly simple, with all decisions based upon incremental cash flows. In practice, though, firms allow poor projects to continue far too long and often invest more to keep these projects going, and this behavior has its roots in the human psyche. Statman and Caldwell provide three behavioral factors that explain why letting go of poor investments is so hard to do:

a. Mental accounting versus economic accounting: In economic accounting, we consider only incremental earnings and cash flows, thus following the conventional rule book in finance. In mental accounting, we keep track of sunk costs and investments already made in investment, thus making it difficult to let go of investments where substantial time and resources have been committed.

- b. Aversion to regret: Individuals distinguish between unrealized paper losses and realized losses and are much more averse to the latter. If terminating a bad project is the realization that a past investment was a mistake, the regret that is associated with this realization may be large enough that managers choose not to terminate. In fact, this resistance seems to increase with the degree of personal responsibility that the manager feels for the investment and with job insecurity.
- c. Procrastination: When faced with unpleasant decisions, it is natural to procrastinate, hoping that time and chance will make the problem go away.

If it is human nature to be resistant to accepting mistakes, there are three things we can to at least partially counter this tendency. The first is to require that all investment be reevaluated at regular intervals, say every two years. The second is to have hard and fast rules on termination, where projects that meet pre-specified criteria (for example: actual revenues less than 70% of expectations, three years of losses) are shut down automatically. The third is to separate project assessment from those who initiated the project or currently manage the investment.

#### Analyzing a Firm's Project Portfolio

Analyzing projects individually becomes impractical when a firm has dozens or even hundreds of projects. Instead, we could consider whether the current portfolio of projects, in which a firm has invested, is earning a sufficient return, relative to its required return. In this section, we will consider two approaches to analyzing a project portfolio – a cash-flow based approach, where we measure returns based upon cash flows, and an earnings-based approach, where we look at accounting returns.

#### Cash Flow Analysis

We could look at a firm's entire portfolio of existing investments and attempt to compute the amount invested in these investments, as well as the cash flows they generate. The problem with this approach is that different investments were made at different points in time, and given the time value of money, they cannot be easily aggregated. Instead, we will consider how to compute a cash flow return, taking into consideration both the investments in projects and the timing of the investments.

The cash flow return on investment (CFROI) for a firm measures the internal rate of return earned by the firm's existing projects. It is calculated using four inputs. The first is the <u>gross investment (GI)</u> that the firm has in its assets in place. This is computed by adding depreciation back to the book value of the assets (net asset value) to arrive at an estimate of the original investment in the asset. The gross investment, thus estimated, is converted into a current dollar value to reflect inflation that has occurred since the asset was purchased.

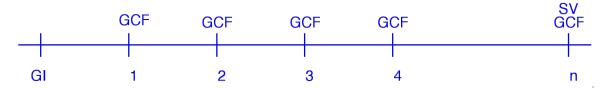
Gross Investment (GI) = Net Asset Value + Cumulated Depreciation on Asset + Current Dollar Adjustment

The second input is the gross cash flow (GCF) earned in the current year on that asset. This is usually defined as the sum of the after-tax operating income of a firm and the non-cash charges against earnings, such as depreciation and amortization. The operating income is adjusted for operating leases and any extraordinary or one-time charges.

Gross Cash Flow (GCF) = Adjusted EBIT (1-t) + Current year's Depreciation & Amortization

The third input is the *expected life of the assets* (n) in place, at the time of the original investment, which can vary from business to business but reflects the earning life of the investments in question. The *expected value of the assets* (SV) at the end of this life, in current dollars, is the final input. This is usually assumed to be the portion of the initial investment, such as land and buildings, that is not depreciable, adjusted to current dollar terms.

Based on these inputs, the timeline for cashflows on the asset can be written as follows:



The gross investment in the asset is treated as the initial investment, the gross cash flow as an annuity for the life of the asset and the expected value at the end of the asset's life

as the salvage value. The CFROI is the internal rate of return of these cash flows, i.e, the discount rate that makes the net present value of the gross cash flows and salvage value equal to the gross investment. It can thus be viewed as a composite internal rate of return, in current dollar terms. This is compared to the firm's real cost of capital to pass judgment on whether assets in place are value creating or value destroying.

## Illustration 6.13: Estimating CFROI for Tata Chemicals

At the beginning of 2009, the book value of the Tata Chemical's assets was Rs 25,149 million, including Rs 15,126 million in net fixed assets and Rs 10,023 million in non-cash working capital. The accumulated depreciation on the fixed assets amounted to Rs 18,424 million. The firm also earned Rs 5,359 million in operating income<sup>14</sup> during 2007-08, and had a depreciation charge of Rs 1,488 million. The average life of the investments that comprised the Tata Chemical's assets was 8 years, and the inflation rate during that 8-year period was approximately 3%. The operating assets are expected to have a remaining life of 12 years and have a salvage value of 20% of current asset value at the end of the investment period. The firm's marginal tax rate is 33.99%.

To estimate the CFROI, we first estimate the gross investment by adjusting the fixed asset value for inflation; we assume that the non-cash working capital and capitalized leases are already at current value.

Gross Investment =  $(\text{Rs } 15,126 + \text{Rs } 18,424) (1.03)^8 + \text{Rs } 10,023 \text{ million}$ 

= \$Rs 52,523 million

To estimate the gross cash flow, we add the non-cash charges back to the after-tax operating income.

Gross Cash Flow = Rs 5,359 (1-.3399) + Rs 1,488 million = Rs 5,025 million

The expected salvage value is assumed to be 20% of the gross investment:

Expected Salvage Value = Gross Investment (0.2) = Rs 52,523 (.2) = Rs 10,505 million To estimate the cash flow return on investment, we use the entire life of the asset obtained by adding together their existing age with the remaining life. The internal rate of return based upon these inputs is 7.78%, and it represents the CFROI.

<sup>&</sup>lt;sup>14</sup> Consistent with our treatment of operating leases as part of the assets, we adjust the operating income for the imputed interest expense on these leases.

Rs 52,523 = \$ 5,025 (PV of Annuity, 20 years, CFROI) + 10,505/(1+CFROI)<sup>20</sup>

This can then be compared to the real cost of capital to evaluate whether the firm's asset are value creating. Tata Chemicals's nominal cost of capital is currently 11.44%. With an expected inflation rate of 3%, the real cost of capital would be 8.19%.

Real Cost of Capital = (1+ Nominal Cost of Capital in Rs)/(1 + Expected Inflation Rate in Rs)

= 1.1144/1.03 - 1 = .0819 or 8.19%

Based on this analysis, Tata Chemicals is earning about 0.41% (7.78% - 8.19%) more than its cost of capital on its existing investments.

*cfroi\_xls*: This spreadsheet allows you to estimate the CFROI for a firm.

#### Accounting Earnings Analysis

In chapter 5, we introduced two measures of accounting return for investments – the return on capital and the return on equity, but our entire discussion revolved around how to analyze individual projects. It is possible, however, to calculate the return on equity or capital for an entire firm, based on its current earnings and book value. The computation parallels the estimation for individual projects but uses the values for the entire firm:

Return on Capital = 
$$\frac{\text{EBIT}(1-t)}{(\text{Book Value of Debt} + \text{Book Value of Equity - Cash})}$$
  
Return on Equity = 
$$\frac{\text{Net Income}}{\text{Book Value of Equity}}$$

We use book value rather than market value because it represents the capital investment in existing investments and net cash out of capital, in computing return on capital, because the income earned on cash balances is not included in operating income.<sup>15</sup> To preserve consistency, the book values used should reflect either the book values at the start of the period (over which the return in earned) or the average capital invested over the period. This return can be used as an approximate measure of the returns that the firm

<sup>&</sup>lt;sup>15</sup> Extending the same principle to return on equity, we generally do not net cash out of book value of equity because net income includes the income from cash holdings. However, we can compute a non-cash version of return on equity:

Non-cash return on equity = (Net Income – Interest income from cash  $(1^--t))$ )/ (BV of Equity – Cash)

is making on its existing investments or assets, as long as the following assumptions hold:

- The income used (operating or net) is income derived from existing projects and is not skewed by expenditures designed to provide future growth (such as R&D expenses) or one-time gains or losses.
- More important, the book value of the assets used measures the actual investment that the firm has in these assets. Here again, stock buybacks, one-time charges and goodwill amortization can create serious distortions in the book value.<sup>16</sup>
- 3. The depreciation and other noncash charges that usually depress income are used to make capital expenditures that maintain the existing asset's income earning potential.

If these assumptions hold, the return on capital becomes a reasonable proxy for what the firm is making on its existing investments or projects, and the return on equity becomes a proxy for what the equity investors are making on their share of these investments.

With this reasoning, a firm that earns a return on capital that exceeds it cost of capital can be viewed as having, on average, good projects on its books. Conversely, a firm that earns a return on capital that is less than the cost of capital can be viewed as having, on average, bad projects on its books. From the equity standpoint, a firm that earns a return on equity that exceeds its cost of equity can be viewed as earning surplus returns for its stockholders, whereas a firm that does not accomplish this is taking on projects that destroy stockholder value.

#### Illustration 6.14: Evaluating Current Investments

In Table 6.10, we summarize the current returns on capital and costs of capital for Disney, Aracruz, Tata Chemicals and Bookscape. The book values of debt, equity and cash at the end of the previous financial year (2007) were used together to compute the book value of capital invested at the beginning of 2008, and the operating income for the

<sup>&</sup>lt;sup>16</sup>Stock buybacks and large write-offs will push down book capital and result in overstated accounting returns. Acquisitions that create large amounts of goodwill will push up book capital and result in understated returns on capital. Adjusting capital invested for these and other actions can be problematic and are examined in more detail in Damodaran, A., 2008, Return on Capital, Return on Invested Capital and Return on Equity: Measurement and Implications, listed as a research paper on http://www.damodaran.com.

most recent financial year (2008) is used to compute the return on capital.<sup>17</sup> Considering the issues associated with measuring debt and cost of capital for financial services firms, we have not computed the values for Deutsche Bank:

								ROC -
	EBIT	BV  of	BV of		BV of	Return on	Cost of	Cost of
Company	(1-t)	Debt	Equity	Cash	Capital	Capital	Capital	Capital
Disney	\$4,359	\$16,892	\$30,753	\$3,670	\$43,975	9.91%	7.51%	2.40%
		R\$						
Aracruz	R\$ 379	3,090	R\$ 5,361	R\$ 22	R\$ 8,430	4.49%	10.63%	-6.14%
Bookscape	\$2.15	\$9.59	\$6.00	\$0.40	\$15.59	13.76%	14.90%	-1.14%
Tata	INR	INR	INR	INR	INR			
Chemicals	4,134	12,614	23,928	725	36,542	11.31%	11.44%	-0.12%

Table 6.10 Return on Capital and Cost of Capital Comparison (Values in millions)

The marginal tax rates used in Chapter 4 are used here as well. This analysis suggests that Disney was the only company earning excess returns in 2008, Bookscape and Tata Chemicals were both close to breaking even and Aracruz wass under performing. There are a few caveats that we would offer:

- The book value of capital is affected fairly dramatically by accounting decisions. The depreciation methods chosen and write offs taken during the year can affect book values and the measured returns.
- 2. We have used the operating income from the most recent year, notwithstanding the volatility in the income. To smooth out the volatility, we can compute the average operating income over the past three years and use it in computing the return on capital; this approach generates a "normalized" return on capital of 8.39% for Disney and 7.68% for Aracruz.
- 3. In keeping with our treatment of operating leases as debt, we have included the present value of operating leases from the prior year in the debt for both Disney and Bookscape. In the case of the latter, not including leases would have generated a much higher return on capital.

<sup>&</sup>lt;sup>17</sup>Some analysts use average capital invested over the year, obtained by averaging the book value of capital at the beginning and end of the year. By using the capital invested at the beginning of the year, we have assumed that capital invested during the course of year is unlikely to generate operating income during that year.

4. For Aracruz, we assume that because the book values are adjusted for inflation, the return on capital is a real return on capital and can be compared to the real cost of capital.<sup>18</sup>

The analysis can also be done purely in equity terms. To do this, we would first compute the return on equity for each company by dividing the net income for the most recent year by the book value of equity at the beginning of the year and compare it to the cost of equity. Table 6.11 summarizes these results.

Company	Net Income	BV of Equity	ROE	Cost of Equity	ROE - Cost of Equity
Disney	\$4,427	\$30,753	14.40%	8.91%	5.49%
Aracruz	-R\$ 4,213	R\$ 5,361	-78.59%	18.45%	-97.05%
Bookscape	\$1.50	\$6.00	25.00%	20.94%	4.06%
Deutsche Bank	-€ 3,835.00	€ 38,466.00	-9.97%	10.72%	-20.69%
Tata Chemicals	INR 9,644	INR 23,928	40.30%	13.93%	26.37%
Tata					
Chemicals(w/o					
extraordinary loss)	INR 3,700	INR 23,928	15.46%	13.93%	1.53%

Table 6.11 Return on Equity and Cost of Equity Comparisons (Values in millions)

Disney's excess equity returns are consistent with what the excess returns we estimated using return on capital and cost of capital. Aracruz and Deutsche reported large losses in 2008, leading to negative returns on equity and negative excess returns. In the case of Aracruz, the net loss stands in contrast to the positive operating income and can be explained by the multi-billion losses incurred on derivatives. Bookscape earns excess returns on an equity basis, whereas it broke even on a capital basis, and we would attribute this to the favorable terms it has on its current operating lease. With Tata Chemicals, the difference is stark, with equity excess returns being dramatically higher (26.37%) than capital excess returns. However, almost all of the excess returns can be attributed to an extraordinary gain of Rs 6,077 million reported in 2008; if we eliminate this extraordinary gain, the return on equity drops to 15.46%, only 1.53% higher than the cost of equity.

This example brings home some of the reasons why excess returns can change when we move from capital to equity measures. First, the net income includes income

<sup>&</sup>lt;sup>18</sup>Brazilian accounting standards allow for the adjustment of book value for inflation.

(and losses) from non-operating assets that can yield different results from looking at income from just operating assets. Second, firms that have been able to lock in debt at favorable terms (interest rates lower than what they should be paying, based upon their default risk should have higher equity excess returns than excess returns on capital. In general, we believe that the excess returns computed from capital measures are more dependable and sustainable than the equity excess returns.

There is a data set online that summarizes, by sector, returns on equity and capital as well as costs of equity and capital.

#### In Practice: Economic Profit or Economic Value Added (EVA)

Economic value added is a value enhancement concept that has caught the attention both of firms interested in increasing their value and portfolio managers looking for good investments. Economic profit or Economic Value Added is a measure of dollar surplus value created by a firm or project and is measured by doing the following:

Economic Value Added (EVA) = (Return on Capital – Cost of Capital) (Capital Invested) The return on capital is measured using "adjusted" operating income, where the adjustments eliminate items that are unrelated to existing investments,<sup>19</sup> and the capital investment is based on the book value of capital but is designed to measure the capital invested in existing assets. Firms that have positive EVA are firms that are creating surplus value, and firms with negative EVA are destroying value.

Although EVA is usually calculated using total capital, it can be easily modified to be an equity measure:

Equity EVA = (Return on Equity – Cost of Equity) (Equity Invested in Project or Firm) Again, a firm that earns a positive equity EVA is creating value for its stockholders, and a firm with a negative equity EVA is destroying value for its stockholders.

The measures of excess returns that we computed in the tables in the last section can be easily modified to become measures of EVA:

<sup>&</sup>lt;sup>19</sup>Stern Stewart, which is the primary proponent of the EVA approach, claims to make as many as 168 adjustments to operating income to arrive at the true return on capital.

Disney	2.40%	\$43,975	\$1,057	5.49%	\$30,753	\$1,688
Aracruz	-6.14%	R\$ 8,430	-R\$ 517	-97.05%	R\$ 5,361	-5203
Bookscape	-1.14%	\$15.59	-\$0.18	4.06%	\$6.00	\$0.24
Deutsche Bank	NMF	NMF	NMF	-20.69%	€ 38,466	-€ 7,959
Tata Chemicals	-0.12%	INR 36,542	-INR 45	1.53%	INR 23,928	INR 367

For Tata Chemicals, we used the net income prior to the extraordinary profits. There are no surprises here, since positive (negative) excess returns translate into positive (negative) economic profits or EVA. Note that while EVA converts the percentage excess returns in these tables to absolute excess returns, it measurement is affected by the same issues of earnings and book value measurement. Ultimately, it is only as good as the operating income and book value of capital numbers that feed into it.

# 6.11:. Stock Buybacks, Return on Capital, and EVA

When companies buy back stock, they are allowed to reduce the book value of their equity by the market value of the stocks bought back. When the market value of equity is well in excess of book value of equity, buying back stock will generally

- a. increase the return on capital but not affect the EVA.
- b. increase the return on capital and increase the EVA.
- c. not affect the return on capital but increase the EVA.
- d. none of the above.

Why or why not?

There is a data set online that summarizes, by sector, the economic value added and the equity economic value added in each.

*evacalc\_xls*: This spreadsheet allows you to estimate the economic value added for a firm.

# Where Do Good Projects Come From?

In the process of analyzing new investments in the preceding chapters, we have contended that good projects have a positive NPV and earn an IRR greater than the hurdle rate. Although these criteria are certainly valid from a measurement standpoint, they do not address the deeper questions about good projects, including the economic conditions that make for a good project and why it is that some firms have a more ready supply of good projects than others.

#### Competitive Advantages

Implicit in the definition of a good project is the existence of **excess returns** to the business considering the project. In a competitive market for real investments, the existence of these excess returns should act as a magnet, attracting competitors to take on similar investments. In the process, the excess returns should dissipate over time; how quickly they dissipate will depend on the ease with which competition can enter the market and provide close substitutes and on the magnitude of any differential advantages that the business with the good projects might possess. Consider an extreme scenario, whereby the business with the good projects has no differential advantage in cost or product quality over its competitors, and new competitors can enter the market easily and at low cost to provide substitutes. In this case the excess returns on these projects should disappear very quickly.

An integral basis for the existence of a good project is the creation and maintenance of barriers to new or existing competitors taking on equivalent or similar projects. These barriers can take different forms, including

a. *Economies of scale*: Some projects might earn high returns only if they are done on a large scale, thus restricting competition from smaller companies. In such cases, large companies in this line of business may be able to continue to earn supernormal returns on their projects because smaller competitors will not be able to replicate them.

b. *Cost Advantages*: A business might work at establishing a cost advantage over its competitors, either by being more efficient or by taking advantage of arrangements that its competitors cannot use. For example, in the late 1980s, Southwest Airlines was able to establish a cost advantage over its larger competitors, such as American Airlines and United, by using nonunion employees, and the company exploited this cost advantage to earn much higher returns.

c. *Capital Requirements*: Entry into some businesses might require such large investments that it discourages competitors from entering, even though projects in those

businesses may earn above-market returns. For example, assume that Boeing is faced with a large number of high-return projects in the aerospace business. Although this scenario would normally attract competitors, the huge initial investment needed to enter this business would enable Boeing to continue to earn these high returns.

d. *Product Differentiation*: Some businesses continue to earn excess returns by differentiating their products from those of their competitors, leading to either higher profit margins or higher sales. This differentiation can be created in a number of ways—through effective advertising and promotion (Coca-Cola), technical expertise (Sony), better service (Nordstrom), and responsiveness to customer needs.

e. *Access to Distribution Channels*: Those firms that have much better access to the distribution channels for their products than their competitors are better able to earn excess returns. In some cases, the restricted access to outsiders is due to tradition or loyalty to existing competitors. In other cases, the firm may actually own the distribution channel, and competitors may not be able to develop their own distribution channels because the costs are prohibitive.

f. *Legal and Government Barriers*: In some cases, a firm may be able to exploit investment opportunities without worrying about competition because of restrictions on competitors from product patents the firm may own to government restrictions on competitive entry. These arise, for instance, when companies are allowed to patent products or services and gain the exclusive right to provide them over the patent life.

# Quality of Management and Project Quality

In the preceding section we examined some of the factors that determine the attractiveness of the projects a firm will face. Some factors, such as government restrictions on entry, may largely be out of the control of incumbent management, but there are other factors that can clearly be influenced by management.<sup>20</sup> Considering each of the factors already discussed, for instance, we would argue that a good management team can increase both the number of and the excess returns on available projects by

<sup>&</sup>lt;sup>20</sup>When government policy is influenced by lobbying by firms, it can be argued that even these factors may be affected by the management of a firm.

- *investing in projects that exploit any economies of scale that the firm may possess*; in addition, management can look for ways it can create economies of scale in the firm's existing operations.
- *establishing and nurturing cost advantages over its competitors*; some cost advantages may arise from labor negotiations, and others may result from long-term strategic decisions made by the firm.
- taking actions that increase the initial cost for new entrants into the business; one of the primary reasons Microsoft was able to dominate the computer software market in the early 1990s was its ability to increase the investment needed to develop and market new business software programs.
- *nurturing markets in which the company's differential advantage is greatest, in terms of either cost of delivery or brand name value.* In some cases, this will involve expanding into foreign markets, as both Levi Strauss and McDonald's did in the 1980s to exploit their higher brand name recognition in those markets. In other cases, this may require concentrating on segments of an existing market, as The Gap did, when it opened its Old Navy stores to cater to more bargain-conscious consumers.
- <u>improving the firm's reputation for customer service and product delivery</u>; this will enable the firm to increase both profits and returns. One of the primary factors behind Chrysler's financial recovery in the 1980s was the company's ability to establish a reputation for producing good-quality cars and minivans.
- *developing distribution channels that are unique and cannot be easily accessed by competitors.* Avon, for instance, employed a large sales force to go door to door to reach consumers who could not be reached by other distribution channels.
- obtaining patents on products or technologies that keep out the competition and earn high returns; doing so may require large investments in R&D over time. It can be argued that success of pharmaceutical companies, small and large, can be traced to their capacity to patent blockbuster drugs.

Although the quality of management is typically related to the quality of projects a firm possesses, a good management team does not guarantee the existence of good projects. In fact, there is a rather large element of chance involved in the process; even the best-laid plans of the management team to create project opportunities may come to naught if circumstances conspire against them—a recession may upend a retailer, or an oil price shock may cause an airline to lose money.

#### Illustration 6.15: Excess Returns and Competitive Advantages: An Assessment

In illustration 6.14, we estimated the excess returns for each of the firms that we are analyzing. Of the four publicly traded firms, only Disney generated returns on capital and equity that exceeded its costs of capital and equity. Aracruz and Deutsche Bank generated negative excess returns and Tata Chemicals roughly broke even on both capital and equity measures.

- a. <u>Disney</u>: While most analysts would attribute Disney's excess returns to its brand name built up over decades, it is worth noting that Disney's excess returns have been volatile since Walt Disney's demise in 1966. After a long period of declining returns in the seventies and early eighties, Disney enjoyed a rebirth with its animated movie hits between 1986 and 1995. Those movies, which included the Little Mermaid, Beauty and the Beast and the Lion King created new franchises for Disney to exploit and a new generation of young fans. That gain was put at risk by the Capital Cities acquisition in 1996 and Disney's excess returns dissipated over the next decade. In 2004, for instance, Disney was earning 4% less that its cost of capital. With Bob Iger at its helm, the company has seen a resurrection, and excess returns have become positive again. While some would read the ups and downs of Disney as just luck, we would read it differently. Disney has core advantages that are almost impossible for other firms to replicate and the firm has done best when it has focused on those businesses where it can use these strengths. Using this template, the acquisition of Pixar and even the investment in the cruise line business (which uses Disney characters to appeal to families) make sense. Disney has faltered when it has strayed from this core mission, as was the case with its early investments in the internet business (Go.com), sports (the California Angels) and its expensive entry into broadcasting (Capital Cities/ABC).
- <u>b.</u> <u>Aracruz</u>: Aracruz's key advantage is its access to and ownership of the ample timber in the Brazilian rainforests. While the company remains dependent upon

commodity prices for year-to-year profit swings, it should be able to use its cost advantages to generate at least moderate excess returns over time. While this was the template it followed over much of its lifetime, the ease with which money could be made speculating on exchange rates led the firm down that path from 2005 through 2007, generating large earnings for the firm, in the process. Since Aracruz really has no core competence in the area of exchange rate forecasting, the huge losses in 2008 from its exchange rate bets were almost predictable. Looking forward, Aracruz has to refocus on the paper business and recognize that there are no easy pathways to profitability.

- c. <u>Tata Chemicals</u>: Tata Chemicals looks like a mature firm in a mature business, with the excess returns (or lack thereof) to match. While managers should search for small competitive advantages in this market, coming perhaps from lower production costs in India and access to a large, vibrant economy, it is important that they show patience and not over reach. In particular, the allure of acquiring growth and entering other markets, especially through acquisition, has to be resisted.
- d. Deutsche Bank: The negative excess returns that Deutsche Bank posted in 2008 are not a surprise, given the turmoil in the financial services sector. These negative excess returns did follow an extended period of profitability for commercial and investment banks. Looking forward, we do know that substantial changes are coming to this business, both from a regulatory standpoint (capital ratios, controls on lending) and from the way the business is structured (risk controls, compensation). While these changes may suggest a cap on profitability, there is one factor working in Deutsche Bank's favor. As a relatively healthy survivor in a business with so many casualties, Deutsche Bank will find itself with less competition and can perhaps exploit this factor to generate higher profits.

# Conclusions

Projects often create side costs and benefits that are not captured in the initial estimates of cash flows used to estimate returns. In this chapter, we examined some of these indirect costs and benefits:

- Investing in one project may prevent a firm from taking alternative investments if these are mutually exclusive. If projects have equal lives and there are no capital rationing constraints, we can pick the investment with the higher NPV. If this is not the case, we have to find ways of controlling for differences in project lives (by computing an equivalent annuity) and for differences in scale (by computing profitability indices).
- Opportunity costs measure the costs of resources that the company already owns that might be used for a new project. Although the business might not spend new money acquiring these resources, there are consequences in terms of the cash flows that have to be reflected in the returns.
- Projects may also provide synergistic benefits for other projects for a firm. These benefits, which also take the form of cash flows, should be reflected in the returns.
- Projects may also create options that are valuable—options to expand into new markets and produce new products. When such options exist, conventional discounted cash flow models will tend to under state the value of investments.

In summary, the project returns have to reflect all of the side costs and benefits.

In the final part of the chapter, we turned our attention from new investments to the existing investments of a firm. We started by looking at how we can extend the conventional tools of investment analysis (including NPV and IRR) to analyzing a past project and deciding whether to extend or terminate an existing one. We closed the section by evaluating the portfolio of existing projects of a firm, by computing an overall return on capital invested in these projects and comparing that return to the cost of capital.

# Live Case Study

# Estimating Earnings and Cash Flows only if feasible

*Objective:* To analyze a firm's existing investments, and to identify differential advantages that explain excess returns on existing investments.

## Key Questions:

- 1. What are the firm's competitive strengths and differential advantages, if any?
- 2. Does this firm earn excess returns on its existing projects? If yes, can it maintain the competitive strengths that allowed it to earn these excess returns? If not, what can it do to start earning excess returns on its projects?
- 3. Does the firm have poor investments? If so, what might be the reasons for the poor returns?

## Framework for Analysis:

1. Analyzing Existing Investments

1.1. What is the accounting return that the firm earns on its existing investments? How does this compare with the cost of equity and capital?

1.2. What was the firm's economic value added in the most recent financial year? How does it compare with the previous year?

1.3. What, if anything, do the accounting returns and economic value added tell you about the quality of the firm's existing investments?

2. Assessing Competitive Strengths

2.1. Who are the primary competitors to this firm and how does the firm compare to them in terms of both quantitative (size, profitability, risk) and qualitative measures (quality of management, service)?

2.2. Does the firm have any special strength that no other firm in the sector possesses?

2.3. Does the firm lag other firms in the sector on any of the measures?

3. Evaluating Sustainability of Competitive Strengths

3.1. Are the firm's competitors catching up with the firm on its strengths?

3.2. Are there new competitors either in the market or on the horizon who could compete with the firm on its strengths?

## **Problems and Questions**

1. A small manufacturing firm, which has limited access to capital, has a capital rationing constraint of \$150 million and is faced with the following investment projects (numbers in millions):

Project	Initial Investment	NPV
А	\$25	\$10
В	\$30	\$25
С	\$40	\$20
D	\$10	\$10
E	\$15	\$10
F	\$60	\$20
G	\$20	\$10
Η	\$25	\$20
Ι	\$35	\$10
J	\$15	\$5

a. Which of these projects would you accept? Why?

b. What is the cost of the capital rationing constraint?

2. A closely held, publicly traded firm faces self-imposed capital rationing constraints of \$100 million in this period and \$75 million in the next period. It has to choose among the following projects (in millions):

	Investmen		
Project	Current Period	Next Period	NPV
А	\$20	\$10	\$20
В	\$25	\$15	\$20
C	\$30	\$30	\$15
D	\$15	\$15	\$20

E	\$40	\$25	\$30
F	\$10	\$10	\$10
G	\$20	\$15	\$20
Н	\$30	\$25	\$35
Ι	\$35	\$25	\$25
J	\$25	\$15	\$10

Set up the linear programming problem, assuming that fractions and multiples of projects cannot be taken.

3. You own a rental building in the city and are interested in replacing the heating system. You are faced with the following alternatives:

a. A solar heating system, which will cost \$12,000 to install and \$500 a year to run and will last forever (assume that your building will, too).

b. A gas heating system, which will cost \$5,000 to install and \$1,000 a year to run and will last twenty years.

c. An oil heating system, which will cost \$3,500 to install and \$1,200 a year to run and will last fifteen years.

If your opportunity cost is 10 percent, which of these three options is best for you?

4. You are trying to choose a new siding for your house. A salesman offers you two choices:

a. Wood siding, which will last ten years and cost \$5,000 to install and \$1,000/year to maintain

b. Aluminum siding, which will last forever, cost \$15,000 to install, and will have a lower maintenance cost per year

If your discount rate is 10 percent, how low would your maintenance costs have to be for you to choose the aluminum siding?

5. You have just been approached by a magazine with an offer for renewing your subscription. You can renew for one year at \$20, two years for \$36, or three years at \$45.

Assuming that you have an opportunity cost of 20 percent and the cost of a subscription will not change over time, which of these three options should you choose?

6. You have been hired as a capital budgeting analyst by a sporting goods firm that manufactures athletic shoes and has captured 10 percent of the overall shoe market (the total market is worth \$100 million a year). The fixed costs associated with manufacturing these shoes is \$2 million a year, and variable costs are 40 percent of revenues. The company's tax rate is 40 percent. The firm believes that it can increase its market share to 20 percent by investing \$10 million in a new distribution system (which can be depreciated over the system's life of 10 years to a salvage value of zero) and spending \$1 million a year in additional advertising. The company proposes to continue to maintain working capital at 10 percent of annual revenues. The discount rate to be used for this project is 8 percent.

a. What is the initial investment for this project?

b. What is the annual operating cash flow from this project?

c. What is the NPV of this project?

d. How much would the firm's market share have to increase for you to be indifferent to taking or rejecting this project?

7. You are considering the possibility of replacing an existing machine that has a book value of \$500,000, a remaining depreciable life of five years, and a salvage value of \$300,000. The replacement machine will cost \$2 million and have a ten-year life. Assuming that you use straight-line depreciation and that neither machine will have any salvage value at the end of the next ten years, how much would you need to save each year to make the change (the tax rate is 40 percent)?

8. You are helping a bookstore decide whether it should open a coffee shop on the premises. The details of the investment are as follows:

• The coffee shop will cost \$50,000 to open; it will have a five-year life and be depreciated straight line over the period to a salvage value of \$10,000.

- The sales at the shop are expected to be \$15,000 in the first year and grow 5 percent a year for the following four years. <AQ: Should this be the following four years instead of five? Yes....>
- The operating expenses will be 50 percent of revenues.
- The tax rate is 40 percent.
- The coffee shop is expected to generate additional sales of \$20,000 next year for the book shop, and the pretax operating margin is 40 percent. These sales will grow 10 percent a year for the following four years.
- a. Estimate the net present value of the coffee shop without the additional book sales.
- b. Estimate the present value of the cash flows accruing from the additional book sales.
- c. Would you open the coffee shop?

9. The lining of a plating tank must be replaced every three years at the cost of approximately \$2,000. A new lining material has been developed that is more resistant to the corrosive effects of the plating liquid and will cost approximately \$4,000. If the required rate of return is 20 percent and annual property taxes and insurance amount to about 4 percent of the initial investment, how long must the new lining last to be more economical than the present one?

	Plan A	Plan B
Initial cost	\$50,000	\$120,000
Annual maintenance cost	\$9,000	\$6,000
Salvage value	\$10,000	\$20,000
Life	20 years	40 years

10. You are a small business owner considering two alternatives for your phone system.

The discount rate is 8 percent. Which alternative would you pick?

11. You have been asked to compare three alternative investments and make a recommendation.

• Project A has an initial investment of \$5 million and after-tax cash flows of \$2.5 million a year for the next five years.

- Project B has no initial investment, after-tax cash flows of \$1 million a year for the next ten years, and a salvage value of \$2 million (from working capital).
- Project C has an initial investment of \$10 million, another investment of \$5 million in ten years, and after-tax cash flows of \$2.5 million a year forever.

The discount rate is 10 percent for all three projects. Which of the three projects would you pick? Why?

12. You are the manager of a pharmaceutical company and are considering what type of laptop computers to buy for your salespeople to take with them on their calls.

- You can buy fairly inexpensive (and less powerful) older machines for about \$2,000 each. These machines will be obsolete in three years and are expected to have an annual maintenance cost of \$150.
- You can buy newer and more powerful laptops for about \$4,000 each. These
  machines will last five years and are expected to have an annual maintenance cost of
  \$50.

If your cost of capital is 12 percent, which option would you pick and why?

13. You are the supervisor of a town where the roads are in need of repair. You have a limited budget and are considering two options:

- You can patch up the roads for \$100,000, but you will have to repeat this expenditure every year to keep the roads in reasonable shape.
- You can spend \$400,000 to repave and repair the roads, in which case your annual expenditures on maintenance will drop.

If your discount rate is 10 percent, how much would the annual expenditures have to drop in the second option for you to consider it?

14. You are the manager of a specialty retailing firm that is considering two strategies for getting into the Malaysian retail market. Under the first strategy, the firm will make an initial investment of \$10 million and can expect to capture about 5 percent of the overall market share. Under the second strategy, the firm will make a much larger commitment of \$40 million for advertising and promotion and can expect to capture about 10 percent of the market share. If the overall size of the market is \$200 million, the firm's cost of

capital is 12 percent, and the typical life of a project in the firm is fifteen years, what would the operating margin have to be for the firm to consider the second strategy? (You can assume that the firm leases its stores and has no depreciation or capital expenditures.)

15. You work for a firm that has limited access to capital markets. As a consequence, it has only \$20 million available for new investments this year. The firm does have a ready supply of good projects, and you have listed all the projects.

Project	Initial Investment	NPV	IRR (%)
	(million)	(million)	
Ι	\$10	\$3	21%
II	\$5	\$2.5	28%
III	\$15	\$4	19%
IV	\$10	\$4	24%
V	\$5	\$2	20%

a. Based on the profitability index, which of these projects would you take?

b. Based on the IRR, which of these projects would you take?

c. Why might the two approaches give you different answers?

16. You are the owner of a small hardware store, and you are considering opening a gardening store in a vacant area in the back of your present store. You estimate that it will cost you \$50,000 to set up the new store, and that you will generate \$10,000 in after-tax cash flows from the store for the life of the store (which is expected to be ten years). The one concern you have is that you have limited parking; by opening the gardening store you run the risk of not having enough parking for customers who shop at your hardware store. You estimate that the lost sales from such occurrence would amount to \$3,000 a year, and that your after-tax operating margin on sales at the hardware store is 40 percent. If your discount rate is 14 percent, would you open the gardening store?

17. You are the manager of a grocery store, and you are considering offering baby-sitting services to your customers. You estimate that the licensing and set up costs will amount to \$150,000 initially and that you will be spending about \$60,000 annually to provide the service. As a result of the service, you expect sales at the store, which is \$5 million

currently, to increase by 20 percent; your after-tax operating margin is 10 percent. If your cost of capital is 12 percent, and you expect the store to remain open for ten years, would you offer the service?

18. You run a financial service firm where you replace your employee's computers every three years. You have 5000 employees, and each computer costs \$2,500 currently—the old computers can be sold for \$500 each. The new computers are generally depreciated straight line over their three-year lives to a salvage value of \$500. A computer-service firm offers to lease you the computers and replace them for you at no cost, if you will pay a leasing fee of \$5 million a year (which is tax-deductible). If your tax rate is 40 percent, would you accept the offer?

19. You are examining the viability of a capital investment in which your firm is interested. The project will require an initial investment of \$500,000 and the projected revenues are \$400,000 a year for five years. The projected cost-of-goods-sold is 40 percent of revenues and the tax rate is 40 percent. The initial investment is primarily in plant and equipment and can be depreciated straight line over five years (the salvage value is zero). The project makes use of other resources that your firm already owns:

• Two employees of the firm, each with a salary of \$40,000 a year, who are currently employed by another division, will be transferred to this project. The other division has no alternative use for them, but they are covered by a union contract that will prevent them from being fired for three years (during which they would be paid their current salary).

• The project will use excess capacity in the current packaging plant. Although this excess capacity has no alternative use now, it is estimated that the firm will have to invest \$250,000 in a new packaging plant in year four as a consequence of this project using up excess capacity (instead of year eight as originally planned).

• The project will use a van currently owned by the firm. Although the van is not currently being used, it can be rented out for \$3,000 a year for five years. The book value of the van is \$10,000 and it is being depreciated straight line (with five years remaining for depreciation).

• The discount rate to be used for this project is 10 percent.

a. What (if any) is the opportunity cost associated with using the two employees from another division?

b. What (if any) is the opportunity cost associated with the use of excess capacity of the packaging plant?

c. What (if any) is the opportunity cost associated with the use of the van?

d. What is the after-tax operating cash flow each year on this project?

e. What is the NPV of this project?

20. Your company is considering producing a new product. You have a production facility that is currently used to only 50 percent of capacity, and you plan to use some of the excess capacity for the new product. The production facility cost \$50 million five years ago when it was built and is being depreciated straight line over twenty-five years (in real dollars, assume that this cost will stay constant over time).

Product	Capacity	Growth Rate (%)	Revenues	Fixed Cost	Variable
Line	Used	/Year Currently	<i>Currently</i> (\$	(\$ million)	Cost (\$
	(%)		million)	/Year	million)/Year
Old	50	5	100	25	50
product					
New	30	10	80	20	44
product					

The new product has a life of ten years, the tax rate is 40 percent, and the appropriate discount rate (real) is 10 percent.

a. If you take on this project, when would you run out of capacity?

b. When you run out of capacity, what would you lose if you chose to cut back production (in present value after-tax dollars)? (You have to decide which product you are going to cut back production on.)

c. What would the opportunity cost to be assigned to this new product be if you chose to build a new facility when you run out of capacity instead of cutting back on production?

21. You are an analyst for a sporting goods corporation that is considering a new project that will take advantage of excess capacity in an existing plant. The plant has a capacity to produce 50,000 tennis racquets, but only 25,000 are being produced currently though

sales of the rackets are increasing 10 percent a year. You want to use some of the remaining capacity to manufacture 20,000 squash rackets each year for the next ten years (which will use up 40 percent of the total capacity), and this market is assumed to be stable (no growth). An average tennis racquet sells for \$100 and costs \$40 to make. The tax rate for the corporation is 40 percent, and the discount rate is 10 percent. Is there an opportunity cost involved? If so, how much is it?

## CAPITAL STRUCTURE: OVERVIEW OF THE FINANCING DECISION

In the past few chapters, we examined the investment principle and argued that projects that earn a return greater than the minimum acceptable hurdle rate are good projects. In coming up with the cost of capital, which we defined to be the minimum acceptable hurdle rate, however, we used the existing mix of debt and equity used by the firm.

In this chapter, we examine the choices that a firm has in terms of both debt and equity and how these choices change over a firm's life cycle. In particular, we look at how the choices change as a firm goes from being a small, private business to a large publicly traded corporation. We then evaluate the basic trade-off between using debt and equity by weighing the benefits of borrowing against its costs. We close the chapter by examining when the costs of borrowing exactly offset its benefits, which essentially makes debt irrelevant, and the implications for corporate finance.

## The Choices: Types of Financing

There are only two ways in which any business can raise money—debt or equity. This may seem simplistic, given the array of choices firms have in terms of financing vehicles. We will begin this section with a discussion of the characteristics of debt and

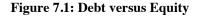
*Hybrid Security*: Any security that shares some of the characteristics of debt and some characteristics of equity.

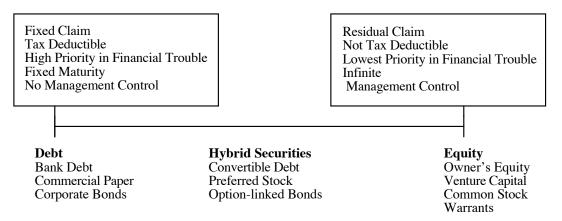
equity and then look at a range of financing vehicles available within each of these categories. We will then examine of a range of securities that share some characteristics with debt and some with equity and are therefore called **hybrid securities**.

#### The Continuum between Debt and Equity

Although the distinction between debt and equity is often made in terms of bonds and stocks, its roots lie in the nature of the cash flow claims of each type of financing. The first distinction is that a *debt claim* entitles the holder to a contractual set of cash flows (usually interest and principal payments), whereas an *equity claim* entitles the holder to any residual cash flows after meeting all other promised claims. This remains the fundamental difference, but other distinctions have arisen, partly as a result of the tax code and partly as a consequence of legal developments.

The second distinction, which is a logical outgrowth of the nature of cash flow claims (contractual versus residual), is that debt has a prior claim on both cash flows on a period-to-period basis (for interest and principal payments) and on the assets of the firm (in the case of liquidation). Third, the tax laws have generally treated interest expenses, which accrue to debt holders, very differently and often much more advantageously than dividends or other cash flows that accrue to equity. In the United States, for instance, interest expenses are tax-deductible to the entity paying them, and thus create tax savings, whereas dividend payments have to be made out of after-tax cash flows. Fourth, debt usually has a fixed maturity date, at which point the principal is due, whereas equity generally has an infinite life. Finally, equity investors, by virtue of their claim on the residual cash flows of the firm, are generally given the bulk of or all of the control of the management of the firm. Debt investors, on the other hand, play a much more passive role in management, exercising at most veto power over significant financial decisions.<sup>1</sup> These differences are summarized in Figure 7.1.





To summarize, debt is defined as any financing vehicle that is a contractual claim on the firm (and not a function of its operating performance), creates tax-deductible

<sup>&</sup>lt;sup>1</sup>Veto power is usually exercised through covenants or restrictions written into bond agreements.

payments, has a fixed life, and has a priority claim on cash flows in both operating periods and in bankruptcy. Conversely, equity is defined as any financing vehicle that is a residual claim on the firm, does not create a tax advantage from its payments, has an infinite life, does not have priority in bankruptcy, and provides management control to the owner. Any security that shares characteristics with both is a hybrid security.

## In Practice: A Financing Checklist for Classifying Securities

Some new securities at first sight are difficult to categorize as either debt or equity. To check where on the spectrum between straight debt and straight equity these securities fall, answer the following questions:

1. Are the payments on the securities contractual or residual?

- If contractually set, it is closer to debt.
- If residual, it is closer to equity.

2. Are the payments tax-deductible?

- If yes, it is closer to debt.
- If no, if is closer to equity.
- 3. Do the cash flows on the security have a high priority or a low priority if the firm is in financial trouble?
- If it has high priority, it is closer to debt.
- If it has low priority, it is closer to equity.

4. Does the security have a fixed life?

- If yes, it is closer to debt.
- If no, it is closer to equity.
- 5. Does the owner of the security get a share of the control of management of the firm?
- If no, it is closer to debt.
- If yes, if is closer to equity

## **7**.1. Is This Debt or Is It Equity?

You have been asked to classify a security as debt or equity and have been provided the following characteristics for the security: It requires fixed monthly payments that are taxdeductible and it has an infinite life. Its claims on the cash flows of the firm, during operation, and on the assets, if the firm goes bankrupt, come after all debt holders' claims (including unsecured debt) are met.

a. It is debt.

b. It is equity.

c. It is a hybrid security.

### A. Equity

Although most people think of equity in terms of common stock, the equity claim on a business can take a variety of forms, depending partly on whether the firm is privately owned or publicly traded and partly on the firm's growth and risk characteristics. Private firms have fewer choices available than do publicly traded firms, because they cannot issue securities to raise equity. Consequently, they have to depend either on the owner or a private entity, usually a venture capitalist, to bring in the equity needed to keep the business operating and expanding. Publicly traded firms have access to capital markets, giving them a wider array of choices.

## 1. Owner's Equity

Most businesses, including the most successful companies of our time, such as Microsoft and Wal-Mart, started off as small businesses with one or a few individuals providing the seed money and plowing back the earnings of the firm into the businesses. These funds, brought in by the owners of the company, are referred to as the *owner's equity* and provide the basis for the growth and eventual success of the business.

#### 2. Venture Capital and Private Equity

As small businesses succeed and grow, they typically run into is a funding constraint, where the funds that they have access to are insufficient to cover their investment and growth needs. A **venture capitalist** or private equity investor provides equity *Venture Capital:* Equity capital provided to a private firm by an investor(s), in exchange for a share of the ownership of the firm.

financing to small and often risky businesses in return for a share of the ownership of the firm.

Generally speaking, the capacity to raise funds from alternative sources and/or to go public will increase with the size of the firm and decrease with the uncertainty about its future prospects. Thus, smaller and riskier businesses are more likely to seek venture capital and are also more likely to be asked to give up a greater share of the value of the firm when receiving the venture capital.

# 7.2. The Effects of Diversification on Venture Capitalists

You are comparing the required returns of two venture capitalists who are interested in investing in the same software firm. One venture capitalist has all of his capital invested in only software firms, whereas the other has invested her capital in small companies in a variety of businesses. Which of these two will demand the higher required rate of return? a. The venture capitalist who is invested only in software companies.

b. The venture capitalist who is invested in a variety of businesses.

c. Cannot answer without more information.

If both venture capitalists had the same expected cash flow estimates for the business, which one would demand a larger share of the ownership for the same capital investment?

- a. The venture capitalist with the higher required rate of return.
- b. The venture capitalist with the lower required rate of return.

### 3. Common Stock

The conventional way for a publicly traded firm to raise equity is to issue common stock at a price the market is willing to pay. For a newly listed company, this price is estimated by the issuing entity (such as an investment banker) and is called the offering price. For an existing publicly traded company, the price at which additional equity is issued is usually based on the current market price. In some cases, the common stock issued by a company is uniform; that is, each share receives a proportional share of both the cash flows (such as dividends) and the voting rights. In other cases, different classes of common stock will provide different dividends and voting rights.

Common stock is a simple security, and it is relatively easy to understand and value. In fact, it can be argued that common stock makes feasible all other security

choices for a publicly traded firm, because a firm without equity cannot issue debt or hybrid securities. The accounting treatment of common stock follows well-established precedent and can be presented easily within the conventional format of financial statements.

### 4. Warrants

In recent years, firms have started looking at equity alternatives to common stock. One alternative used successfully by Japanese companies in the late 1980s involved **warrants**, where the holders received the right to buy shares in the company at a fixed

price sometime in the future in return for paying for the warrants up front. Because their value is derived from the price of the underlying common stock, warrants have to be treated as another form of equity.

*Warrant:* A security issued by a company that provides the holder with the right to buy a share of stock in the company at a fixed price during the life of the warrant.

Why might a firm use warrants rather than common stock to raise equity? We can think of several reasons. First, warrants are priced based on the implied volatility assigned to the underlying stock; the greater the volatility, the greater the value. To the degree that the market overestimates how risky a firm is, the firm may gain by using warrants and option-like securities. Second, warrants by themselves create no financial obligations at the time of the issue. Consequently, issuing warrants is a good way for a high-growth firm to raise funds, especially when current cash flows are low or negative. Third, for financial officers who are sensitive to the dilution created by issuing common stock, warrants seem to provide the best of both worlds—they do not create any new additional shares currently while they raise equity investment funds for current use.

# 7.3. Stock Price Variance and the Use of Warrants

Companies with high variance in their stock prices should use warrants more than companies with low variance in their stock prices, because warrant prices increase with variance.

- a. True
- b. False

#### **In Practice: Valuing Warrants**

Warrants are long-term call options, but standard option pricing models are based on the assumption that exercising an option does not affect the value of the underlying asset. This may be true for listed options on stocks, but it is not true for warrants, because their exercise increases the number of shares outstanding and brings fresh cash into the firm, both of which will affect the stock price. The expected negative impact (dilution) of their exercise will make warrants less valuable than otherwise similar call options. There are two significant differences between the inputs we use to value conventional options (see appendix 4 for more on option pricing models) and the inputs used to value a dilution-adjusted option.

• The stock price is adjusted for the expected dilution from warrant exercise.

Dilution-Adjusted  $S = (Sn_s + Wn_w)/(n_s + n_w)$ 

where

S = current value of the stock;

 $n_w$  = number of warrants outstanding;

W = market value of warrants outstanding;

 $n_s$  = number of shares outstanding.

When the warrants are exercised, the number of shares outstanding will increase, reducing the stock price. The numerator reflects the market value of equity, including both stocks and warrants outstanding. Making this adjustment will lower the stock price used in the model and hence the value of the warrant.

#### 5. Contingent Value Rights

**Contingent value rights** provide investors with the right to sell stocks for a fixed price and thus derive their value from the volatility of the stock and the desire on the part of investors to hedge away their losses. *Put options*, which are traded on the option exchanges, give their holders a similar right to sell the underlying stock at a fixed price. There are two primary differences between contingent value rights and put options. First, the proceeds from the contingent value rights sales go to the firm, whereas those from the

sale of listed put options go to private parties. Second, contingent value rights tend to be much more long-term than typical listed put options.

There are several reasons why a firm may choose to issue contingent value rights. The most *Contingent Value Rights:* A contingent value right provides the holder with the right to sell a share of stock in the underlying company at a fixed price during the life of the right.

obvious is that the firm believes it is significantly undervalued by the market. In such a scenario, the firm may offer contingent value rights to take advantage of its belief and to provide a signal to the market of the undervaluation. Contingent value rights are also useful if the market is overestimating volatility and the put price reflects this misestimated volatility. Finally, the presence of contingent value rights as insurance may attract new investors to the market for the common stock.

## B. Debt

The clear alternative to using equity, which is a residual claim, is to borrow money. This option both creates a fixed obligation to make cash flow payments and provides the lender with prior claims if the firm is in financial trouble.

#### 1. Bank Debt

Historically, the primary source of borrowed money for all private firms and many publicly traded firms have been banks, with the interest rates on the debt based on the perceived risk of the borrower. Bank debt provides the borrower with several advantages. First, it can be used for borrowing relatively small amounts of money; in contrast, bond issues thrive on economies of scale, with larger issues having lower costs. Second, if the company is neither well known nor widely followed, bank debt provides a convenient mechanism to convey information to the lender that will help in both pricing and evaluating the loan; in other words, a borrower can provide internal information about projects and the firm to the lending bank. The presence of hundreds of investors in bond issues makes this both costly and not feasible if bonds are issued as the primary vehicle for debt. Finally, to issue bonds, firms have to submit to being rated by ratings agencies and provide sufficient information to make this rating Dealing with a rating agency might be much more difficult and costly for many firms, especially smaller firms, than dealing with a lending bank.

Besides being a source of both long-term and short-term borrowing for firms, banks also often offer them a flexible option to meet unanticipated or seasonal financing needs. This option is a *line of credit*, which the firm can draw on only if it needs financing. In most cases, a line of credit specifies an amount the firm can borrow and links the interest rate on the borrowing to a market rate, such as the prime rate or Treasury rates. The advantage of having a line of credit is that it provides the firm with access to the funds without having to pay interest costs if the funds remain unused. Thus, it is a useful type of financing for firms with volatile working capital needs. In many cases, however, the firm is required to maintain a compensating balance on which it earns either no interest or below-market rates. For instance, a firm that wants a \$20 million line of credit from a bank might need to maintain a compensating balance of \$2 million, on which it earns no interest. The opportunity cost of having this compensating balance must be weighed against the higher interest costs that will be incurred by taking on a more conventional loan to cover working capital needs.

# **V**7.4. Corporate Bonds and Bank Debt

If a company can issue corporate bonds, it should not use bank debt.

a. True

b. False

Explain.

#### 2. Bonds

For larger, publicly traded firms, an alternative to bank debt is to issue bonds. Generally speaking, bond issues have several advantages for these firms. The first is that bonds usually carry more favorable financing terms than equivalent bank debt, largely because risk is shared by a larger number of financial market investors. The second is that bond issues might provide a chance for the issuer to add on special features that could not be added on to bank debt. For instance, bonds can be convertible into common stock or be tied to commodity prices (commodity bonds). When borrowing money, firms have to make a variety of choices, including the maturity of the borrowing (short-term or longterm), whether the debt should have fixed interest payments or an interest rate tied to market rates (fixed and floating rates), the nature of the security offered to those buying the bonds (secured versus unsecured) and how the debt will be repaid over time. In Chapter 9, we will examine how best to make these choices.

## 3. Leases

A firm often borrows money to finance the acquisition of an asset needed for its operations. An alternative approach that might accomplish the same goal is to lease the asset. In a lease, the firm commits to making fixed payments to the owner of the asset for the rights to use the asset. These fixed payments are either fully or partially tax-deductible, depending on how the lease is categorized for accounting purposes. Failure to make lease payments initially results in the loss of the leased asset but can also result in bankruptcy, though the claims of the lessors (owners of the leased assets) may sometimes be subordinated to the claims of other lenders to the firm.

A lease agreement is usually categorized as either an operating lease or a capital lease. For *operating leases*, the term of the lease agreement is shorter than the life of the asset, and the present value of lease payments is generally much lower than the actual price of the asset. At the end of the life of the lease, the asset reverts back to the lessor, who will either offer to sell it to the lessee or lease it to somebody else. The lessee usually has the right to cancel the lease and return the asset to the lessor. Thus, the ownership of the asset in an operating lease clearly resides with the lessor, with the lessee bearing little or no risk if the asset becomes obsolete. Operating leases cover the store spaces leased out by specialty retailing firms like The Gap and Ann Taylor, for instance.

A *capital lease* generally lasts for the life of the asset, with the present value of lease payments covering the price of the asset. A capital lease generally cannot be canceled, and the lease can be renewed at the end of its life at a reduced rate or the asset acquired by the lessee at a favorable price. In many cases, the lessor is not obligated to pay insurance and taxes on the asset, leaving these obligations up to the lessee; the lessee consequently reduces the lease payments, leading to what are called *net leases*. A capital lease places substantial risk on the shoulders of the lessee if the asset loses value or

becomes obsolete. Although the differences between operating and financial leases are obvious, some lease arrangements do not fit neatly into one or another of these extremes; rather, they share some features of both types of leases. These leases are called *combination leases*.

## 7.5. Debt Maturity and Interest Rates

Assume that long-term interest rates are much higher than short-term rates (a steeply upward-sloping yield curve) and that your investment banker advises you to issue short-term debt because it is cheaper than long-term debt. Is this statement true?

a. Yes

b. False

Why or why not?

## In Practice: Leasing versus Borrowing

If borrowing money to buy an asset and leasing the asset are both variations on debt, why might a firm choose one over the other? We can think of several factors that may sway firms in this choice:

1. *Service Reasons*: In some cases, the lessor of an asset will bundle service agreements with the lease agreement and offer to provide the lessee with service support during the life of the lease. If this service is unique—either because of the lessor's reputation or because the lessor is also the manufacturer of the asset—and if the cost of obtaining this service separately is high, the firm may choose to lease rather than buy the asset. IBM, for instance, has traditionally leased computers to users, with an offer to service them when needed.

2. *Flexibility*: Some lease agreements provide the lessee with the option to exchange the asset for a different or upgraded version during the life of the lease. This flexibility is particularly valuable when the firm is unsure of its needs and when technology changes rapidly. Flexibility is also useful when the asset is required for a period much shorter than the life of the asset, because buying the asset and selling it again is expensive in terms of transaction time and cost.

3. *Tax Reasons*: The classic reason provided for leasing is that different entities face different tax rates. An entity with a high tax rate buys an asset and leases it to one with no or a low tax rate. By doing so, the lessor obtains the tax benefits, which are greater because of its higher tax rate. The lessee, in turn, gets the use of the asset and also gains by sharing in some of the tax benefits.

In addition, if a lease qualifies as an operating lease, it essentially operates as off-balancesheet debt and may make firms that use it look safer to a careless analyst. If firms consider leasing as an alternative to borrowing, the choice becomes primarily financial. Operating leases create lease obligations to the firm, and these obligations are taxdeductible. The present value of these after-tax lease obligations has to be weighed against the present value of the after-tax cash flows that would have been generated if the firm had borrowed the money and bought the asset instead. The after-tax cash flows from borrowing and buying the asset have to include not only the interest and principal payments on the debt but also the tax benefits accruing from depreciation from owning the asset and the expected value of the asset at the end of operations.

### C. Hybrid Securities

Summarizing our analysis thus far, equity represents a residual claim on the cash flows and assets of the firm and is generally associated with management control. Debt, on the other hand, represents a fixed claim on the cash flows and assets of the firm and is usually not associated with management control. There are a number *Convertible Debt:* Debt that can be converted into equity at a rate that is specified as part of the debt agreement (conversion rate).

of securities that do not fall neatly into either of these two categories; rather, they share some characteristics with equity and some with debt. These securities are called hybrid securities.

### 1. Convertible Debt

A **convertible bond** is a bond that can be converted into a predetermined number of shares, at the discretion of the bondholder. Although it generally does not pay to convert at the time of the bond issue, conversion becomes a more attractive option as stock prices increase. Firms generally add conversions options to bonds to lower the interest rate paid on the bonds.

In a typical convertible bond, the bondholder is given the option to convert the bond into a specified number of shares of stock. The *conversion ratio* measures the number of shares of stock for which each bond may be exchanged. Stated differently, the *market conversion value* is the current value of the shares for which the bonds can be exchanged. The *conversion premium* is the excess of the bond value over the conversion value of the bond.

Thus, a convertible bond with a par value of 1,000, which is convertible into fifty shares of stock, has a conversion ratio of 50. The conversion ratio can also be used to compute a conversion price—the par value divided by the conversion ratio—yielding a conversion price of \$20. If the current stock price is \$25, the market conversion value is \$1,250 (50 \* \$25). If the convertible bond is trading at \$1,300, the conversion premium is \$50.

#### In Practice: A Simple Approach to Decomposing Debt and Equity

The value of a convertible debt can be decomposed into straight debt and equity components using a simple approach. Because the price of a convertible bond is the sum of the straight debt and the conversion option components, the value of the straight bond component in conjunction with the market price of the convertible bond should be sufficient to estimate the conversion option component, which is also the equity component:

Value of Equity Component = Price of Convertible Bond – Value of Straight Bond

#### Component

The value of the straight bond component can be estimated using the coupon payments on the convertible bond, the maturity of the bond, and the market interest rate the company would have to pay on a straight debt issue. This last input can be estimated directly if the company also trades straight bonds in the market place, or it can be based on the bond rating, if any, assigned to the company.

For instance, assume that you have a ten-year convertible bond, with a 5 percent coupon rate trading at \$1,050, and that the company has a debt rating of BBB (with a

market interest rate of 8 percent). The value of the straight bond and equity components can be estimated as follows:

Straight Bond Component =  $50 (PVA, 10 \text{ years}, 8\%) + 1000/1.08^{10} = $799$ 

Equity Component = \$1,050 - \$799 = \$251

## **7**.6. Convertible Debt and Yields

The yields on convertible bonds are much lower than the yields on straight bonds issued by a company. Therefore, convertible debt is cheaper than straight debt.

a. True

b. False

Why or why not?

### 2. Preferred Stock

**Preferred stock** is another security that shares some characteristics with debt and some with equity. Like debt, preferred stock has a fixed dollar dividend; if the firm does

not have the cash to pay the dividend, it is accumulated and paid in a period when there are sufficient earnings. Like debt, preferred stockholders do not have a share of control in the firm, and their

*Preferred Stock:* A hybrid security. Like debt, it has a promised payment (the preferred dividend) in each period. Like equity, its cash flows are not tax-deductible, and it has an infinite life.

voting privileges are strictly restricted to issues that might affect their claims on the firm's cash flows or assets. Like equity, payments to preferred stockholders are not taxdeductible and come out of after-tax cash. Also like equity, preferred stock does not have a maturity date when the face value is due. In terms of priority, in the case of bankruptcy, preferred stockholders have to wait until the debt holders' claims have been met before receiving any portion of the assets of the firm.

Although accountants and ratings agencies continue to treat preferred stock as equity, it can be argued that the fixed commitments that preferred stock create are like debt obligations and have to be dealt with likewise. The obligations created by preferred stock are generally less onerous than those created by debt; however, because they are generally cumulated, cannot cause default, and do not have priority over debt claims in the case of bankruptcy.

Unlike convertible debt, which can be decomposed into equity and debt components, preferred stock cannot really be treated as debt because preferred dividends are not tax-deductible and certainly cannot be viewed as the equivalent of equity because of the differences in cash flow claims and control. Consequently, preferred stock is treated as a third component of capital, in addition to debt and equity, for purposes of capital structure analysis and for estimating the cost of capital.

## 7.7. Preferred Stock and Equity

Many ratings agencies and regulators treat preferred stock as equity in computing debt ratios, because it does not have a finite maturity and firms cannot be forced into bankruptcy if they fail to pay preferred dividends. Do you agree with this categorization?

a. Yes

b. No

Why or why not?

### 3. Option-Linked Bonds

In recent years, firms have recognized the value of combining options with straight bonds to create bonds that more closely match the firm's specific needs. We considered one when with convertble bonds. Consider two other examples. In the first, commodity companies issued bonds

*Commodity-Linked Bonds:* Bonds where the interest and/or the principal payments are linked to the price of the commodity. In most cases, the payments will increase with the price of the commodity and decrease if it drops.

linking the principal and even interest payments to the price of the commodity. Thus interest payments would rise if the price of the commodity increased and vice versa. The benefit for the company was that it tailored the cash flows on the bond to the cash flows of the firm and reduced the likelihood of default. These **commodity-linked bonds** can be viewed as a combination of a straight security and a call option on the underlying commodity. In the second example, consider insurance companies that have recently issued bonds whereby the principal on the bond is reduced in the case of a specified

catastrophe and remains unaffected in its absence. For instance, an insurance firm that has the bulk of its revenues coming from homeowners' insurance in California might attach a provision that reduces principal and/or interest in the case of a major earthquake. Again, the rationale is to provide the firm with some breathing room when it needs it the most—when a catastrophe creates huge cash outflows for the firm.

#### Illustration 7.1: Financing Choices in 2008- Disney, Aracruz and Tata Chemicals

Disney, Aracruz and Tata Chemicals all have debt on their books in 2008. We well begin by taking a look at both the amount of the debt and the composition of this debt in table 7.1:

	Disney	Aracruz	Tata Chemicals
Debt due	\$13.27 billion	R\$ 24.20 billion	Rs 42.22 billion
Loans vs Bonds	Corporte Bonds		
Maturity	5-10 years year 1-5 years		
Leases	Has operating leases with a debt value of \$1.46 billion (see chapter 4)	No stated lease commitments	Small lease commitments.
Fixed vs	76% Fixed Rate	100% Fixed Rate	100% Fixed Rate
Floating	24% Floating Rate		
Currency	90% US dollar	100% R\$	97% Rupees
	10% Japanese Yen		3% US dollar
Other	43% of bonds are callable	Small portion of debt is convertible	Bank debt is term loans
	10% of bonds are putable	Bank debt is term loans	

Table 7.1: Debt Breakdown for Disney, Aracruz and Tata Chemicals

Looking at the breakdown of the debt, we can draw some preliminary conclusions:

- a. Disney used the corporate bond market much more extensively than Aracruz and Tata Chemicals in 2008, with 92% of its debt taking the form of bonds, reflecting both its standing as a large market capitalization company and its access to capital markets as a US-based company.
- b. While Disney has the higher proportion of short term debt of the three companies, it is the only one of the three companies with debt maturing in more than 10 years. That may also be a reflection of its use of the bond market, since banks, especially in emerging markets, may be unwilling to commit to long term loans.
- c. Disney is the only one of the three companies with a significant portion of floating rate debt, where the interest will vary across time, as a function of index rates (LIBOR, in the case of Disney).
- d. All three companies borrow predominantly in their domestic currencies. Disney does have some Japanese debt and Tata Chemicals has two small US dollar bond issues.
- e. Disney's corporate bonds follow the conventional form and have only coupon payments during their lifetime, with the face value due at the end (bullet payments). In contrast, the bank loans used by Aracruz and Tata Chemicals require that the principal be repaid over the course of the debt (term loans).
- f. A large portion of Disney's bonds can be called back by the firm, if it chooses to do so, an option that will probably be exercised if interest rates drop significantly. A small portion of the bonds can be put back by the bondholders to the firm, a protection against actions that Disney may take that reduce the value of the bonds.

While we did not break out Bookscape's debt in table 7.1, the only debt it has takes the form of an operating lease on its premises. As we noted in chapter 4, the present value of the lease commitments (of \$750,000 each year for the next 25 years) is \$9.6 million.

### **Financing Behavior**

We spent the last section looking at the different financing choices available to a firm. They all represent external financing, that is, funds raised from outside the firm.

Many firms meet the bulk of their funding needs internally with cash flows from existing assets. In this section, we begin by presenting the distinction between internal and external financing and the factors that may affect how much firms draw on each source. We then turn our attention again to external financing. We consider how and why the financing choices may change as a firm goes through different stages of its life cycle, from start-up to expansion to high growth to stable growth and on to decline. We will follow up by looking why some choices dominate in some stages and do not play a role in others.

#### **Internal versus External Financing**

Cash flows generated by the existing assets of a firm can be categorized as internal financing. Because these cash flows belong to the equity owners of the business, they are called *internal equity*. Cash flows raised outside the firm, whether from private sources or from financial markets, can be categorized as *external financing*. External financing can, of course, take the form of new debt, new equity, or hybrids.

A firm may prefer internal to external financing for several reasons. For private firms, external financing is typically difficult to raise, and even when it is available (from a venture capitalist, for instance) it is accompanied by a loss of control (the venture capitalist wants a share of control). For publicly traded firms, external financing may be easier to raise, but it is still expensive in terms of issuance costs (especially in the case of new equity). Internally generated cash flows, on the other hand, can be used to finance operations without incurring large transaction costs or losing control.

Despite these advantages, there are limits to the use of internal financing to fund projects. First, firms have to recognize that internal equity has the same cost as external equity, before the transaction cost differences are factored in. The cost of equity, computed using a risk and return model, such as the CAPM or APM, applies as much to internal as to external equity. Thus, Disney has a cost of equity of 10.00 percent for internal equity (or retained earnings) and external equity (new stock or equity option issues). This equivalence implies that a project financed with internal equity should pass the same test as a project financed with external equity; Disney has to earn a return on equity for investors that is greater than 10 percent on projects funded with either external equity or retained earnings. Second, internal equity is clearly limited to the cash flows generated by the firm for its stockholders. Even if the firm does not pay dividends, these cash flows may not be sufficient to finance the firm's projects. Depending entirely on internal equity can therefore result in project delays or the possible loss of these projects to competitors. Third, managers should not make the mistake of thinking that the stock price does not matter just because they use only internal equity for financing projects. In reality, stockholders in firms whose stock prices have dropped are much less likely to trust their managers to reinvest their cash flows for them than are stockholders in firms with rising stock prices.

#### Growth, Risk, and Financing

As firms grow and mature, their cash flows and risk exposure follow fairly predictable patterns. Cash flows become larger, relative to firm value, and risk approaches the average risk for all firms. The financing choices that a firm makes will reflect these changes. To understand these choices, let us consider five stages in a firm's life cycle:

- 1. *Start-Up*: This represents the initial stage after a business has been formed. Generally, this business will be a private business, funded by owner's equity and perhaps bank debt. It will also be restricted in its funding needs, as it attempts to gain customers and get established.
- 2. *Expansion*: Once a firm succeeds in attracting customers and establishing a presence in the market, its funding needs increase as it looks to expand. Because this firm is unlikely to be generating high cash flows internally at this stage and investment needs will be high, the owners will generally look to private equity or venture capital initially to fill the gap. Some firms in this position will make the transition to publicly traded firms and raise the funds they need by issuing common stock.
- 3. *High Growth*: With the transition to a publicly traded firm, financing choices increase. Although the firm's revenues are growing rapidly, earnings are likely to lag behind revenues and internal cash flows lag behind reinvestment needs. Generally, publicly traded firms at this stage will look to more equity issues, in the form of

common stock, warrants, and other equity options. If they are using debt, convertible debt is most likely to be used to raise capital.

- 4. *Mature Growth*: As growth starts leveling off, firms will generally find two phenomena occurring. The earnings and cash flows will continue to increase rapidly, reflecting past investments, and the need to invest in new projects will decline. The net effect will be an increase in the proportion of funding needs covered by internal financing and a change in the type of external financing used. These firms will be more likely to use debt in the form of bank debt or corporate bonds to finance their investment needs.
- 5. *Decline*: The last stage in this corporate life cycle is decline. Firms in this stage will find both revenues and earnings starting to decline as their businesses mature and new competitors overtake them. Existing investments are likely to continue to produce cash flows, albeit at a declining pace, and the firm has little need for new investments. Thus, internal financing is likely to exceed reinvestment needs. Firms are unlikely to be making fresh stock or bond issues but are more likely to be retiring existing debt and buying back stock. In a sense, the firm is gradually liquidating itself.

Figure 7.2 summarizes both the internal financing capabilities and external financing choices of firms at different stages in the growth life cycle.

\$ Revenues/ Earnings					Revenues Earnings
External funding needs	High, but constrained by infrastructure	High, relative to firm value.	Moderate, relative to firm value.	Declining, as a percent of firm value	Low, as projects dry up.
Internal financing	Negative or low	Negative or low	Low, relative to funding needs	High, relative to funding needs	More than funding needs
External Financing	Owner's Equity Bank Debt	Venture Capital Common Stock	Common stock Warrants Convertibles	Debt	Retire debt Repurchase stock
Growth stage	Stage 1 Start-up	Stage 2 Rapid Expansion	Stage 3 High Growth	Stage 4 Mature Growth	Stage 5 Decline
Financing		Luitel Dublic offer	• • • • • • • • • • • • • • • • • • •	Dendierer	►

Transitions Accessing private equity Inital Public offering Seasoned equity issue Bond issues

Not all firms go through these five phases, and the choices are not the same for all of them. First, many firms never make it past the start-up stage in this process. Of the tens of thousands of businesses that are started each year by entrepreneurs, many fail to survive, and even those that survive often continue as small businesses with little expansion potential. Second, not all successful private firms become publicly traded corporations. Some firms, like Cargill and Koch Industries, remain private and manage to raise enough capital to continue growing at healthy rates over long periods. Third, there are firms like Microsoft that are in high growth and seem to have no need for external financing, because internal funds prove more than sufficient to finance this growth. There are high-growth firms that issue debt, and low-growth firms that raise equity capital. In short, there are numerous exceptions, but the life cycle framework still provides a useful device to explain why different kinds of firms do what they do and what causes them to deviate from the prescribed financing choices.

Note that when we look at a firm's choices in terms of debt and equity at different stages in the growth life cycle, there are two things we do not do in this analysis. First,

we do not explain in any detail why firms at each stage in the growth life cycle pick the types of financing that they do. Second, we do not consider what kind of debt is best for a firm—short-term or long-term, dollar or foreign currency, fixed rate or floating rate. The reason is that this choice has more to do with the types of assets the firm owns and the nature of the cash flows from these assets than with where in its life cycle a firm is in. We will return to examine this issue in more detail in Chapter 9.

#### **How Firms Have Actually Raised Funds**

In the first part of this chapter, we noted the range of choices in terms of both debt and equity that are available to firms to raise funds. Before we look at which of these choices should be used, it is worth noting how firms have historically raised funds for operations. Firms have used debt, equity, and hybrids to raise funds, but their dependence on each source has varied across time. In the United States, for instance, firms collectively have generally raised external financing through debt issues rather than equity issues, and have primarily raised equity funds internally from operations. Figure 7.3 illustrates the proportion of funds from new debt and equity issues, as well as from internal funds, for U.S. corporations between 1975 and 2007.

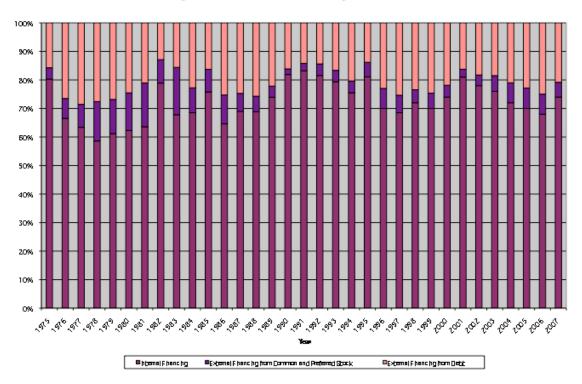


Figure 7.3: External and Internal Financing at US Firms

In every year, firms have relied more heavily on internal financing to meet capital needs than on external financing. Furthermore, when external financing is used, it is more likely

There are wide differences across firms in the United States in how much and what type of external financing is used. The evidence is largely consistent with the conclusions that emerge from looking at a firm's place in the growth cycle in Figure 7.2. Fluck, Holtz-Eakin, and Rosen looked at several thousand firms that were incorporated in Wisconsin; most of these firms were small, private businesses.<sup>2</sup> The authors find that these firms depend almost entirely on internal financing, owner's equity, and bank debt to cover capital needs. The proportion of funds provided by internal financing increases as the firms became older and more established. A small proportion of private businesses manage to raise capital from venture capitalists and private equity investors. Many of these firms ultimately plan on going public, and the returns to the private equity investors come at the time of the public offering. Bradford and Smith looked at sixty computerrelated firms prior to their initial public offerings (IPOs) and noted that forty-one of these firms had private equity infusions before the public offering.<sup>3</sup> The median number of private equity investors in these firms was between two and three, and the median proportion of the firm owned by these investors was 43.8 percent; an average of 3.2 years elapsed between the private equity investment and the IPO at these firms. Although this is a small sample of firms in one sector, it does suggest that private equity plays a substantial role in allowing firms to bridge the gap between private businesses and publicly traded firms.

to be new debt rather than new equity or preferred stock.

When we compare the financing patterns of U.S. companies to companies in other countries, we find some evidence that U.S. companies are much more heavily dependent

<sup>&</sup>lt;sup>2</sup>Fluck, Z., D. Holtz-Eakin and H.S. Rosen, 1998, *Where does the money come from? The Financing of Small Entrepreneurial Enterprises?*, Working Paper, NYU Salomon Center. This is a unique data set, because this information is usually either not collected or not available to researchers.

<sup>&</sup>lt;sup>3</sup> Bradford, T. and R.C. Smith, 1997, *Private Equity: Sources and Uses*, Journal of Applied Corporate Finance, v10(1), 89-97.

on debt than equity for external financing than their counterparts in other countries. Figure 7.4 summarizes new security issues in the G-7 countries between 1984 to 1991.<sup>4</sup>

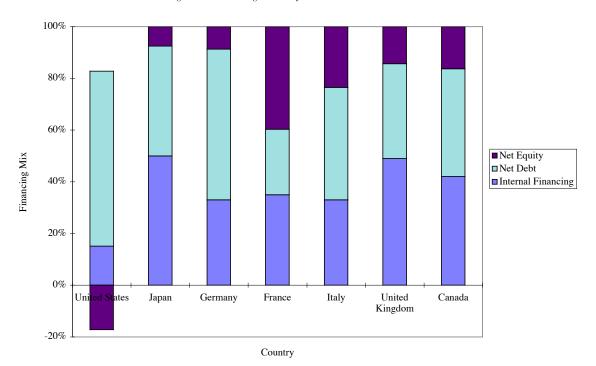


Figure 7.4: Financing Patterns for G-7 Countries – 1984-91

Net equity in Figure 7.4 refers to the difference between new equity issues and stock buybacks. Firms in the United States, during the period of this comparison, bought back more stock than they issued, leading to negative net equity. In addition, a comparison of financing patterns in the United States, Germany, and Japan reveals that German and Japanese firms are much more dependent on bank debt than firms in the United States, which are much likely to issue bonds.<sup>5</sup> Figure 7.5 provides a comparison of bank loans

<sup>&</sup>lt;sup>4</sup>See Rajan, Raghuram G. and Luigi Zingales. *What Do We Know About Capital Structure? Some Evidence From International Data*, Journal of Finance, 1995, v50(5), 1421-1460. This is based on OECD data, summarized in the OECD publication "Financial Statements of Non-Financial Enterprises." The G7 countries represent seven of the largest economies in the world. The leaders of these countries meet every year to discuss economic policy.

<sup>&</sup>lt;sup>5</sup>Hackethal, A. and R.H. Schmidt, 1999, *Financing Patterns: Measurement Concepts and Empirical Results*, Working Paper, University of Frankfurt.. They compare financing patterns in the three countries.

and bonds as sources of debt for firms in the three countries, as reported in Hackethal and Schmidt .<sup>6</sup>

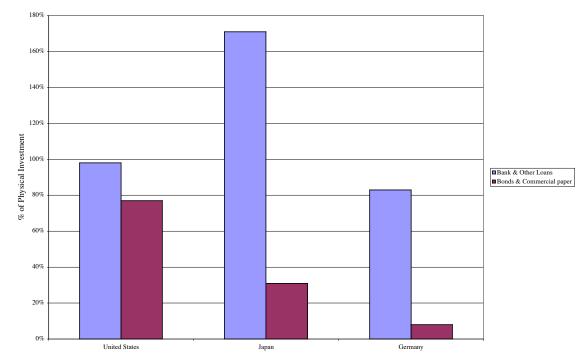


Figure 7.5: Bonds versus Bank Loans - 1990-96

There is also some evidence that firms in some emerging markets, such as Brazil and India, use equity (internal and equity) much more than debt to finance their operations. Some of this dependence can be attributed to government regulation that discourages the use of debt, either directly by requiring the debt ratios of firms to be below specified limits or indirectly by limiting the deductibility of interest expenses for tax purposes. One of the explanations for the greater dependence of U.S. corporations on debt issues relies on where they are in their growth life cycle. Firms in the United States, in contrast to firms in emerging markets, are much more likely to be in the mature growth stage of the life cycle. Consequently, firms in the United States should be less dependent on external equity. Another factor is that firms in the United States have far more access to corporate bond markets than do firms in other markets. Firms in Europe, for instance, often have to

<sup>&</sup>lt;sup>6</sup> Hackethal, A. and R.H. Schmidt, 1999, *Financing Patterns: Measurement Concepts and Empirical Results*, Working Paper, University of Frankfurt.

raise new debt from banks, rather than bond markets. This may constrain them in the use of new debt.

## 7.8. Corporate Bond Markets and the Use of debt

Companies in Europe and emerging markets have historically depended on bank debt to borrow and have had limited access to corporate bond markets. In recent years, their access to corporate bond markets, both domestically and internationally, has increased. As a result, which of the following would you expect to happen to debt ratios in these countries?

- a. Debt ratios should go up.
- b. Debt ratios should go down.
- c. Debt ratios should not change much.

## Why firms are reluctant to raise new equity: A Behavioral Perspective

If there is a common theme to the financing choices that publicly traded firms make, at least in the United States, it is that they are reluctant to issue new shares to raise funds, which manifests itself in the low proportion of new funding that comes from equity (see figure 7.3) and an unwillingness to use rights issues, even though it is less expensive way of raising equity than issuing new shares at the current stock price. Since the same firms are willing to use internal equity (retained earnings) to fund projects, we can attribute this behavior to an aversion to equity or a preference for debt. There are two behavioral explanations:

<u>a.</u> <u>Anchoring/ Framing</u>: A common theme in behavioral finance is that how individuals make decisions is a function of how they frame the outcomes and their choices of anchors. For better or worse, the number that equity research analysts seem to pay the most attention to, when looking at corporate earnings, is earnings per share. Any new equity issue, no matter what its justification, increases the number of shares outstanding and by doing so, will reduce earnings per share, at least in the near term. When firms do decide to raise external equity, rights issues, widely used by European

companies to raise equity, are used infrequently by US companies, primarily because it results in more shares being issued to raise the same funds.

b. Over confidence: Malmendier and Tate (2004) note that the same over confidence that leads managers to over estimate cash flows on investments also can lead them to believe that their stock is under priced by the market, and this perception makes it less likely that they will issue shares at the price.

It is interesting to note that the aversion to reducing earnings per share and issuing new equity is selective. The same firms that are reluctant to make rights issues are more than willing to split their stock and seem to put aside the unwillingness to issue new common stock, when issuing convertible debt and preferred stock. Put another way, managers seem to averse to actions that increase the number of shares today but not to actions that potentially could increase the number of shares in the future.

## The Process of Raising Capital

Looking back at Figure 7.2, we note four financing transitions, where the source of funding for a firm is changed by the introduction of a new financing choice. The first occurs when a private firm approaches a private equity investor or venture capitalist for new financing. The second occurs when a private firm decides to offer its equity to financial markets and become a publicly traded firm. The third takes place when a publicly traded firm decides to revisit equity markets to raise more equity. The fourth occurs when a publicly traded firms decides to raise debt from financial markets by issuing bonds. In this section, we examine the process of making each of these transitions. Because the processes for making seasoned equity and bond issues are very similar, we will consider them together.

#### **Private Firm Expansion: Raising Funds from Private Equity**

Private firms that need more equity capital than can be provided by their owners can approach venture capitalists and private equity investors. Venture capital can prove useful at different stages of a private firm's existence. *Seed-money venture capital*, for instance, is provided to start-up firms that want to test a concept or develop a new product, whereas *start-up venture capital* allows firms that have established products and

concepts to develop and market them. Additional rounds of venture capital allow private firms that have more established products and markets to expand. There are five steps associated with how venture capital gets to be provided to firms and how venture capitalists ultimately profit from these investments.

- **Provoke Equity Investor's Interest**: The first step that a private firm wanting to raise private equity has to take is to get private equity investors interested in investing in it. There are a number of factors that help the private firm at this stage. One is the *type of business* that the private firm is in and how attractive this business is to private equity investors. The second factor is the track record of the top manager(s) of the firm. Top managers, who have a track record of converting private businesses into publicly traded firms, have an easier time raising private equity capital.
- Valuation and Return Assessment: Once private equity investors become interested in investing in a firm, the value of the private firm has to be assessed by looking at both its current and expected prospects. This is usually done using the *venture capital method*, whereby the earnings of the private firm are forecast in a future year, when the company can be expected to go public. These earnings, in conjunction with a price-earnings multiple, estimated by looking at publicly traded firms in the same business, is used to assess the value of the firm at the time of the IPO; this is called the *exit or terminal value*.
- For instance, assume that Bookscape is expected to have an IPO in three years and that the net income in three years for the firm is expected to be \$4 million. If the price-earnings ratio of publicly traded retail firms is 25, this would yield an estimated exit value of \$100 million. This value is discounted back to the present at what venture capitalists call a *target rate of return*, which measures what venture capitalists believe is a justifiable return, given the risk to which they are exposed. This target rate of return is usually set at a much higher level than the traditional cost of equity for the firm.<sup>7</sup>
  - Discounted Terminal Value = Estimated exit value  $/(1 + \text{Target return})^n$

<sup>&</sup>lt;sup>7</sup>For instance, the target rate of return for private equity investors is in excess of 30 percent.

- Using the Bookscape example again, if the venture capitalist requires a target return on 30 percent on his or her investment, the discounted terminal value for Bookscape would be
  - Discounted Terminal Value for Bookscape =  $100 \text{ million}/1.30^3 = 45.52 \text{ million}$
- *Structuring the Deal*: In structuring the deal to bring private equity into the firm, the private equity investor and the firm have to negotiate two factors. First, the investor has to determine what proportion of the value of the firm he or she will demand in return for the private equity investment. The owners of the firm, on the other hand, have to determine how much of the firm they are willing to give up in return for the capital. In these assessments, the amount of new capital being brought into the firm has to be measured against the estimated firm value. In the Bookscape example, assuming that the venture capitalist is considering investing \$12 million, he or she would want to own at least 26.36 percent of the firm.<sup>8</sup>
  - Ownership Proportion = Capital Provided/Estimated Value

• = 12/\$45.52 = 26.36%

- Second, the private equity investor will impose constraints on new investments and fresh financing on the managers of the firm in which the investment is being made. This is to ensure that the private equity investors are protected and that they have a say in how the firm is run.
- **Post-deal Management**: Once the private equity investment has been made in a firm, the investor will often take an active role in the management of the firm. Private equity investors and venture capitalists bring not only a wealth of management experience to the process but also contacts that can be used to raise more capital and get fresh business for the firm.
- *Exit*: Private equity investors and venture capitalists invest in private businesses because they are interested in earning a high return on these investments. How will these returns be manifested? There are three ways a private equity investor can profit from an investment in a business. The first and usually the most lucrative alternative

<sup>&</sup>lt;sup>8</sup>Many private equity investors draw a distinction between premoney valuation, or the value of the company without the cash inflow from the private equity investor, and postmoney valuation, which is the

is an IPO made by the private firm. Although venture capitalists do not usually liquidate their investments at the time of the IPO, they can sell at least a portion of their holdings once they are traded.<sup>9</sup> The second alternative is to sell the private business to another firm; the acquiring firm might have strategic or financial reasons for the acquisition. The third alternative is to withdraw cash flows from the firm and liquidate the firm over time. This strategy would not be appropriate for a high-growth firm, but it may make sense if investments made by the firm no longer earn excess returns.

While there are well known and publicized success stories of private businesses making it to prosperity, the reality is more sobering. Most private businesses do not make it. There are several studies that back up this statement, though they vary in the failure rates that they find. A study of 5196 start-ups in Australia found that the annual failure rate was in excess of 9% and that 64% of the businesses failed in a 10-year period.<sup>10</sup> Knaup and Piazza (2005,2008) used data from the Bureau of Labor Statistics Quarterly Census of Employment and Wages (QCEW) to compute survival statistics across firms.<sup>11</sup> This census contains information on more than 8.9 million U.S. businesses in both the public and private sector. Using a seven-year database from 1998 to 2005, the authors concluded that only 44% of all businesses that were founded in 1998 survived at least 4 years and only 31% made it through all seven years.

#### From Private to Publicly Traded Firm: The IPO

A private firm is restricted in its access to external financing, both for debt and equity. In our earlier discussion of equity choices, we pointed out the hard bargain venture capitalists extract for investing equity in a private business. As firms become

value of the company with the cash influx from the private equity investors. They argue that their ownership of the firm should be based on the former (lower) value.

<sup>&</sup>lt;sup>9</sup>Black, B.S and R.J. Gilson, 1998, *Venture Capital and the Structure of Capital Markets: Banks versus Stock Markets*, Journal of Financial Economics, v47, 243-277. They argue that one of the reasons why venture capital is much more active in the United States than in Japan or Germany is because the option to go public is much more easily exercised in the United States.

<sup>&</sup>lt;sup>10</sup> John Watson and Jim Everett, 1996, "Do Small Businesses Have High Failure Rates?" *Journal of Small Business Management*, v34, pg 45-63.

<sup>&</sup>lt;sup>11</sup> Knaup, Amy E., May 2005,, "Survival and longevity in the Business Employment Dynamics data," *Monthly Labor Review*, pp. 50–56; Knaup, Amy E. and MC. Piazza, September 2007, Business Employment Dynamics Data: Survival and Longevity, Monthly Labor Review, pp 3-10.

larger and their capital needs increase, some of them decide to become publicly traded and to raise capital by issuing shares of their equity to financial markets.

#### Staying Private versus Going Public

When a private firm becomes publicly traded, the primary benefit is increased access to financial markets and capital for projects. This access to new capital is a significant gain for high-growth businesses with large and lucrative investment opportunities. A secondary benefit is that the owners of the private firm are able to cash in on their success by attaching a market value to their holdings. These benefits have to be weighed against the potential costs of being publicly traded. The most significant of these costs is the loss of control that may ensue from being a publicly traded firm. As firms get larger and the owners are tempted to sell some of their holdings over time, the owner's share of the outstanding shares will generally decline. If the stockholders in the firm come to believe that the owner's association with the firm is hurting rather than helping it, they may decide to put pressure for the owner's removal.

Other costs associated with being a publicly traded firm are the information disclosure requirements and the legal requirements.<sup>12</sup> A private firm experiencing challenging market conditions (declining sales, higher costs) may be able to hide its problems from competitors, whereas a publicly traded firm has no choice but to reveal the information. Yet another cost is that the firm has to spend a significant portion of its time on investor relations, a process in which equity research analysts following the firm are cultivated and provided with information about the firm's prospects.<sup>13</sup>

Overall, the net trade-off to going public will generally be positive for firms with large growth opportunities and funding needs. It will be smaller for firms that have smaller growth opportunities, substantial internal cash flows, and owners who value the complete control they have over the firm.

<sup>&</sup>lt;sup>12</sup>The costs are twofold. One is the cost of producing and publicizing the information itself. The other is the loss of control over how much and when to reveal information about the firm to others.

<sup>&</sup>lt;sup>13</sup>"Cultivated" may sound like an odd word choice, but it is accurate. Buy recommendations from equity research analysts following the firm provoke investor interest and can have a significant impact on the stock price; sell recommendations, on the other, can cause the stock price to drop. This is especially true for small, lightly followed firms.

#### Steps in an IPO

Assuming that the benefits outweigh the costs, there are five steps involved in an IPO.

*Step 1: Choose an investment banker based on reputation and marketing skills*. In most IPOs, this investment banker underwrites the issue and guarantees a specified price for the stock. This investment banker then puts together a group of several banks (called a syndicate) to spread the risk of the offering and to increase marketing reach. <sup>14</sup> Private firms tend to pick investment bankers based on reputation and expertise, rather than price. A good reputation provides the credibility and the comfort level needed for investors to buy the stock of the firm; expertise applies not only to the pricing of the issue and the process of going public but also to other financing decisions that might be made in the aftermath of a public issue. The investment banking agreement is then negotiated, rather than opened up for competition.

Step 2: Assess the value of the company and set issue details. This valuation is generally done by the lead investment bank, with substantial information provided by the issuing firm. The value is sometimes estimated using discounted cash flow models. More often, though, the value is estimated by using a multiple, like a price-earnings ratio, and by looking at the pricing of comparable firms that are already publicly traded. Whichever approach is used, the absence of substantial historical information, in conjunction with the fact that these are small companies with high growth prospects, makes the estimated, the value per share is obtained by dividing by the number of shares, which is determined by the price range the issuer would like to have on the issue. If the equity in the firm is valued at \$50 million, for example, the number of shares would be set at 5 million to get a target price range of \$10, or at 1 million shares to get a target price range of \$50 per share. The final step in this process is to set the offering price per share. Most investment banks set the offering price below the estimated value per share for two reasons. First, it reduces the bank's risk exposure. If the offering price is set too high and the investment

<sup>&</sup>lt;sup>14</sup> In 2004, Google broke with precedent and decided to go public without an investment banking syndicate backing it. Using an auction process to set the stock price, it saved itself the normal costs associated with issuance fees. It remains to be seen whether Google is unique or at the vanguard of a new trend.

bank is unable to sell all of the shares offered, it has to use its own funds to buy the shares at the offering price. Second, investors and investment banks view it as a good sign if the stock increases in price in the immediate aftermath of the issue. For the clients of the investment banker who get the shares at the offering price, there is an immediate payoff; for the issuing company, the ground has been prepared for future issues.

*Step 3: Gauge investor demand at the offering price*. In setting the offering price, investment bankers have the advantage of first checking investor demand. This process, which is called *building the book*, involves polling institutional investors prior to pricing an offering to gauge the extent of the demand for an issue. It is also at this stage in the process that the investment banker and issuing firm will present information to prospective investors in a series of presentations called *road shows*. In this process, if the demand seems very strong, the offering price will be increased; in contrast, if the demand seems weak, the offering price will be lowered. In some cases, a firm will withdraw an IPO at this stage if investors are not enthusiastic about it.<sup>15</sup>

Step 4: Meet SEC filing requirements and issue a prospectus. To make a public offering in the United States, a firm has to meet several requirements. First, it has to file a registration statement and prospectus with the SEC, providing information about it's financial history, its forecasts for the future, and how it plans for the funds it raises from the IPO. The prospectus provides information about the riskiness and prospects of the firm for prospective investors in its stock. The SEC reviews this information and either approves the registration or sends out a deficiency memorandum asking for more information. While the registration is being reviewed, the firm may not sell any securities, though it can issue a preliminary prospectus, called a *red herring*, for informational purposes only. Once the registration has been approved by the SEC, the firm can place a *tombstone advertisement* in newspapers and other publications.

Step 5: Allocate stock to those who apply to buy it at offering price. If the demand for the stock exceeds the supply (which will happen if the offering price is set too low), you will have to ration the stock. If the supply exceeds the demand, the investment banker will

<sup>&</sup>lt;sup>15</sup>One study of IPOs between 1979 and 1982 found that 29 percent of firms terminated their IPOs at this stage in the process.

have to fulfill the underwriting guarantee and buy the remaining stock at the offering price.

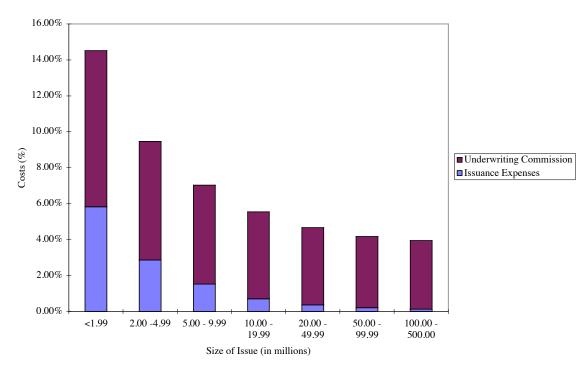
On the offering date—the first date the shares can be traded—the market price is determined by supply and demand. If the offering price has been set too high, as is sometimes the case, the investment bankers will have to discount the offering to sell it and make up the difference to the issuer because of the underwriting agreement. If the offering price is set too low, as is often the case, the traded price on the offering date will be much higher than the offering price, thus enriching those who were allocated shares in the IPO.

#### The Costs of Going Public

There are three costs associated with an IPO. First, the firm must consider the legal and administrative cost of making a new issue, including the cost of preparing registration statements and filing fees. Second, the firm should examine the underwriting commission—the gross spread between the offering price and what the firm receives per share, which goes to cover the underwriting, management, and selling fees on the issue. This commission can be substantial and decreases as the size of the issue increases. Figure 7.6 summarizes the average issuance and underwriting costs for issues of different sizes, reported by Ritter (1998).<sup>16</sup>

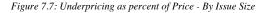
<sup>&</sup>lt;sup>16</sup> Ritter, J., 1998, *Initial Public Offerings*, Contemporary Finance Digest, v2, 5-30.

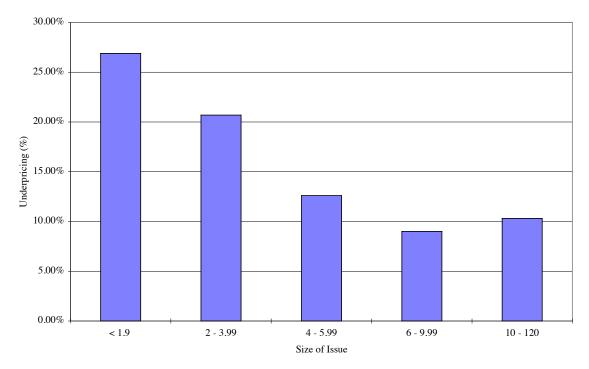
Figure 7.6: Issuance Costs by Size of Issue



The third cost is any underpricing on the issue, which provides a windfall to the investors who get the stock at the offering price and sell it at the much higher market price. Although precise estimates vary from year to year, the average IPO seems to be underpriced by 10 to 15 percent. Ibbotson, Sindelar, and Ritter in a study of the determinants of underpricing, estimate its extent as a function of the size of the issue.<sup>17</sup> Figure 7.7 summarizes the underpricing as a percent of the price by size of issue.

<sup>&</sup>lt;sup>17</sup> Ibbotson, Roger G., Jody L. Sindelar and Jay R. Ritter. 1994, *The Market's Problems With The Pricing Of Initial Public Offerings*, Journal of Applied Corporate Finance4, v7(1), 66-74.





Source: Ibbotson, Sindelar, and Ritter (1994).

Investment banks are fairly open about the fact that they under price IPOs. This gives rise to two questions. First, why don't the offering firms express more outrage about the value left on the table by the underpricing? Second, can investors take advantage of the underpricing by subscribing to dozens of IPOs? There are answers to both questions. First, it is true that an underpriced IPO results in less proceeds going to the issuing firms. However, the loss of wealth is a function of how much of the equity of the firm is offered in the initial offering. If only 10 percent of the stock is being offered at the initial offering, we can see why many issuing firms go along with the underpricing. The favorable publicity associated with a strong opening day of trading may act as promotion for subsequent offerings that the firm plans to make in future months or even years. Second, it is not easy constructing an investment strategy that takes advantage of IPO mispricing. If an investor applies for shares in a number of offerings, he or she is likely to get all the shares requested in the offerings that are underpriced (where there will be rationing because of excess demand). The resulting portfolio will be over weighted in overpriced

public offerings and underweighted with the underpriced offerings, and the returns will not match up to those reported in IPO studies.

## The under pricing of IPOs: A Behavioral Perspective

While conventional finance has viewed the under pricing of initial public offerings as a puzzle, there are two explanations that have their basis in behavioral finance.

- a. <u>Stable buyers</u>: The investors who subscribe to an initial public offering provide a home and a stable price for the stock, and by doing so, allay the fears that other investors may have about investing in a young company. The initial discount is the price that investment banks pay to the initial investors for voluntarily restricting their selling.<sup>18</sup>
- b. <u>The impresario hypothesis</u>: The high initial return to investors in a public offering helps to create or sustain enthusiasm for initial offerings in general. Since IPOs occur in waves and often are concentrated on specific sectors at any time (technology stocks in the late 1990s), investment bankers pricing offerings have to work at keeping the enthusiasm going by under pricing them. Implicit here is the assumption that waves of new offerings are in essence taking advantage of an underlying bubble in a sector or the market, and that the under pricing feeds that illusion.

<u>F</u>inally, there are two other characteristics that feed the under pricing. The first is that investment bankers who are "averse to losses" will under price initial public offerings. The other is that the under pricing is compensation for the winner's curse in initial public offerings, i.e., that less informed investors over subscribe to over priced offerings and that the winners therefore have to offer their shares at a discount to keep these investors from dropping out of the game. Thus, informed investors in the IPO game will walk away with excess returns.

<sup>&</sup>lt;sup>18</sup> Since the restriction is voluntary, those investors who violate this implicit agreement will not be allocated stock in future initial public offerings.

#### Illustration 7.2: The IPO for United Parcel Service (UPS)

On July 21, 1999, UPS, the world's largest private package company, announced plans to sell its shares to the public. The company, which was wholly owned by its managers and employees, announced that it was going public to raise capital to make acquisitions in the future. UPS reported revenues of \$24.8 billion and net income of \$1.7 billion in 1998 and at that time employed about 330,000 people.

UPS followed the initial announcement by filing a prospectus with the SEC on the same day, announcing its intention of creating two classes of shares. Class A shares, with ten votes per share, would be held by the existing owners of UPS, and class B shares, having one vote per share, would be offered to the public.

The firm chose Morgan Stanley as its lead investment banker, and Morgan Stanley put together a syndicate that included Goldman Sachs and Merrill Lynch as senior comanagers. Other comanagers included Credit Suisse, Salomon Smith Barney, and Warburg Dillon Read. On October 20, 1999, UPS filed a statement with the SEC (called an S-1 registration statement) announcing that it planned to issue 109.4 million shares (about 10 percent of the 1.1 billion outstanding shares) at a price range of \$36 to \$42,<sup>19</sup> and that the IPO would occur sometime in early November.

Based on the strong demand from institutional investors, gauged in the process of building the book, the investment banking syndicate increased the offering price to \$50 per share on November 8, 1999, and set the offering date at November 10, 1999. At that time, it was the largest IPO ever by a U.S. company.

On November 10, 1999, the stock went public. The stock price jumped to \$70.1325 from the offering price of \$50. At the end of the trading day, UPS shares were trading at \$67.25. Based on this price and the total number of shares outstanding, the market value of UPS was assessed at \$80.9 billion.

### 7.9. The Cost of Underpricing

<sup>&</sup>lt;sup>19</sup>The process by which this price range was set was not made public. We would assume that it was partially based on how the market was pricing two other publicly traded rivals—FedEx and Airborne Freight.

Assume that the market is correct in its assessment of UPS value and that the investment bankers underpriced the issue. How much did the underpricing cost the owners of UPS?

- a. About \$22 billion
- b. About \$50 billion
- c. About \$2.2 billion
- d. None of the above

#### The Choices for a Publicly Traded Firm

Once a firm is publicly traded, it can raise new financing by issuing more common stock, equity options, or corporate bonds. Additional equity offerings made by firms that are already publicly traded are called seasoned equity issues. In making stock and bond offerings, a publicly traded firm has several choices. It can sell these securities with underwritten general subscriptions, where stocks and bonds are offered to the public at an offering price guaranteed by the investment banker. It can also privately place both bonds and stocks with institutional investors or issue stocks and bonds directly to investors without any middlemen.

#### General Subscriptions

In a *general subscription*, the issue is open to any member of the general public to subscribe. In that sense, it is very similar to an IPO, though there are some basic differences:

• Underwriting Agreement: The underwriting agreement of an IPO almost always involves a firm guarantee and is generally negotiated with the investment banker, whereas the underwriting agreements for seasoned issues take on a wider variety of forms. First, there is the potential for competitive bids to arise on seasoned issues, because investment bankers have the information to promise a fixed price.<sup>20</sup> There is evidence that competitive bids reduce the spread, though even seasoned firms continue to prefer negotiated offerings. Second, seasoned issues also offer a wider range of underwriting guarantees; some issues are backed up by a *best efforts* 

*guarantee*, which does not guarantee a fixed price; other issues come with *standby guarantees*, where the investment banker provides back-up support, in case the actual price falls below the offering price. The payoff from relaxing the guarantee comes as lower underwriting commissions.

• *Pricing of Issue*: The issuer of an IPO has to estimate the value of the firm and then the per-share value before pricing the issue, whereas the pricing of a seasoned issue starts with the current market price, simplifying the process. Often, the price of a seasoned issue will be set just below the current market price.

The overall evidence on the cost of public offerings indicates that it is still clearly much more expensive to issue stock rather than bonds, and the cost of the issue is a decreases with the size of the issue.

#### **Private Placements**

An alternative to a general subscription is a *private placement*, in which securities are sold directly to one or a few investors. The terms for the securities are negotiated between the two parties. The primary advantage of private placements over general subscriptions is the lower cost, because there are fewer intermediaries and no need for underwriting guarantees or marketing. There are also substantial savings in time and administrative costs because the SEC registration requirements are bypassed. The other advantages are that the terms of the bond can be tailored to meet the specific needs of the buyer, and the firm can convey proprietary information (presumably positive) to the potential investors.

The primary disadvantage of private placements is that there are relatively few potential investors, because large private placements may expose the investor to firmspecific risks. This is why private placements of corporate bonds are much more common than private placement of equity. In a typical private placement, the buyer tends to be a long-term institutional investor, such as a life insurance company or a pension fund. These investors tend to invest in these bonds and hold them until maturity. Private

 $<sup>^{20}</sup>$ The information takes two forms. The first are the filings that every publicly traded firm has to make with the SEC. The other, and more important, is the current stock price.

placements generally range from \$25 million to \$250 million in size and have more restrictions associated with them than typical corporate bond issues.

#### **Rights Offerings**

The third option available to seasoned issuers is a *rights offering*. In this case, instead of trying to sell new stock at the current market price to all investors, the existing investors in the firm are given the right to buy additional shares, in proportion to their current holdings, at a price much lower than the current market price.

A company that uses a rights offering generally issues one right for each outstanding common share, allowing each stockholder to use those rights to buy additional shares in the company at a subscription price, generally much lower than the market price. Rational stockholders will either exercise the right or sell it. Those investors who let a right expire without doing either will find that the market value of their remaining holding shrinks-the market price will almost certainly drop when the rights are exercised because the subscription price is set much lower than the market price. In general, the value of a right should be equal to the difference between the stock price with the rights attached—the *rights-on price*—and the stock price without the rights attached—the *ex-rights price*. The reasoning is simple. If this were not true, there would be opportunities for easy profits on the part of investors and the resulting price would not be stable. To illustrate, if the price of the right were greater than the difference between the rights-on price and the ex-rights price, every stockholder would be better off selling the right rather than exercising it. This, in turn, would push the price down toward the equilibrium price. If the price of the right were lower than the difference between the rights-on and the ex-right price, there would be an equally frenzied rush to buy the right and exercise it, which in turn would push the price up toward the equilibrium price. The value of a right can be estimated using the following equation:

Price of a Right = (Rights-On Price – Subscription Price)/(n + 1)where *n* is the number of rights required for each new share.

Rights offerings are a much less expensive way of raising capital than public issues, for two reasons. First, the underwriting commissions are much lower, because a rights offering has little risk of not receiving subscriptions if the subscription price is set well below the market price. Second, the other transaction and administrative costs should also be lower because there is a far smaller need for marketing and distribution.

What is the drawback of making a rights issue? The primary reservation seems to be that it increases the number of shares outstanding far more than a general subscription at the existing stock price. To illustrate, a firm that makes a rights issue at \$5 per share when the stock price is \$10 will have to issue 10 million shares to raise \$50 million. In contrast, the same firm would have had to issue only 5 million shares if the issue had been at the existing stock price of \$10. Some financial managers argue that this dilutes the share holding and lowers the market price. Although this is true in a technical sense, the existing stockholders should not object because they are the only ones who receive the rights. In other words, the stock price will drop, but everyone will own proportionately more shares in the firm. In general, firms in the United States have been much more reluctant to use rights issues than European firms, in spite of the significant cost savings that could accrue from them. Part of this reluctance can be attributed to the fear of dilution.

#### Illustration 7.3: Valuing a Rights Offering: Tech Temp

Tech Temp has 10 million shares outstanding trading at \$25 per share. It needs to raise \$25 million in new equity and decides to make a rights offering. Each stockholder is provided with one right for every share owned, and five rights can be used to buy an additional share in the company at \$12.50 per share. The value of a right can be calculated as follows:

	Before Rights Exercised	After Rights Exercised
Number of shares	10 million	12 million
Value of equity	\$250 million	\$275 million
Price per share	\$25.00	\$22.92

The rights-on price is \$25.00 per share, and the ex-rights price is \$22.92, leading to a perright value of \$2.08. This can be confirmed by using the equation:

Value per Right = (Rights-On Price – Subscription Price)/(n + 1)

$$=(\$25 - \$12.50)/(5 + 1)$$

$$=$$
 \$12.50/6  $=$  \$2.08

If the rights price were greater than this value, investors would want to sell their rights. Alternatively, if the rights could be acquired for less than \$2.08, there would be an opportunity to gain by acquiring the rights at the lower price and exercising them.

*rights.xls*: This spreadsheet allows you to estimate the ex-rights price and the value per right in a rights issue.

## **7.10. Rights Issues and Existing stockholders**

Assume that you own 1,000 shares in Tech Temp, trading at \$25 a share, and that you receive the rights described in the last illustration. Assume also that due to an oversight, you neither exercise the right nor sell it. How much would you expect to lose as a result of the oversight?

- a. Nothing; you still own the shares
- <u>b.</u> \$416
- <u>c.</u> \$2,080
- <u>d.</u> \$12,500

#### Shelf Registrations

Firms that want to raise external financing have to disclose information and file the required statements with the SEC before they can issue securities. This registration process is costly and time-consuming and is one reason why some firms rely on internal financing. In response to this criticism, the SEC simplified its rules and allowed firms more flexibility in external financing. Rule 415, which was issued in 1982, allows firms to make a *shelf registration*, in which they can file a single prospectus for a series of issues they expect to make over the next two years.

Besides making the process less cumbersome, shelf registration also gives firms more flexibility in terms of timing, because stock and bond issues can be made when windows of opportunity open up. Thus, a firm might make a shelf registration for \$200 million in bonds and make the bond issue when interest rates are at a low point. This flexibility in timing also allows firms to open up the process to aggressive bidding from investment banks, reducing transaction costs substantially. Some firms make the issues themselves rather than use investment bankers because the process is simpler and faster.

Overall, the spreads on new issues, especially for bonds, have been under pressure since the passage of shelf registration. In spite of its benefits, however, shelf registration is more likely to be used by large firms making bond issues and less likely to be used by small firms making equity issues.

#### The Trade-Off of Debt

Now that we have defined debt and considered how financing choices change as a function of where a firm is in its life cycle, we can tackle a fundamental question. Why use debt instead of equity? In this section, we will first examine the benefits of using debt instead of equity and then follow up by looking at the costs.

#### The Benefits of Debt

In the broadest terms, debt provides two differential benefits over equity. The first is the *tax benefit*: Interest payments on debt are tax-deductible, whereas cash flows on

equity are not. The second is the *added discipline imposed on management* by having to make payments on debt. Both benefits can and should be quantified if firms want to make reasonable judgments on debt capacity.

#### 1. Debt Has a Tax Advantage

The primary benefit of debt relative to equity is the tax advantage it confers on the borrower. In the United

States, interest paid on debt is tax-deductible, whereas cash flows on equity (such as dividends) have to be paid out of after-tax cash flows. For the most part, this is true in other countries as well, though some countries try to provide partial protection against the **double taxation** of dividends by providing a tax credit to investors who receive the dividends for the corporate taxes paid (Britain) or by taxing retained earnings at a rate higher than dividends (Germany).

The tax benefits from debt can be presented in three ways. The first two measure the benefit in absolute terms, whereas the third measures it as a percentage cost.

**Double Taxation:** There is double taxation when the same income gets taxed twice, once at the entity level and once at the individual level. Thus, dividends, which are paid out of after-tax corporate profits, are double-taxed when individuals have to pay taxes on them as well.

□ In the first approach, the dollar tax savings in any financial year created by interest expenses can be computed by multiplying the interest expenses by the marginal tax rate of the firm. Consider a firm that borrows B to finance it operations, on which it faces an interest rate of *r* percent, and assume that it faces a marginal tax rate of *t* on income. The annual tax savings from the interest tax deduction can be calculated as follows:

Annual Interest Expense Arising from the Debt = rBAnnual Tax Savings Arising from the Interest Payment = trB

□ In the second approach, we can compute the present value of tax savings arising from interest payments over time. The present value of the annual tax savings can be computed by making three other assumptions. The first is that the debt is perpetual, which also means that the dollar savings are a perpetuity. The second is that the appropriate discount rate for this cash flow is the interest rate on the debt, because it reflects the riskiness of the debt. The third is that the expected tax rate for the firm will remain unchanged over time and that the firm is in a tax-paying position. With these three assumptions, the present value of the savings can be computed as follows:

Present Value of Tax Savings from Debt = trB/r = tB

= Marginal Tax Rate \* Debt

Although the conventional view is to look at the tax savings as a perpetuity, the approach is general enough to be used to compute the tax savings over a shorter period (say, ten years.) Thus, a firm that borrows \$100 million at 8 percent for ten years and has a tax rate of 40 percent, can compute the present value of its tax savings as follows:

Present Value of Interest Tax Savings = Annual Tax Savings (PV of Annuity)

= (0.08 \* 0.4 \* \$100 million) (PV of Annuity, 8%, 10 years) = \$21.47 millionWhen asked to analyze the effect of adding debt on value, some analysts use a shortcut and simply add the tax benefit from debt to the value of the firm with no debt:

Value of Levered Firm with Debt B = Value of Unlevered Firm + tB

The limitation of this approach is that it considers only the tax benefit from borrowing and none of the additional costs. It also yields the unrealistic conclusion that firm value always increases as you borrow more money.

□ In the third approach, the tax benefit from debt is expressed in terms of the difference between the pretax and after-tax cost of debt. To illustrate, if *r* is the interest rate on debt, and *t* is the marginal tax rate, the after-tax cost of borrowing  $(k_d)$  can be written as follows:

#### After-Tax Cost of Debt $(k_d) = r(1 - t)$

This is the familiar formula used for calculating the cost of debt in the cost of capital calculation. In this formula, the after-tax cost of debt is a decreasing function of the tax rate. A firm with a tax rate of 40 percent, which borrows at 8 percent, has an after-tax cost of debt of 4.8 percent. Another firm with a tax rate of 70 percent, which borrows at 8 percent, has an after-tax cost of debt of 2.4 percent.

Other things remaining equal, the benefits of debt are much greater when tax rates are higher. Consequently, there are three predictions that can be made about debt ratios across companies and across time.

- The debt ratios of entities facing higher tax rates should be higher than the debt ratios of comparable entities facing lower tax rates. Other things remaining equal, you would expect German companies that face a 38.5 percent marginal corporate tax rate to borrow more money than Irish companies that face a 12.5 percent marginal corporate tax rate.
- If tax rates increase over time, we would expect debt ratios to go up over time as well, reflecting the higher tax benefits of debt.
- Companies with large net operating losses carried forward should get far less in tax benefits from debt than firms without these net operating losses.

There is a data set online that summarizes by sector the effective tax rates of firms.

## 7.11. Net Operating Loss Carryforward and Tax Benefits

You have been asked to assess the after-tax cost of debt for a firm that has \$2 billion in net operating losses to carry forward, and operating income of roughly \$2 billion this year. If the company can borrow at 8 percent, and the marginal corporate tax rate is 40 percent, the after-tax cost of debt this year is

8 percent.

4.8 percent.

What would your after-tax cost of debt be next year?

#### 2. Debt May Make Managers More Disciplined

In the 1980s, in the midst of the leveraged buyout boom, a group of practitioners and academics, led by Michael Jensen at Harvard, developed and expounded a new rationale for borrowing, based on improving firms' efficiency in the utilization of their

free cash flows. **Free cash flows** represent cash flows made on operations over which managers have discretionary spending power—they may use them to take projects, pay them out to

*Free Cash Flows (Jensen's):* The free cash flows referred to here are the operating cash flows after taxes but before discretionary capital expenditures.

stockholders, or hold them as idle cash balances. The group argued that managers in firms that have substantial free cash flows and no or low debt have such a large cash cushion against mistakes that they have no incentive to be efficient in either project choice or project management. One way to introduce discipline into the process is to force these firms to borrow money, because borrowing creates the commitment to make interest and principal payments, increasing the risk of default on projects with substandard returns. It is this difference between the forgiving nature of the equity commitment and the inflexibility of the debt commitment that have led some to call equity a cushion and debt a sword.

The underlying assumptions in this argument are that there is a conflict of interest between managers and stockholders and that managers will not maximize shareholder wealth without a prod (debt). From our discussion in Chapter 2, it is clear that this assumption is grounded in fact. Most large U.S. corporations employ managers who own only a very small portion of the outstanding stock in the firm; they receive most of their income as managers rather than stockholders. Furthermore, evidence indicates that managers at least sometimes put their interests ahead those of stockholders.

The argument that debt adds discipline to the process also provides an interesting insight into management perspectives on debt. Based purely on managerial incentives, the optimal level of debt may be much lower than that estimated based on shareholder wealth maximization. Left to themselves, why would managers want to burden themselves with debt, knowing full well that they will have to become more efficient and pay a larger price for their mistakes? The corollary to this argument is that the debt ratios of firms in countries in which stockholder power to influence or remove managers is minimal will be much lower than optimal because managers enjoy a more comfortable existence by carrying less debt than they can afford to. Conversely, as stockholders acquire power, they will push these firms to borrow more money and, in the process, increase their stock prices.

Do increases in debt lead to improved efficiency and higher returns on investments? The answer to this question should provide some insight into whether the argument for added discipline has some basis. A number of studies have attempted to answer this question, though most have done so indirectly.

• Firms that are acquired in hostile takeovers are generally characterized by poor performance in both accounting profitability and stock returns. Bhide, for instance, noted that the return on equity of these firms is 2.2 percent below their peer group, whereas the stock returns are 4 percent below the peer group's returns.<sup>21</sup> Although this poor performance by itself does not constitute support for the free cash flow hypothesis, Palepu presented evidence that target firms in acquisitions carry less debt than similar firms that are not taken over.<sup>22</sup>

*Leveraged Recapitalization:* In a leveraged recapitalization, a firm borrows money and either buys back stock or pays a dividend, thus increasing its debt ratio substantially.

<sup>&</sup>lt;sup>21</sup> Bhide, A., 1993, Reversing Corporate Diversification, in The New Corporate Finance- Where Theory meets Practice, ed. D.H. Chew Jr., McGraw Hill.

<sup>&</sup>lt;sup>22</sup> Palepu, Krishna G., 1986, Predicting Takeover Targets: A Methodological And Empirical Analysis, 1986, Journal of Accounting and Economics, v8(1), 3-35.

• There is evidence that increases in leverage are followed by improvements in operating efficiency, as measured by operating margins and returns on capital. Palepu presented evidence of modest improvements in operating efficiency at firms involved in leveraged buyouts.<sup>23</sup> Kaplan and Smith in separate studies, also found that firms earn higher returns on capital following leveraged buyouts.<sup>24</sup> Denis and Denis presented more direct evidence on improvements in operating performance after **leveraged recapitalizations**.<sup>25</sup> In their study of twenty-nine firms that increased debt substantially, they report a median increase in the return on assets of 21.5 percent. Much of this gain seems to arise out of cutbacks in unproductive capital investments, because the median reduction in capital expenditures of these firms is 35.5 percent.

Of course, we must consider that the evidence presented is consistent with a number of different hypotheses. For instance, it is possible that the management itself changes at these firms and that the change of management rather than the additional debt leads to higher investment returns.

## 7.12. Debt as a Disciplining Mechanism

Assume that you buy into the argument that debt adds discipline to management. Which of the following types of companies will most benefit from debt adding this discipline? Conservatively financed, privately owned businesses

Conservatively financed, publicly traded companies with a wide and diverse stock holding

Conservatively financed, publicly traded companies, with an activist and primarily institutional holding.

(By "conservatively financed," we mean primarily with equity.)

<sup>&</sup>lt;sup>23</sup> Palepu, K. G., 1990, Consequences of Leveraged Buyouts, Journal of Financial Economics, v26, 247-262.

<sup>&</sup>lt;sup>24</sup> See Kaplan, S.N.,1989, Campeau's Acquisition of Federated: Value Destroyed or Value Added, Journal of Financial Economics, v25, 191-212; Smith, A.J., 1990, Corporate Ownership Structure and Performance: The Case of Management Buyouts, Journal of Financial Economics, v27, 143-164.

<sup>&</sup>lt;sup>25</sup>Denis, David J. and Diane K. Denis. Leveraged Recaps In The Curbing Of Corporate Overinvestment, Journal of Applied Corporate Finance, 1993, v6(1), 60-71.

#### The Costs of Debt

As any borrower will attest, debt certainly has disadvantages. In particular, borrowing money can expose the firm to default and eventual liquidation, increase the agency problems arising from the conflict between the interests of equity investors and lenders, and reduce the flexibility of the firm to take actions now or in the future.

#### 1. Debt Increases Expected Bankruptcy Costs

The primary concern when borrowing money is the increase in expected bankruptcy costs that typically follows. The expected bankruptcy cost can be written as a product of the probability of bankruptcy and the direct and indirect costs of bankruptcy.

#### The Probability of Bankruptcy

The *probability of bankruptcy* is the likelihood that a firm's cash flows will be insufficient to meet its promised debt obligations (interest or principal). Although such a failure does not automatically imply bankruptcy, it does trigger default, with all its negative consequences. Using this definition, the probability of bankruptcy should be a function of both the size of the operating cashflows of the firm – larger cashflows should reduce the likelihood of default – and the volatiltty in these cashflows – more volatile cashflows should resulty in a higher probability of bankruptcy.

Accordingly, the probability of bankruptcy increases marginally for all firms as they borrow more money, irrespective of how large their cash flows might be, and the increase should be greater for firms in riskier businesses.

#### The Cost of Bankruptcy

The cost of going bankrupt is neither obvious nor easily quantified. It is true that bankruptcy is a disaster for all involved in the firm—lenders often get a fraction of what they are owed, and equity investors get nothing—but the overall cost of bankruptcy includes the indirect costs on operations of being perceived as having high default risk.

#### a. Direct Costs

The direct, or deadweight, cost of bankruptcy is that which is incurred in terms of cash outflows at the time of bankruptcy. These costs include the legal and administrative

costs of a bankruptcy, as well as the present value effects of delays in paying out the cash flows. In a widely quoted study of railroad bankruptcies in the 1970s, Warner estimated the legal and administrative costs of eleven railroads to be on average 5.3 percent of the value of the assets at the time of the bankruptcy. He also estimated that it took, on average, thirteen years before the railroads were reorganized and released from the bankruptcy costs.<sup>26</sup> These costs, although certainly not negligible, are not overwhelming, especially in light of two additional factors. First, the direct cost as a percentage of the value of the assets decreases to 1.4 percent if the asset value is computed five years before the bankruptcy. Second, railroads in general are likely to have higher bankruptcy costs than other companies because of the nature of their assets (real estate and fixed equipment).

#### b. Indirect Costs

If the only costs of bankruptcy were the direct costs, the low leverage maintained by many firms would be puzzling. There are, however, much larger costs associated with taking on debt and increasing default risk, which arise prior to the bankruptcy, largely as a consequence of the perception that a firm is in financial trouble. The first is the perception on the part of the customers that the firm is in trouble. When this happens, customers may stop buying the product or service because of the fear that the company will go out of business. In 1980, for example, when car buyers believed that Chrysler was on the verge of bankruptcy, they chose to buy from Ford and GM, largely because they were concerned about receiving service and parts for their cars after their purchases. Similarly, in the late 1980s, when Continental Airlines found itself in financial trouble, business travelers switched to other airlines because they were unsure about whether they would be able to accumulate and use their frequent-flier miles on the airline. The second indirect cost is the stricter terms suppliers start demanding to protect themselves against the possibility of default, leading to an increase in working capital and a decrease in cash flows. The third cost is the difficulty the firm may experience trying to raise fresh capital for its projects—both debt and equity investors are reluctant to take the risk, leading to capital rationing constraints and the rejection of good projects.

<sup>&</sup>lt;sup>26</sup> Warner, J.N., 1977, *Bankruptcy Costs: Some Evidence*, Journal of Finance, v32, 337-347.

Given this reasoning, the indirect costs of bankruptcy are likely to be higher for the following types of firms:<sup>27</sup>

- *Firms that sell durable products with long lives that require replacement parts and service*: Thus, a personal computer manufacturer would have higher indirect costs associated with bankruptcy than would a grocery store.
- *Firms that provide goods or services for which quality is an important attribute but is difficult to determine in advance*: Because the quality cannot be determined easily in advance, the reputation of the firm plays a significant role in whether the customer will buy the product in the first place. For instance, the perception that an airline is in financial trouble may scare away customers who worry that the planes belonging to the airline will not be maintained.
- Firms producing products whose value to customers depends on the services and complementary products supplied by independent companies: Returning to the example of personal computers, a computer system is valuable only insofar as there is software available to run on it. If the firm manufacturing the computers is perceived to be in trouble, it is entirely possible that the independent suppliers that produce the software might stop providing it. Thus, if Apple Computers gets into financial trouble, many software manufacturers might stop producing software for its machines, leading to an erosion in its potential market.
- *Firms that sell products that require continuous service and support from the manufacturer*: A manufacturer of copying machines, for which constant service seems to be a necessary operating characteristic, would be affected more adversely by the perception of default risk than would a furniture manufacturer, for example.

#### Implications for Optimal Capital Structure

If the expected bankruptcy cost is indeed the product of the probability of bankruptcy and the direct and indirect bankruptcy cost, interesting and testable implications emerge for capital structure decisions.

<sup>&</sup>lt;sup>27</sup> See Shapiro, A., 1989, *Modern Corporate Finance*, Macmillan, New York; Titman, S., 1984, *The Effect of Capital Structure on a Firm's Liquidation Decision*, Journal of Financial Economics, v13, 1371-51.

- Firms operating in businesses with volatile earnings and cash flows should use debt less than otherwise similar firms with stable cash flows. For instance, regulated utilities in the United States have high leverage because the regulation and the monopolistic nature of their businesses result in stable earnings and cash flows. At the other extreme, toy-manufacturing firms, such as Mattel, can have large shifts in income from one year to another, based on the commercial success or failure of a single toy.<sup>28</sup> These firms should use leverage far less in meeting their funding needs.
- If firms can structure their debt in such a way that the cash flows on the debt increase and decrease with their operating cash flows, they can afford to borrow more. This is because the probability of default is greatest when operating cash flows decrease and the concurrent reduction in debt cash flows makes the default risk lower. Commodity companies, whose operating cash flows increase and decrease with commodity prices, may be able to use more debt if the debt payments are linked to commodity prices. Similarly, a company whose operating cash flows increase as interest rates (and inflation) go up and decrease when interest rates go down may be able to use more debt if the debt has a floating rate feature.
- If an external entity provides protection against bankruptcy, by providing either insurance or bailouts, firms will tend to borrow more. To illustrate, the deposit insurance offered by the FSLIC and the FDIC enables savings and loans and banks to maintain higher leverage than they otherwise could. Although one can argue for this insurance on the grounds of preserving the integrity of the financial system, undercharging for the insurance will accentuate this tendency and induce high-risk firms to take on too much debt, letting taxpayers bear the cost. Similarly, governments that step in and regularly bail out firms on social grounds (e.g., to save jobs) will encourage all firms to overuse debt.
- Because the direct bankruptcy costs are higher, when the assets of the firm are not easily divisible and marketable, firms with assets that can be easily divided and sold should be able to borrow more than firms with assets that do not share these features. Thus, a firm, such as Weyerhaeuser, whose value comes from its real estate holdings

<sup>&</sup>lt;sup>28</sup>In years past, a single group of toys, such as the Teenage Mutant Ninja Turtles or the Power Rangers,

should be able to borrow more money than a firm such as Coca-Cola, which derives a great deal of its value from its brand name.

• Firms that produce products that require long-term servicing and support generally should have lower leverage than firms whose products do not share this feature, as discussed before.

## 7.13. Debt and Bankruptcy

Rank the following companies on the magnitude of bankruptcy costs from most to least, taking into account both explicit and implicit costs:

A grocery store An airplane manufacturer

High-technology company

Explain.

There is a data set online that summarizes variances in operating earnings by sector.

#### 2. Debt Creates Agency Costs

Equity investors, who receive a residual claim on the cash flows, tend to favor actions that increase the value of their holdings, even if that means increasing the risk that the bondholders (who have a fixed claim on the cash flows) will not receive their promised payments. Bondholders, on the other hand, want to preserve and increase the security of their claims. Because the equity investors generally control the firm's management and decision making, their interests will dominate bondholder interests unless bondholders take some protective action. By borrowing money, a firm exposes itself to this conflict and its negative consequences and it pays the price in terms of both higher interest rates and a loss of freedom in decision making.

The conflict between bondholder and stockholder interests appears in all three aspects of corporate finance: (1) deciding what projects to take (making investment decisions),

could account for a substantial proportion of a major toy manufacturer's profits.

(2) choosing how to finance these projects, and (3) determining how much to pay out as dividends:

- *Risky Projects*: In the section on investment analysis, we argued that a project that earn a return that exceed the hurdle rate, adjusted to reflect the risk of the project, should be accepted and will increase firm value. The caveat, however, is that bondholders may be hurt if the firm accepts some of these projects. Bondholders lend money to the firm with the expectation that the projects accepted will have a certain risk level, and they set the interest rate on the bonds accordingly. If the firm chooses projects that are riskier than expected, however, bondholders will lose on their existing holdings because the price of the holdings will decrease to reflect the higher risk.
- *Subsequent Financing*: The conflict between stockholder and bondholder interests also arises when new projects have to be financed. The equity investors in a firm may favor new debt, using the assets of the firm as security and giving the new lenders prior claims over existing lenders. Such actions will reduce the interest rate on the new debt. The existing lenders in a firm obviously do not want to give new lenders priority over their claims, because it makes the existing debt riskier (and less valuable).
- *Dividends and Stock Repurchases*: Dividend payments and equity repurchases also divide stockholders and bondholders. Consider a firm that has built up a large cash reserve but has very few good projects available. The stockholders in this firm may benefit if the cash is paid out as a dividend or used to repurchase stock. The bondholders, on the other hand, will prefer that the firm retain the cash, because it can be used to make payments on the debt, reducing default risk. It should come as no surprise that stockholders, if not constrained, will pay the dividends or buy back stock, overriding bondholder concerns. In some cases, the payments are large and can increase the default risk of the firm dramatically.

The potential for disagreement between stockholders and bondholders can show up in as real costs in two ways:

- a. If bondholders believe there is a significant chance that stockholder actions might make them worse off, they can build this expectation into bond prices by demanding much higher interest rates on debt.
- b. If bondholders can protect themselves against such actions by writing in restrictive covenants, two costs follow:
  - the direct cost of monitoring the covenants, which increases as the covenants become more detailed and restrictive.
  - the indirect cost of lost investments, because the firm is not able to take certain projects, use certain types of financing, or change its payout; this cost will also increase as the covenants becomes more restrictive.

As firms borrow more and expose themselves to greater agency costs, these costs will also increase.

Because agency costs can be substantial, two implications relating to optimal capital structure follow. First, the agency cost arising from **risk shifting** is likely to be greatest in firms whose investments cannot be easily observed and monitored. For example, a lender to a firm that invests in real estate is less exposed to agency cost than is a lender to a firm that invests in people (consulting, for example) or intangible assets (as is the case with technology firms). Consequently, it is not surprising that manufacturing companies and railroads, which invest in substantial real assets, have much higher debt ratios than service companies. Second, the agency cost associated with monitoring management actions and second-guessing investment decisions is likely to be largest for firms whose projects are long term, follow unpredictable paths, and may take years to come to fruition. Pharmaceutical companies in the United States, for example, which often take on research projects that may take years to yield commercial products, have historically maintained low debt ratios, even though their cash flows would support more debt.

## **7**.14. **Risk Shifting and Bondholders**

It is often argued that bondholders who plan to hold their bonds until maturity and collect the coupons and the face value are not affected by risk shifting that occurs after they buy the bonds, because the effect is only on market value. Do you agree? Yes No Explain.

#### 3. Using Up Excess Debt Capacity Reduces Financial Flexibility

As noted earlier, one of the by-products of the conflict between stockholders and bondholders is the introduction of strict bond covenants that reduce the flexibility of firms to make investment, financing, or dividend decisions. It can be argued that this is part of a much greater loss of flexibility arising from taking on debt. One of the reasons firms do not use their available debt capacity is that they like to preserve it for a rainy day, when they might need the debt to meet funding needs or specific contingencies. Firms that borrow to *Financial Flexibility:* The capacity of firms to meet any unforeseen contingencies that may arise (such as recessions and sales downturns) and take advantage of unanticipated opportunities (such as great projects), using the funds they have on hand and any excess debt capacity that they might have nurtured.

capacity lose this flexibility and have no fallback funding if they get into trouble.

Firms value **financial flexibility** for two reasons. First, the value of the firm may be maximized by preserving some flexibility to take on future projects as they arise. Second, flexibility provides managers with more breathing room and more power, and it protects them from the monitoring that comes with debt. Thus, although the argument for maintaining flexibility in the interests of the firm is based on sound principles, it is sometimes used as camouflage by managers pursuing their own interests. There is also a trade-off between not maintaining enough flexibility (because a firm has too much debt) and having too much flexibility (by not borrowing enough).

So, how best can we value financial flexibility? If flexibility is needed to allow firms to take advantage of unforeseen investment opportunities, its value should ultimately be derived from two variables. The first is access to capital markets. After all, firms that have unlimited access to capital markets will not need to maintain excess debt capacity because they can raise funds as needed for new investments. Smaller firms and those in emerging markets, on the other hand, should value financial flexibility more. The second is the potential for excess returns on new investments. If a firm operates in a mature business where new investments, unpredictable though they might be, earn the cost of capital, there is no value to maintaining flexibility. Alternatively, a firm that operates in a volatile business with high excess returns should attach a much higher value to financial flexibility.

## 7.15. Value of Flexibility and Firm Characteristics

Both Ford and Microsoft have huge cash balances (as a percent of firm value); assume that you are a stockholder in both firms. The management of both firms claims to hold the cash because they need the flexibility. Which of the two managements are you more likely to accept this argument from?

- a. Microsoft's management
- b. Ford's management

#### Explain.

#### The Trade-Off in a Balance Sheet Format

Bringing together the benefits and the costs of debt, we can present the trade-off in a balance sheet format in Table 7.2:

Advantages of Borrowing	Disadvantages of Borrowing		
<i>1. Tax Benefit</i> : Higher tax rates $\rightarrow$ Higher	1. Bankruptcy Cost: Higher business risk		
tax benefit	and bankruptcy cost $\rightarrow$ Higher cost		
2. Added Discipline: Greater the separation	2. Agency Cost: Greater the separation		
between managers and stockholders $\rightarrow$	between stockholders and lenders $\rightarrow$		
Greater the benefit	Higher cost		
	3. Loss of Future Financing Flexibility:		
	Greater the uncertainty about future		
	financing needs $\rightarrow$ Higher cost		

Table 7.2: Trade-Off on Debt versus Equity

Overall, if the marginal benefits of borrowing exceed the marginal costs, the firm should borrow money. Otherwise, it should use equity.

What do firms consider when they make capital structure decisions? To answer this question, Pinegar and Wilbricht surveyed financial managers at 176 firms in the United States.<sup>29</sup> They concluded that the financial principles listed in Table 7.3 determine capital structure decisions, in the order of importance in which they were given.

Planning Principle by Order of Importance	Percentage of Responses Within Each Rank <sup>a</sup>						
	Unimportant	2	3	4	Important	Not Ranked	Mean <sup>t</sup>
1. Maintaining financial flexibility	0.6	0.0	4.5	33.0	61.4	0.6	4.55
2. Ensuring long-term survivability	4.0	1.7	6.8	10.8	76.7	0.0	4.55
3. Maintaining a predictable source of funds	1.7	2.8 •	20.5	39.2	35.8	0.0	4.05
<ol><li>Maximizing security prices</li></ol>	3.4	4.5	19.3	33.5	37.5	1.7	3.99
5. Maintaining financial inde- pendence	3.4	4.5	22.2	27.3	4().9	1.7	3.99
6. Maintaining a high debt rating	2.3	9.1	32.4	43.2	13.1	0.0	3.56
7. Maintaining comparability with other firms in the industry	15.9	36.9	33.0	10.8	2.8	0.6	2.47

Table 7.3: Financial Principles Determining Capital Structure Decisions

The foremost principles the survey participants identified were maintaining financial flexibility and ensuring long-term survivability (which can be construed as avoiding bankruptcy). Surprisingly few managers attached much importance to maintaining comparability with other firms in their industries or maintaining a high debt rating.

# Illustration 7.4: Evaluating the Debt Trade-Off: Disney, Aracruz, Tata Chemicals and Bookscape

In Table 7.4, we summarize our views on the potential benefits and costs to using debt, instead of equity, at Disney, Aracruz, and Tata Chemicals.

Item	Disney	Aracruz	Tata Chemicals
Tax benefits	Significant. The firm has a	Significant. The firm has a	Significant. The firm has a
	marginal tax rate of 38%.	marginal tax rate of 34%,	33.99% tax rates It does
	It does have large	as well. It does not have	have significant non-
	depreciation tax shields.	very much in noninterest	interest tax shields in the
		tax shields.	form of depreciation.
Added discipline	Benefits will be high,	Benefits are smaller,	Since the Tata family runs
	because managers are not	because the voting shares	the firm, the benefits from
	large stockholders.	are closely held by	added discipline are small.
		insiders.	
Bankruptcy costs	Movie and broadcasting	Variability in paper prices	Firm is mature, with fairly
	businesses have volatile	makes earnings volatile.	stable earnings and cash
	earnings. Direct costs of	Direct and indirect costs	flows from its chemicals
	bankruptcy are likely to be	of bankruptcy likely to be	and fertilizer business.

Table 7.4: The Debt Equity Trade-Off: Disney, Aracruz. and Tata Chemicals

<sup>&</sup>lt;sup>29</sup> Pinegar, J. Michael and Lisa Wilbricht. 1989, *What Managers Think Of Capital Structure Theory: A Survey*, Financial Management, v18(4), 82-91

	small, but indirect costs can be significant.	moderate, since assets are marketable (timber, paper plants)	Indirect bankruptcy costs should be low, since physical assets are marketable.
Agency costs	High. Although theme park assets are tangible and fairly liquid, is much more difficult to monitor movie and broadcasting businesses.	Low. Assets are tangible and liquid.	Biggest concern is that debt may be utilized in other (riskier) Tata companies.
Flexibility needs	Low in theme park business but high in media businesses because technological change makes future investment uncertain.		Low. Tata Chemicals is a mature company with established reinvestment needs.

Based on this analysis, qualitative though it might be, we would argue that all three firms could benefit from borrowing, as long as the borrowing does not push it below an acceptable default risk threshold. For Aracruz and Tata Chemicals, the overlay of country risk (India and Brazil are both emerging markets, with substantial growth opportunities but significant risk) will be a factor that holds back additional debt, since a market shock can not only cause capital markets to shut down but also make earnings more volatile.

For Bookscape, the trade off is more personal, since the owner is fully invested in the company and is not diversified. Consequently, while the tax benefits of debt remain high, bankruptcy costs are likely to loom larger in the decision of whether to borrow money. If the firm defaults on its debt, the owner's entire wealth would be at risk, as would his reputation. While this will serve to keep debt in check, it has to be weighed off against the absence of alternative ways of raising financing. As a private business, Bookscape cannot easily raise fresh equity and may be entirely dependent on bank loans for external financing.

#### No Optimal Capital Structure

We have just argued that debt has advantages, relative to equity, as well as disadvantages. Will trading off the costs and benefits of debt yield an optimal mix of debt and equity for a firm? In this section, we will present arguments that it will not and the resulting conclusion that there is no such optimal mix. The seeds of this argument were

sown in one of the most influential papers ever written in corporate finance, containing one of corporate finance's best-known theorems, the *Modigliani-Miller theorem*. <sup>30</sup>

When they first looked at the question of whether there is an optimal capital structure, Miller and Modigliani drew their conclusions in a world void of taxes, transaction costs, and the possibility of default. Based on these assumptions, they concluded that the value of a firm was unaffected by its leverage and that investment and financing decisions could be separated. Their conclusion can be confirmed in several ways; we present two in this section. We will also present a more complex argument for why there should be no optimal capital structure even in a world with taxes, made by Miller almost two decades later.

#### The Irrelevance of Debt in a Tax-Free World

In their initial work, Modigliani and Miller made three significant assumptions about the markets in which their firms operated. First, they assumed there were no taxes. Second, they assumed firms could raise external financing from debt or equity, with no issuance costs. Third, they assumed there were no costs—direct or indirect—associated with bankruptcy. Finally, they operated in an environment in which there were no agency costs; managers acted to maximize stockholder wealth, and bondholders did not have to worry about stockholders expropriating wealth with investment, financing, or dividend decisions.

In such an environment, reverting back to the trade-off that we summarized in Table 7.2 it is quite clear that all the advantages and disadvantages disappear, leaving debt with no marginal benefits and no costs. In Table 7.5 we modify Table 7.2 to reflect the assumptions just listed

Advantages of Debt	Disadvantages of Debt
1. Tax Benefit: Zero, because there are no	1. Bankruptcy Cost: Zero, because there
taxes.	are no bankruptcy costs.

Table 7.5: The Trade-Off on Debt: No Taxes, Default Risk, and Agency Costs

<sup>&</sup>lt;sup>30</sup> Modigliani, F. and M. Miller, 1958, *The Cost of Capital, Corporation Finance and the Theory of Investment*, American Economic Review, v48, 261-297.

2. Added Discipline: Zero, because	2. Agency Cost: Zero, because
managers already maximize stockholder	bondholders are fully protected from
wealth.	wealth transfer.
	3. Loss of Future Financing Flexibility:
	Not costly, because firms can raise
	external financing costlessly.

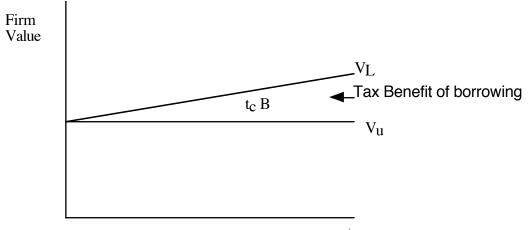
Debt creates neither benefits nor costs and thus has a neutral effect on value. In such an environment, the capital structure decision becomes irrelevant.

In a later study, Miller and Modigliani preserved this environment but made one change, allowing for a tax benefit for debt. In this scenario, where debt continues to have no costs, the optimal debt ratio for a firm is 100 percent debt. In fact, in such an environment the value of the firm increases by the present value of the tax savings for interest payments.

```
Value of Levered Firm = Value of Unlevered Firm + t_c B
```

where  $t_c$  is the corporate tax rate and *B* is the dollar borrowing. Note that the second term in this valuation is the present value of the interest tax savings from debt, treated as a perpetuity. Figure 7.8 graphs the value of a firm with just the tax benefit from debt.

Figure 7.8: Value of Levered Firm: MM with Taxes



Debt (\$ B)

Miller and Modigliani presented an alternative proof of the irrelevance of leverage, based on the idea that debt does not affect the underlying operating cash flows of the firm in the absence of taxes. Consider two firms that have the same cash flow (X) from operations. Firm A is an all-equity firm, whereas firm B has both equity and debt. The interest rate on debt is *r*. Assume you are an investor and you buy a fraction ( $\alpha$ ) of the equity in firm A, and the same fraction of both the equity and debt of firm B. Table 7.6 summarizes the cash flows that you will receive in the next period.

	Firm A	Firm B		
Type of firm	All-equity firm $(V_u = E)$	Has some equity and debt		
Actions now	Investor buys a fraction $\alpha$	Investor buys a fraction a of		
	of the firm $(\alpha V_u)$	both equity and debt of the		
		firm; $\alpha E_L + \alpha D_L$		
Next period	Investor receives a	Investor receives the		
	fraction $\alpha$ of the cash flow	following: $\alpha(X - rD_L) + \alpha rD_L$		
	$(\alpha X)$	$= \alpha X$		

Table 7.6: Cash Flows to Investor from Levered and All-Equity Firm

Because you receive the same total cash flow in both firms, the price you will pay for either firm has to be the same. This equivalence in values of the two firms implies that leverage does not affect the value of a firm. Note that this proof works only if the firm does not receive a tax benefit from debt; a tax benefit would give firm B a higher cash flow than firm A.

#### The Irrelevance of Debt with Taxes

It is clear, in the Miller-Modigliani model, that when taxes are introduced into the model, debt does affect value. In fact, introducing both taxes and bankruptcy costs into the model creates a trade-off, where the financing mix of a firm affects value, and there is an optimal mix. In an address in 1979, however, Miller argued that the debt irrelevance theorem could apply even in the presence of corporate taxes if taxes on the equity and interest income individuals receive from firms were included in the analysis.<sup>31</sup>

To demonstrate the Miller proof of irrelevance, assume that investors face a tax rate of  $t_d$  on interest income and a tax rate of  $t_e$  on equity income. Assume also that the

<sup>&</sup>lt;sup>31</sup> Miller, M., 1977, Debt and Taxes, Journal of Finance, v32, 261-275.

firm pays an interest rate of r on debt and faces a corporate tax rate of  $t_c$ . The after-tax return to the investor from owning debt can then be written as:

After-Tax Return from Owning Debt =  $r(1 - t_d)$ 

The after-tax return to the investor from owning equity can also be estimated. Because cash flows to equity have to be paid out of after-tax cash flows, equity income is taxed twice—once at the corporate level and once at the equity level:

After-Tax Return from Owning Equity =  $k_e(1 - t_c)(1 - t_e)$ 

The returns to equity can take two forms—dividends or capital gains; the equity tax rate is a blend of the tax rates on both. In such a scenario, Miller noted that the tax benefit of debt, relative to equity becomes smaller, because both debt and equity now get taxed, at least at the level of the individual investor.

Tax Benefit of Debt, Relative to Equity =  $\{1 - (1 - t_c)(1 - t_e)\}/(1 - t_d)$ With this relative tax benefit, the value of the firm, with leverage, can be written as:

$$V_L = V_u + [1 - (1 - t_c)(1 - t_e)/(1 - t_d)]B$$

where

 $V_L$  is the value of the firm with leverage,

 $V_U$  is the value of the firm without leverage,

*B* is the dollar debt.

With this expanded equation, which includes both personal and corporate taxes, there are several possible scenarios:

a. *Personal tax rates on both equity and dividend income are zero*: if we ignore personal taxes, this equation compresses to the original equation for the value of a levered firm, in a world with taxes but no bankruptcy costs:

$$V_L = V_u + t_c B$$

b. *The personal tax rate on equity is the same as the tax rate on debt*: If this were the case, the result is the same as the original one—the value of the firm increases with more debt.

$$V_L = V_u + t_c B$$

c. *The tax rate on debt is higher than the tax rate on equity*: In such a case, the differences in the individual investor tax rates may more than compensate for the double taxation of equity cash flows. To illustrate, assume that the tax rate on ordinary income is 70 percent, the tax rate on capital gains on stock is 28 percent, and the tax rate on corporations is 35 percent. In such a case, the tax liabilities for debt and equity can be calculated for a firm that pays no dividend as follows:

Tax Rate on Debt Income = 70%

Tax Rate on Equity Income = 1 - (1 - 0.35)(1 - 0.28) = 0.532 or 53.2%

This is a plausible scenario, especially considering tax law in the United States until the early 1980s. In this scenario, debt creates a tax disadvantage to investors.

d. *The tax rate on equity income is just low enough to compensate for the double taxation*: In this case, we are back to the original debt irrelevance theorem.

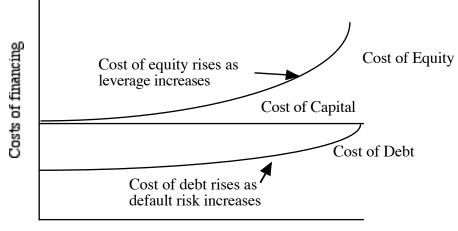
 $(1 - t_d) = (1 - t_c)(1 - t_e) \dots$  Debt is irrelevant

Miller's analysis brought investor tax rates into the analysis for the first time and provided some insight into the role of investor tax preferences on a firm's capital structure. As Miller himself notes, however, this analysis does not reestablish the irrelevance of debt under all circumstances; rather, it opens up the possibility that debt could still be irrelevant despite its tax advantages.

#### The Consequences of Debt Irrelevance

If the financing decision is irrelevant, as proposed by Miller and Modigliani, corporate financial analysis is simplified in a number of ways. The cost of capital, which is the weighted average of the cost of debt and the cost of equity, is unaffected by changes in the proportions of debt and equity. This might seem unreasonable, especially because the cost of debt is much lower than the cost of equity. In the Miller-Modigliani world, however, any benefits incurred by substituting cheaper debt for more expensive equity are offset by increases in both their costs, as shown in Figure 7.9.

Figure 7.9: Cost of Capital in the MM World



## Debt Ratio

The value of the firm is also unaffected by the amount of leverage it has. Thus, if the firm is valued as an all-equity entity, its value will remain unchanged if it is valued with any other debt ratio. (This actually follows from the implication that the cost of capital is unaffected by changes in leverage and from the assumption that the operating cash flows are determined by investment decisions rather than financing decisions.)

Finally, the investment decision can be made independently of the financing decision. In other words, if a project is a bad project when evaluated as an all-equity project, it will remain so using any other financing mix.

## The Contribution of the Miller-Modigliani Theorem

It is unlikely that capital structure is irrelevant in the real world, given the tax preferences for debt and existence of default risk. In spite of this, Miller and Modigliani were pioneers in moving capital structure analysis from an environment in which firms picked their debt ratios based on comparable firms and management preferences, to one that recognized the trade-offs. They also drew attention to the impact of good investment decisions on firm value. To be more precise, a firm that invests in poor projects cannot hope to recoup the lost value by making better financing decisions; a firm that takes good projects will succeed in creating value, even if it uses the wrong financing mix. Finally, although the concept of a world with no taxes, default risk, or agency problems may seem a little far-fetched, there are some environments in which the description might hold. Assume, for instance, that the U.S. government decides to encourage small businesses to invest in urban areas by relieving them of their tax burden and providing a back-up guarantee on loans (default protection). Firms that respond to these initiatives might find that their capital structure decisions do not affect their value.

Finally, surveys of financial managers indicate that in practice, they do not attach as much weight to the costs and benefits of debt as we do in theory. In the survey quoted earlier by Pinegar and Wilbricht, managers were asked to cite the most important inputs governing their financial decisions. Their responses are ranked in the order of the importance managers attached to them in Table 7.7.

	Percentage of Responses within Each Rank						
	Least Important				Most Important		
Inputs/assumptions by order of importance	1	2	3	4	5	Not Ranked	Mean
1. Projected cash flow from asset to be financed	1.7%	1.1%	9.7%	29.5%	58.0%	0.0%	4.41
2. Avoiding dilution of common equity's claims	2.8%	6.3%	18.2%	39.8%	33.0%	0.0%	3.94
3. Risk of asset to be financed	2.8%	6.3%	20.5%	36.9%	33.0%	0.6%	3.91
4. Restrictive covenants on senior securities	9.1%	9.7%	18.7%	35.2%	27.3%	0.0%	3.62
5. Avoiding mispricing of securities to be issued.	3.4%	10.8%	27.3%	39.8%	18.7%	0.0%	3.60
6. Corporate tax rate	4.0%	9.7%	29.5%	42.6%	13.1%	1.1%	3.52
7. Voting control	17.6%	10.8%	21.0%	31.2%	19.3%	0.0%	3.24
8. Depreciation & other tax shields	8.5%	17.6%	40.9%	24.4%	7.4%	1.1%	3.05
9. Correcting mispricing of securities	14.8%	27.8%	36.4%	14.2%	5.1%	1.7%	2.66
10. Personal tax rates of debt and equity holders	31.2%	34.1%	25.6%	8.0%	1.1%	0.0%	2.14
11. Bankruptcy costs	69.3%	13.1%	6.8%	4.0%	4.5%	2.3%	1.58

Table 7.7: Inputs into Capital Structure Decisions

Financial managers seem to weigh financial flexibility and potential dilution much more heavily than bankruptcy costs and taxes in their capital structure decisions.

## In Practice: The Dilution Bogey

The dilution effect refers to the possible decrease in earnings per share from any action that might lead to an increase in the number of shares outstanding. As evidenced in Table 7.7, managers (especially in the United States) weigh these potential dilution effects heavily in decisions on what type of financing to use and how to fund projects. Consider, for instance, the choice between raising equity using a rights issue, where the stock is issued at a price below the current market price, and a public issue of stock at the market price. The latter is a much more expensive option, from the perspective of investment banking fees and other costs, but is chosen nevertheless because it results in fewer shares being issued (to raise the same amount of funds). The fear of dilution is misplaced for the following reasons:

- 1. Investors measure their returns in terms of total return and not just in terms of stock price. Although the stock price will go down more after a rights issue, each investor will be compensated adequately for the price drop (by either receiving more shares or by being able to sell their rights to other investors). In fact, if the transactions costs are considered, stockholders will be better off after a rights issue than after an equivalent public issue of stock.
- 2. Although the earnings per share will always drop in the immediate aftermath of a new stock issue, the stock price will not necessarily follow suit. In particular, if the stock issue is used to finance a good project (i.e., a project with a positive net present value), the increase in value should be greater than the increase in the number of shares, leading to a higher stock price.

Ultimately, the measure of whether a company should issue stock to finance a project should depend on the quality of the investment. Firms that dilute their stockholdings to take good investments are choosing the right course for their stockholders.

## There Is an Optimal Capital Structure

The counter to the Miller-Modigliani proposition is that the trade-offs on debt may work in favor of the firm (at least initially) and that borrowing money may lower the cost of capital and increase firm value. We will examine the mechanics of putting this argument into practice in the next chapter; here, we make a case for the existence of an optimal capital structure and look at some of the empirical evidence for and against it.

## The Case for an Optimal Capital Structure

If the debt decision involves a trade-off between the benefits of debt (tax benefits and added discipline) and the costs of debt (bankruptcy costs, agency costs, and lost flexibility), it can be argued that the marginal benefits will be offset by the marginal costs *only in exceptional cases* and not always then (as argued by Miller and Modigliani). In fact, under most circumstances, the marginal benefits will either exceed the marginal costs (in which case debt is good and will increase firm value) or fall short of marginal costs (in which case equity is better). Accordingly, there is an optimal capital structure for most firms at which firm value is maximized.

Of course, it is always possible that managers may be operating under an illusion that capital structure decisions matter when the reality might be otherwise. Consequently, we examine some of the empirical evidence to see if it is consistent with the theory of an optimal mix of debt and equity.

## **Empirical Evidence**

The question of whether there is an optimal capital structure can be answered in a number of ways. The first is to see if differences in capital structure across firms can be explained systematically by differences in the variables driving the trade-offs. Other things remaining equal, we would expect to see relationships listed in Table 7.8.

Variable	Effect on Debt Ratios		
Marginal tax rate	As marginal tax rates increase, debt ratios		
	increase.		
Separation of ownership and management	The greater the separation of ownership		
	and management, the higher the debt ratio.		
Variability in operating cash Flows	As operating cash flows become more		
	variable, the bankruptcy risk increases,		

Table 7.8 Debt Ratios and Fundamentals

	resulting in lower debt ratios.
Debt holders' difficulty in monitoring firm	The more difficult it is to monitor the
actions, investments, and performance	actions taken by a firm, the lower the
	optimal debt ratio.
Need for flexibility	The greater the need for decision making
	flexibility in future periods, the lower the
	optimal debt ratio.

This may seem like a relatively simple test to run, but keeping all other things equal in the real world is often close to impossible. In spite of this limitation, attempts to see if the direction of the relationship is consistent with the theory have produced mixed results.

Bradley, Jarrell, and Kim analyzed whether differences in debt ratios can be explained by proxies for the variables involved in the capital structure trade-off.<sup>32</sup> They noted that the debt ratio is:

- *negatively correlated with the volatility in annual operating earnings*, as predicted by the bankruptcy cost component of the optimal capital structure trade-off.
- *positively related to the level of nondebt tax shields*, which is counter to the tax hypothesis, which argues that firms with large nondebt tax shields should be less inclined to use debt.
- *negatively related to advertising and R&D expenses used as a proxy for agency costs;* this is consistent with optimal capital structure theory.

Others who have attempted to examine whether cross-sectional differences in capital structure are consistent with the theory have come to contradictory conclusions.

An alternate test of the optimal capital structure hypothesis is to examine the stock price reaction to actions taken by firms either to increase or decrease leverage. In evaluating the price response, we have to make some assumptions about the motivation of the firms making these changes. If we assume that firms are rational and that they make these changes to get closer to their optimal, both leverage-increasing and - decreasing actions should be accompanied by positive excess returns, at least on average. Smith (1986) noted that the evidence is *not* consistent with an optimal capital structure

hypothesis, however, because leverage-increasing actions seem to be accompanied by positive excess returns whereas leverage-reducing actions seem to be followed by negative returns.<sup>33</sup> The only way to reconcile this tendency with an optimal capital structure argument is by assuming that managerial incentives (desire for stability and flexibility) keep leverage below optimal for most firms and that actions by firms to reduce leverage are seen as serving managerial interests rather than stockholder interests.



# The Debt Equity Trade off: A Behavioral Perspective

The trade off between the benefits of debt – tax advantages and added discipline – and the costs of debt – expected bankruptcy costs and agency costs- is not always done rationally. Managers bring to this trade off all of the behavioral characteristics that influence other corporate finance decisions. Several papers note that managers who are over confident in their abilities to deliver cash flows (and thus take negative NPV investments) also tend to borrow too much. Put another, they under estimate the bankruptcy costs of debt and over estimate its benefits.<sup>34</sup> The same over confidence, though, can reduce agency costs since over confident managers are less likely to divert funds away from the stated investments.<sup>35</sup>

How do we counter the tendency of firms with optimistic, over confident managers to borrow too much? The first line of defense has to be lenders. Historically, banks have played the role of the realistic pessimist, who sees the potential downside to the management's upside, restraining borrowing. However, the shift to corporate bonds has weakened this constraint. The second line of defense are the bond ratings agencies, especially for firms that borrow through corporate bonds. It is the role of ratings agencies to look past the hype and the sales pitches made by managers and to assess default risk realistically.

<sup>&</sup>lt;sup>32</sup> Bradley, M., G. Jarrell and E.H. Kim, 1984, *On the Existence of an Optimal Capital Structure: Theory and Evidence*, Journal of Finance, v39, 857-878.

<sup>&</sup>lt;sup>33</sup> Smith, C.W., 1986, *Investment Banking and the Capital Acquisition Process*, Journal of Financial Economics, v15, 3-29.

<sup>&</sup>lt;sup>34</sup> Fairchild, R. (2005b), "The effect of managerial overconfidence, asymmetric information, and moral hazard on capital structure decisions." ICFAI Journal of Behavioral Finance, vol II, no 4, 46- 68.

<sup>&</sup>lt;sup>35</sup> Hackbart, D., 2007, Managerial Trails and Capital Structure Decisions, Working paper, ssrn.com.

There are periods in history when both lines of defense crumble and lenders do not operate as restraints on managers. It is in these environments that we see firms collectively borrow too much at interest rates that do no adequately reflect the underlying default risk. Eventually, though, the bubble bursts, leaving bondholders, banks and the borrowing firms feeling the pain.

There is a data set online that summarizes debt ratios and averages by sector for the fundamental variables that should determine debt ratios.

# How Firms Choose Their Capital Structures

We have argued that firms should choose the mix of debt and equity by trading off the benefit of borrowing against the costs. There are, however, three alternative views of how firms choose a financing mix. The first is that the choice between debt and equity is determined by where a firm is in the growth life cycle. High-growth firms will tend to use debt less than more mature firms. The second is that firms choose their financing mix by looking at other firms in their business. The third view is that firms have strong preferences in for the kinds of financing they prefer to use, that is, a financing hierarchy, and that they deviate from these preferences only when they have no choice. We will argue that in each of these approaches, firms still implicitly make the trade-off between costs and benefits, though the assumptions needed for each approach to work are different.

### Financing Mix and a Firm's Life Cycle

Earlier in this chapter, we looked at how a firm's financing choices might change as it makes the transition from a start-up firm to a mature firm to final decline. We can also look at how a firm's financing mix changes over the same life cycle. Typically, startup firms and firms in rapid expansion use debt sparingly; in some cases, they use no debt at all. As the growth eases and as cash flows from existing investments become larger and more predictable, we see firms beginning to use debt. Debt ratios typically peak when firms are in mature growth. How does this empirical observation relate to our earlier discussion of the benefits and costs of debt? We argue that the behavior of firms at each stage in the life cycle is entirely consistent with making this trade-off. In the start-up and high-growth phases, the tax benefits to firms from using debt tend to be small or nonexistent because earnings from existing investments are low or negative. The owners of these firms are usually actively involved in the management of these firms, reducing the need for debt as a disciplinary mechanism.

On the other side of the ledger, the low and volatile earnings increase the expected bankruptcy costs. The absence of significant existing investments or assets and the magnitude of new investments makes lenders much more cautious about lending to the firm, increasing the agency costs; these costs show up as more stringent covenants or in higher interest rates on borrowing. As growth eases, the trade-off shifts in favor of debt. The tax benefits increase and expected bankruptcy costs decrease as earnings from existing investments become larger and more predictable. The firm develops both an asset base and a track record on earnings, which allows lenders to feel more protected when lending to the firm. As firms get larger, the separation between owners (stockholders) and managers tends to grow, and the benefits of using debt as a disciplinary mechanism increase. We have summarized the trade-off at each stage in the life cycle in Figure 7.10.

Figure 7.10: The Debt-Equity Trade off and Life Cycle

\$ Revenues/ Earnings	Stage 1 Start-up	Stage 2 Rapid Expansion	Stage 3 High Growth	Stage 4 Mature Growth	Stage 5 Decline Revenues Earnings
Tax Benefits	Zero, if losing money	Low, as earnings are limited	Increase, with earnings	High	High, but declining
Added Disceipline of Debt	Low, as owners run the firm	Low. Even if public, firm is closely held.	Increasing, as managers own less of firm	High. Managers are separated from owners	Declining, as firm does not take many new investments
Bamkruptcy Cost	Very high. Firm has no or negative earnings.	Very high. Earnings are low and volatile	High. Earnings are increasing but still volatile	Declining, as earnings from existing assets increase.	Low, but increases as existing projects end.
Agency Costs	has almost no	High. New nvestments are difficult to monitor	High. Lots of new investments and unstable risk.	Declining, as assets in place become a larger portion of firm.	Low. Firm takes few new investments
Need for Flexibility	looks for ways to	High. Expansion needs are large and inpredicatble	High. Expansion needs remain unpredictable	Low. Firm has low and more predictable investment needs.	Non-existent. Firm has no new investment needs.
Net Trade Off	Costs exceed benefits Minimal debt	Costs still likely o exceed benefits. Mostly equity	Debt starts yielding net benefits to the firm	Debt becomes a more attractive option.	Debt will provide benefits.

As with our earlier discussion of financing choices, there will be variations between firms in different businesses at each stage in the life cycle. For instance, a mature steel company may use far more debt than a mature pharmaceutical company because lenders feel more comfortable lending on a steel company's assets (that are tangible and easy to liquidate) than on a pharmaceutical company's assets (which might be patents and other assets that are difficult to liquidate). Similarly, we would expect a company like IBM to have a higher debt ratio than a firm like Microsoft at the same stage in the life cycle because Microsoft has large insider holdings, making the benefit of discipline that comes from debt much smaller.

## **Financing Mix Based on Comparable Firms**

Firms often try to use a financing mix similar to that used by other firms in their business. With this approach, Bookscape would use a low debt to capital ratio because

other book retailers have low debt ratios. Bell Atlantic, on the other hand, would use a high debt to capital ratio because other phone companies have high debt to capital ratios.

The empirical evidence about the way firms choose their debt ratios strongly supports the hypothesis that they tend not to stray too far from their sector averages. In fact, when we look at the determinants of the debt ratios of individual firms, the strongest determinant is the average debt ratio of the industries to which these firms belong. Some would view this approach to financing as contrary to the approach where we trade off the benefits of debt against the cost of debt, but we do not view it thus. If firms within a business or sector share common characteristics, it should not be surprising if they choose similar financing mixes. For instance, software firms have volatile earnings and high growth potential and choose low debt ratios. In contrast, phone companies have significant assets in place and high and stable earnings; they tend to use more debt in their financing. Thus, choosing a debt ratio similar to that of the industry in which you operate is appropriate, when firms in the industry are at the same stage in the life cycle and, on average, choose the right financing mix for that stage.

It can be dangerous to choose a debt ratio based on comparable firms under two scenarios. The first occurs when there are wide variations in growth potential and risk across companies within a sector. Then we would expect debt ratios to be different across firms. The second occurs when firms on average have too much or too little debt given their characteristics. This can happen when an entire sector changes. For instance, phone companies have historically had stable and large earnings because they have had monopoly power. As technology and deregulation breaks down this power, it is entirely possible that earnings will become more volatile and that these firms should carry a lot less debt than they do currently.

## **Following a Financing Hierarchy**

There is evidence that firms follow a *financing hierarchy*: retained earnings are the most preferred choice for financing, followed by debt, new equity, common, and preferred; convertible preferred is the least preferred choice. Going back again to the survey by Pinegar and Wilbricht (Table 7.9), managers were asked to rank six different sources of financing—internal equity, external equity, external debt, preferred stock, and hybrids (convertible debt and preferred stock)—from most preferred to least preferred.<sup>36</sup>

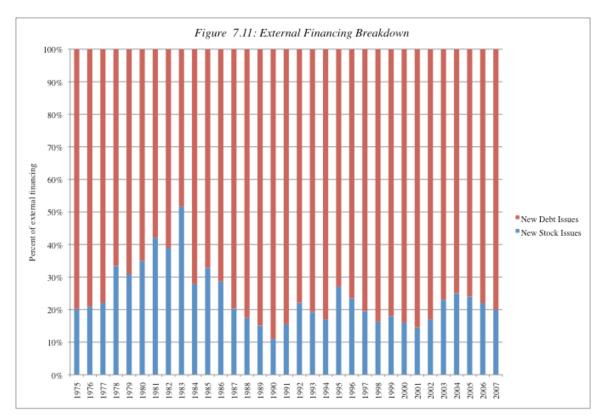
Table 7.9 Survey Results on Planning Principles

Ranking	Source	Planning Principle Cited
1	Retained earnings	None
2	Straight debt	Maximize security prices
3	Convertible debt	Cash flow and survivability
4	Common stock	Avoiding dilution
5	Straight preferred stock	Comparability
6	Convertible preferred	None
	stock	

One reason for this hierarchy is that managers value *flexibility and control*. To the extent that external financing reduces flexibility for future financing (especially if it is debt) and control (bonds have covenants; new equity attracts new stockholders into the company and may reduce insider holdings as a percentage of total holding), managers prefer retained earnings as a source of capital. Another reason is it costs nothing in terms of issuance costs to use retained earnings, whereas *it costs more* to use external debt and even more to use external equity.

The survey yielded some other interesting conclusions as well. External debt is strongly preferred over external equity as a way of raising funds. The percentages of external financing from debt and external equity between 1975 and 2007, issued by U.S. corporations, are shown in Figure 7.11 and bear out this preference.

<sup>&</sup>lt;sup>36</sup> Pinegar, J. Michael and Lisa Wilbricht. 1989, *What Managers Think Of Capital Structure Theory: A Survey*, Financial Management, v18(4), 82-91.



Source: Compustat.

Given a choice, firms would much rather use straight debt than convertible debt, even though the interest rate on convertible debt is much lower. Managers perhaps have a much better sense of the value of the conversion option than is recognized.

A firm's choices may say a great deal about its financial strength. Thus, the 1993 decisions by RJR Nabisco and GM to raise new funds through convertible preferred stock were seen by markets as an admission of their financial weakness. Not surprisingly, the financial market response to the issue of securities listed in Table 7.9 mirrors the preferences: The most negative responses are reserved for securities near the bottom of the list, the most positive (or at least the least negative) for those at the top of the list.

Why do firms have a financing hierarchy? In the discussion of financing choices so far, we have steered away from questions about how firms convey information to financial markets with their financing choices and how well the securities that the firms issue are priced. Firms know more about their future prospects than do the financial markets that they deal with; markets may under or overprice securities issued by firms. Myers and Majluf note that in the presence of this asymmetric information, firms that believe their securities are underpriced, given their future prospects, may be inclined to reject good projects rather than raise external financing. Alternatively, firms that believe their securities are overpriced are more likely to issue these securities, even if they have no projects available.<sup>37</sup> In this environment, the following implications emerge:

- Managers prefer retained earnings to external financing, because it allows them to consider projects on their merits, rather than depending on whether markets are pricing their securities correctly. It follows then that firms will be more inclined to retain earnings over and above their current investment requirements to finance future projects.
- When firms issue securities, markets will consider the issue a signal that these securities are overvalued. This signal is likely to be more negative for securities, such as stocks, where the asymmetry of information is greater, and smaller for securities, such as straight bonds, where the asymmetry is smaller. This would explain both the rankings in the financial hierarchy and the market reaction to these security issues.

# **7.16.** Value of Flexibility and Firm Characteristics

You are reading the *Wall Street Journal* and notice a tombstone ad for a company offering to sell convertible preferred stock. What would you hypothesize about the health of the company issuing these securities?

Nothing

Healthier than the average firm

In much more financial trouble than the average firm

## Conclusion

In this chapter, we laid the groundwork for analyzing a firm's optimal mix of debt and equity by laying out the benefits and the costs of borrowing money. In particular, we made the following points:

• We differentiated between debt and equity at a generic level by pointing out that any financing approach that results in contractual cash flows and has prior claims in the case of default, fixed maturity, and no voting rights is debt, whereas a financing

<sup>&</sup>lt;sup>37</sup> Myers, S.C. and N.S. Majluf, 1984, Corporate Financing and Investment Decisions when Firms have Information that Investors do not have, Journal of Financial Economics, v13, 187-221.

approach that provides for residual cash flows and has low or no priority in claims in the case of default, infinite life, and a lion's share of the control is equity.

- Although all firms, private as well as public, use both debt and equity, the choices in terms of financing and the type of financing used change as a firm progresses through the life cycle, with equity dominating at the earlier stages and debt as the firm matures.
- The primary benefit of debt is a tax benefit: Interest expenses are tax-deductible and cash flows to equity (dividends) are not. This benefit increases with the tax rate of the entity taking on the debt. A secondary benefit of debt is that it forces managers to be more disciplined in their choice of projects by increasing the costs of failure; a series of bad projects may create the possibility of defaulting on interest and principal payments.
- The primary cost of borrowing is an increase in the expected bankruptcy cost—the product of the probability of default and the cost of bankruptcy. The probability of default is greater for firms that have volatile cash flows. The cost of bankruptcy includes both the direct costs (legal and time value) of bankruptcy and the indirect costs (lost sales, tighter credit, and less access to capital). Borrowing money exposes the firm to the possibility of conflicts between stock and bondholders over investment, financing, and dividend decisions. The covenants that bondholders write into bond agreements to protect themselves against expropriation cost the firm in both monitoring costs and lost flexibility. The loss of financial flexibility that arises from borrowing money is more likely to be a problem for firms with substantial and unpredictable investment opportunities.
- In the special case where there are no tax benefits, default risk, or agency problems, the financing decision is irrelevant. This is known as the Miller-Modigliani theorem. In most cases, however, the trade-off between the benefits and costs of debt will result in an optimal capital structure whereby the value of the firm is maximized.
- Firms generally choose their financing mix in one of three ways—based on where they are in the life cycle, by looking at comparable firms, or by following a financing hierarchy where retained earnings is the most preferred option and convertible preferred stock the least.

## Live Case Study

## Analyzing a Firm's Current Financing Choices

**Objective** To examine a firm's current financing choices and to categorize them into debt (borrowings) and equity and to examine the trade-off between debt and equity for your firm.

## Key Questions

- Where and how does the firm get its current financing?
- Would these financing choices be classified as debt, equity, or hybrid securities?
- How large, in qualitative or quantitative terms, are the advantages to this company from using debt?
- How large, in qualitative or quantitative terms, are the disadvantages to this company from using debt?
- From the qualitative trade-off, does this firm look like it has too much or too little debt?

## Framework for Analysis

- Assessing Current Financing
  - 1.1. How does the firm raise equity?
    - a. If it is a publicly traded firm, it can raise equity from common stock and warrants or options.
    - b. If is a private firm, the equity can come from personal savings and venture capital.
  - 1.2. How (if at all) does the firm borrow money?
    - a. Does it use bank loans or corporate bonds?
    - b. What is the maturity structure for the debt?
    - c. What type of debt does the firm have? (Currency mix, fixed versus floating)

1.3. Does the firm use any hybrid approaches to raising financing that combine some of the features of debt and some of equity?

- Examples would include preferred stock, convertible bonds, and bonds with warrants attached to them.
- 2. Detailed Description of Current Financing

2.1. If the firm raises equity from warrants or convertibles, what are the characteristics of the options (exercise price, maturity, etc.)?

2.2. If the firm has borrowed money, what are the characteristics of the debt (maturity, coupon or stated interest rate, call features, fixed or floating rate, secured or unsecured, and currency)?

2.3. If the firm has hybrid securities, what are the features of the hybrid securities?

3. Breakdown into Debt and Equity

3.1. If the firm has financing with debt and equity components (such as convertible bonds), how much of the value can be attributed to debt and how much to equity?

3.2. Given the coupon or stated interest rate and maturity of the nontraded debt, what is the current estimated market value of the debt?

3.3 What is the market value of equity that the firm has outstanding?

4. Trade-Off on Debt versus Equity

Benefits of Debt

- What marginal tax rate does this firm face, and how does this measure up to the marginal tax rates of other firms? Are there other tax deductions that this company has (like depreciation) to reduce the tax bite?
- Does this company have high free cash flows (for example, EBITDA/firm value)? Has it taken and does it continue to have good investment projects? How responsive are managers to stockholders? (Will there be an advantage to using debt in this firm as a way of keeping managers in line or do other [cheaper] mechanisms exist?)

Costs of Debt

- How high are the current cash flows of the firm (to service the debt) and how stable are these cash flows? (Look at the variability in the operating income over time.)
- How easy is it for bondholders to observe what equity investors are doing? Are the assets tangible or intangible? If not, what are the costs in terms of monitoring stockholders or in terms of bond covenants?
- How well can this firm forecast its future investment opportunities and needs?

## **Getting Information about Current Financing Choices**

The information about current financing choices can almost all be extracted from the financial statements. The balance sheet should provide a summary of the book values of the various financing choices made by the firm, though hybrids are usually categorized into debt (if they are debt hybrids) and equity (if they are equity hybrids). The description of warrants outstanding as well as the details of the borrowing that the firm has should be available in the footnotes to the balance sheets. In particular, the maturity dates for different components of borrowing, the coupon rates and information on any other special features should be available in the notes.

Online sources of information: Review

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

#### **Problems and Questions**

- 1. An income bondholder receives interest payments only if the firm makes income. If the firm does not make interest payments in a year, the interest is cumulated and paid in the first year the firm makes income. A preferred stock receives preferred dividends only if the firm makes income. If a firm does not make preferred dividend payments in a year, the dividend is cumulated and paid in the first year the firm makes income. Are income bonds really preferred stock? What are the differences? For purposes of calculating debt. how would you differentiate between income bonds and regular bonds?
- 2. A commodity bond links interest and principal payments to the price of a commodity. Differentiate a commodity bond from a straight bond, and then from equity. How would you factor these differences into your analysis of the debt ratio of a company that has issued exclusively commodity bonds?
- 3. You are analyzing a new security that has been promoted as equity, with the following features:
- The dividend on the security is fixed in dollar terms for the life of the security, which is twenty years.
- The dividend is not tax-deductible.
- In the case of default, the holders of this security will receive cash only after all debt holders, secured as well as unsecured, are paid.
- The holders of this security will have no voting rights.

Based on the description of debt and equity in the chapter, how would you classify this security? If you were asked to calculate the debt ratio for this firm, how would you categorize this security?

- 4. You are analyzing a convertible preferred stock with the following characteristics for the security:
- There are 50,000 preferred shares outstanding, with a face value of \$100 and a 6 percent preferred dividend rate.

- The firm has straight preferred stock outstanding, with a preferred dividend rate of 9 percent.
- The preferred stock is trading at \$105.

Estimate the preferred stock and equity components of this preferred stock.

- 5. You have been asked to calculate the debt ratio for a firm that has the following components to its financing mix:
- The firm has 1 million shares outstanding, trading at \$50 per share.
- The firm has \$25 million in straight debt, carrying a market interest rate of 8 percent.
- The firm has 20,000 convertible bonds outstanding, with a face value of \$1,000, a market value of \$1,100, and a coupon rate of 5 percent.

Estimate the debt ratio for this firm.

- 6. You have been asked to estimate the debt ratio for a firm with the following financing details:
- The firm has two classes of shares outstanding: 50,000 shares of class A stock, with 2 voting rights per share, trading at \$100 per share, and 100,000 shares of class B stock, with 1/2 voting right per share, trading at \$90 per share.
- The firm has \$5 million in bank debt, and the debt was taken on recently.

Estimate the debt ratio. Why does it matter when the bank debt was taken on?

Zycor Corporation obtains most of its funding internally. Assume that the stock has a beta of 1.2, the riskless rate is 6.5 percent, and the market risk premium is 6 percent.
 a. Estimate the cost of internal equity.

b. Now assume that the cost of issuing new stock is 5 percent of the proceeds. Estimate the cost of external equity.

8. Office Helpers is a private firm that manufactures and sells office supplies. The firm has limited capital and is estimated to have a value of \$80 million with the capital constraints. A venture capitalist is willing to contribute \$20 million to the firm in exchange for 30 percent of the value of the firm. With this additional capital, the firm will be worth \$120 million.

a. Should the firm accept the venture capital?

b. At what percentage of firm value would you (as the owner of the private firm) break even on the venture capital financing?

- 9. Assume now that Office Helpers decides to go public and would like to have its shares trade at a target price of \$10 per share. If the IPO is likely to be underpriced by 20 percent, how many shares should the firm have?
- 10. You are a venture capitalist and have been approached by Cirrus Electronics, a private firm. The firm has no debt outstanding and does not have earnings now but is expected to be earning \$15 million in four years, when you also expect it to go public. The average price-earnings ratio of other firms in this business is 50.
  - a. Estimate the exit value of Cirrus Electronics.
  - b. If your target rate of return is 35 percent, estimate the discounted terminal value of Cirrus Electronics.

c. If you are contributing \$75 million of venture capital to Cirrus Electronics, at a minimum what percentage of the firm value would you demand in return?

11. The unlevered beta of electronics firms, on average, is 1.1. The riskless rate is 6.5 percent and the market risk premium is 6 percent.

a. Estimate the expected return, using the CAPM.

b. If you are a venture capitalist, why might you have a target rate of return much higher than this expected return?

- 12. Sunshine Media has just completed an IPO, where 50 million shares of the 125 million shares outstanding were issued to the public at an offering price of \$22 per share. On the offering date, the stock price zoomed to \$40 per share. Who gains from this increase in the price? Who loses, and how much?
- 13. IPOs are difficult to value because firms going public tend to be small and little information is available about them. Investment bankers have to underprice IPOs because they bear substantial pricing risk. Do you agree with this statement? How would you test it empirically?

14. You are the owner of a small and successful firm with an estimated market value of \$50 million. You are considering going public.

a. What are the considerations you would have in choosing an investment banker? b. You want to raise \$20 million in new financing, which you plan to reinvest back in the firm. (The estimated market value of \$50 million is based on the assumption that this \$20 million is reinvested.) What proportion of the firm would you have to sell in the IPO to raise \$20 million?

c. How would your answer to **b** change if the investment banker plans to underprice your offering by 10 percent?

d. If you wanted your stock to trade in the \$20–25 range, how many shares would you have to create? How many shares would you have to issue?

- 15. You have been asked for advice on a rights offering by a firm with 10 million shares outstanding trading at \$50 per share. The firm needs to raise \$100 million in new equity. Assuming that the rights subscription price is \$25, answer the following questions.
  - a. How many rights would be needed to buy one share at the subscription price?
  - b. Assuming that all rights are subscribed to, what will the ex-rights price be?
  - c. Estimate the value per right.

d. If the price of a right were different (higher or lower) than the value estimated in **c**, how would you exploit the difference?

- 16. You are stockholder in a SmallTech, a company that is planning to raise new equity. The stock is trading at \$15 per share, and there are 1 million shares outstanding. The firm issues 500,000 rights to buy additional shares at \$10 per share to its existing stockholders.
  - a. What is the expected stock price after the rights are exercised?

b. If the rights are traded, what is the price per right?

c. As a stockholder, would you be concerned about the dilution effect lowering your stock price? Why or why not?

- 17. Assume that SmallTech has net income of \$1 million and that the earnings will increase in proportion with the additional capital raised.
  - a. Estimate the earning per share that SmallTech will have after the rights issue described in the last problem.
  - b. Assume that SmallTech could have raised the capital by issuing 333,333 shares at the prevailing market price of \$15 per share (thus raising the same amount of equity as was raised in the rights issue) to the public. Estimate the earnings per share that SmallTech would have had with this alternative.
  - c. As a stockholder, are you concerned about the fact that the rights issue results in lower earnings per share than the general subscription offering (described in b).
- 18. MVP, a manufacturing firm with no debt outstanding and a market value of \$100 million, is considering borrowing \$40 million and buying back stock. Assuming that the interest rate on the debt is 9 percent and that the firm faces a tax rate of 35 percent, answer the following questions:

a. Estimate the annual interest tax savings each year from the debt.

b. Estimate the present value of interest tax savings, assuming that the debt change is permanent.

c. Estimate the present value of interest tax savings, assuming that the debt will be taken on for ten years only.

d. What will happen to the present value of interest tax savings if interest rates drop tomorrow to 7 percent but the debt itself is fixed rate debt?

19. A business in the 45 percent tax bracket is considering borrowing money at 10 percent.

a. What is the after-tax interest rate on the debt?

b. What is the after-tax interest rate if only half of the interest expense is allowed as a tax deduction?

c. Would your answer change if the firm is losing money now and does not expect to have taxable income for three years?

20. WestingHome is a manufacturing company that has accumulated a net operating loss of \$2 billion over time. It is considering borrowing \$5 billion to acquire another company.

a. Based on the corporate tax rate of 36 percent, estimate the present value of the tax savings that could accrue to the company.

b. Does the existence of a net operating loss carryforward affect your analysis? (Will the tax benefits be diminished as a consequence?)

21. Answer true or false to the following questions relating to the free cash flow hypothesis (as developed by Jensen).

a. Companies with high operating earnings have high free cash flows.

b. Companies with large capital expenditures relative to earnings have low free cash flows.

c. Companies that commit to paying a large portion of their free cash flow as dividends do not need debt to add discipline.

d. The free cash flow hypothesis for borrowing money makes more sense for firms in which there is a separation of ownership and management.

e. Firms with high free cash flows are inefficiently run.

- 22. Assess the likelihood that the following firms will be taken over, based on your understanding of the free cash flow hypothesis. You can assume that earnings and free cash flows are highly correlated.
  - a. A firm with high growth prospects, good projects, low leverage, and high earnings.
  - b. A firm with low growth prospects, poor projects, low leverage, and poor earnings.
  - c. A firm with high growth prospects, good projects, high leverage, and low earnings.
  - d. A firm with low growth prospects, poor projects, high leverage, and good earnings.
  - e. A firm with low growth prospects, poor projects, low leverage, and good earnings.
- 23. Nadir, an unlevered firm, has expected earnings before interest and taxes of \$2 million per year. Nadir's tax rate is 40 percent, and the market value is V = E = \$12 million. The stock

has a beta of 1, and the risk-free rate is 9 percent. [Assume that  $E(R_m) - R_f = 6\%$ ] Management is considering the use of debt; debt would be issued and used to buy back stock, and the size of the firm would remain constant. The default free interest rate on debt is 12 percent. Because interest expense is tax-deductible, the value of the firm would tend to increase as debt is added to the capital structure, but there would be an offset in the form of the rising cost of bankruptcy. The firm's analysts have estimated approximately that the present value of any bankruptcy cost is \$8 million and the probability of bankruptcy will increase with leverage according to the following schedule:

Value of Debt	Probability of Failur
\$2,500,000	0.00%
\$5,000,000	8.00%
\$7,500,000	20.5%
\$8,000,000	30.0%
\$9,000,000	45.0%
\$10,000,000	52.5%
\$12,500,000	70.0%

a. What is the cost of equity and WACC at this time? <AQ: WACC has not been defined in this chapter, so it should be spelled out here.>

- b. What is the optimal capital structure when bankruptcy costs are considered?
- c. What will the value of the firm be at this optimal capital structure?
- 24. A firm that has no debt has a market value of \$100 million and a cost of equity of 11 percent. In the Miller-Modigliani world,
  - a. what happens to the value of the firm as the leverage is changed (assume no taxes)?
  - b. what happens to the cost of capital as the leverage is changed (assume no taxes)?
  - c. how would your answers to **a** and **b** change if there are taxes?
- 25. Assume that personal investors pay a 40 percent tax rate on interest income and only a 20 percent tax rate on equity income. If the corporate tax rate is 30 percent, estimate whether debt has a tax benefit, relative to equity. If a firm with no debt and \$100 million in market value borrows money in this world, estimate what the value of the firm will be if the firm borrows \$50 million.

- 26. In the illustration in Problem 25, what would the tax rate on equity income need to be for debt to not have an effect on value?
- 27. XYZ Pharma is a pharmaceutical company that traditionally has not used debt to finance its projects. Over the past ten years, it has also reported high returns on its projects and growth and made substantial research and development expenses over the time period. The health care business overall is growing much slower now, and the projects that the firm is considering have lower expected returns.a. How would you justify the firm's past policy of not using debt?b. Do you think the policy should be changed now? Why or why not?
- 28. Unitrode, which makes analog/linear integrated circuits for power management, is a firm that has not used debt in the financing of its projects. The managers of the firm contend that they do not borrow money because they want to maintain financial flexibility.

a. How does not borrowing money increase financial flexibility?

b. What is the trade-off you would be making if you have excess debt capacity and you choose not to use it because you want financial flexibility?

29. Consolidated Power is a regulated electric utility that has equity with a market value of \$1.5 billion and debt outstanding of \$3 billion. A consultant notes that this is a high debt ratio relative to the average across all firms, which is 27 percent, and suggests that the firm is overlevered.

a. Why would you expect a electric utility to be able to maintain a higher debt ratio than the average company?

b. Does the fact that the company is a regulated monopoly affect its capacity to carry debt?

## CAPITAL STRUCTURE: THE OPTIMAL FINANCIAL MIX

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

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

#### **Operating Income Approach**

The *operating income approach* is the simplest and one of the most intuitive ways of determining how much a firm can afford to borrow. We determine a firm's maximum acceptable probability of default as our starting point, and based on the distribution of operating income and cash flows, we then estimate how much debt the firm can carry.

#### **Steps in Applying Operating Income Approach**

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

1. We assess the firm's capacity to generate operating income based on both current conditions and past history. The result is a distribution for expected operating income, with probabilities attached to different levels of income.

2. For any given level of debt, we estimate the interest and principal payments that have to be made over time.

3. Given the probability distribution of operating income and the debt payments, we estimate the probability that the firm will be unable to make those payments.

4. We set a limit or constraint on the probability of its being unable to meet debt payments. Clearly, the more conservative the management of the firm, the tighter this probability constraint will be.

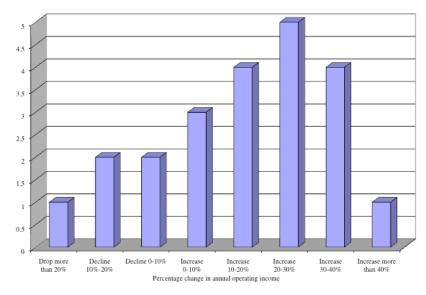
5. We compare the estimated probability of default at a given level of debt to the probability constraint. If the probability of default is higher than the constraint, the firm chooses a lower level of debt; if it is lower than the constraint, the firm chooses a higher level of debt.

#### Illustration 8.1: Estimating Debt Capacity Based on Operating Income Distribution

In the following analysis, we apply the operating income approach to analyzing whether Disney should issue an additional \$10 billion in new debt. We will assume that Disney does not want the probability of being unable to make its total debt payments from current operating income to exceed 5%.

*Step 1*: We derive a probability distribution for expected operating income from Disney's historical earnings and estimate percentage differences in operating income from 1988 to 2008 and present it in Figure 8.1.

Figure 8.1: Disney: Operating Income Changes - 1988-2008



The average change in operating income on an annual basis over the period was 13.26%, and the standard deviation in the annual changes is 19.80%. If we assume that the changes are normally distributed, these statistics are sufficient for us to compute the approximate probability of being unable to meet the specified debt payments.<sup>1</sup>

*Step 2*: We estimate the interest and principal payments on a proposed bond issue of \$10 billion by assuming that the <u>debt will be rated BBB</u>, lower than Disney's current bond rating of A. Based on this rating, we estimated an interest rate of 7% on the debt. In addition, we assume that the sinking fund payment set aside to repay the bonds is 10% of the bond issue.<sup>2</sup> This results in an annual debt payment of \$1,700 million:

Additional Debt Payment = Interest Expense + Sinking Fund Payment

= 0.07 \* \$10,000 + 0.10 \* \$10,000 = \$1,700 million

The total debt payment then can be computed by adding the interest payment of \$728 million on existing debt and the operating lease expenses of \$550 million (from the

 $<sup>^{\</sup>rm l}$  Assuming income changes are normally distributed is undoubtedly a stretch. You can try alternative distributions that better fit the actual data.

 $<sup>^{2}</sup>$  A sinking fund payment allows a firm to set aside money to pay off a bond when it comes due at maturity in annual installments.

<sup>3</sup> 

current year) to the additional debt payment that will be created by taking on \$10 billion in additional debt.

Total Debt Payment = Interest on Existing Debt + Operating Lease Expense + Additional

Debt Payment = \$728 million + \$550 million + \$1,700 million = \$2,978 million *Step 3*: We can now estimate the probability of default<sup>3</sup> from the distribution of operating income. The simplest computation is to assume the percentage changes in operating income are normally distributed, with the operating income of \$6,726 million that Disney earned the last four quarters, as the base year income, and the standard deviation of 19.8% from the historical data as the expected future standard deviation. The resulting t statistic is 2.81:

*t*-Statistic = (Current EBIT – Debt Payment)/ $\sigma_{OI}$  (Current Operating Income) = (\$6,726 - \$2.978)/(0.1980 \* \$6,726) = 2.81

Based on the *t*-statistic, the probability that Disney will be unable to meet its debt payments in the next year is 0.24%.<sup>4</sup>

*Step 4*: Because the estimated probability of default is indeed less than 5%, Disney can afford to borrow more than \$10 billion. If the distribution of operating income changes is normal, we can estimate the level of debt payments Disney can afford to make for a probability of default of 5%.

*t*-Statistic for 5% probability level = 1.645

Consequently, the debt payment can be estimated as

(\$6,726 - X)/(0.1980 \* \$6,726) = 1.645

Solving for X, we estimate a breakeven debt payment of

Break-Even Debt Payment = \$4,535 million

Subtracting out the existing interest and lease payments from this amount yields the breakeven additional debt payment of \$ 3,257 million.

Break-Even Additional Debt Payment = \$4,535 - 728 - 550 = \$3,257 million

<sup>&</sup>lt;sup>3</sup>This is the probability of defaulting on interest payments in one period. The cumulative probability of default over time will be much higher.

<sup>&</sup>lt;sup>4</sup> This is likely to be a conservative estimate because it does not allow for the fact that Disney has a cash balance of \$3,795 million that can be used to service debt, if the operating income falls short.

If we assume that the interest rate remains unchanged at 7% and the sinking fund will remain at 10% of the outstanding debt, this yields an optimal additional debt of \$ 19,161 million.

Optimal Additional Debt = Break-Even Additional Debt Payment/(Interest Rate +

#### Sinking Fund Rate)

#### = \$3,257/(0.07 + 0.10) = \$ 19,161 million

Based on this analysis, Disney should be able to more than double its existing debt (\$16,682 million) and stay within its constraint of keeping the probability of default to less than 5%.

#### Limitations of the Operating Income Approach

Although this approach may be intuitive and simple, it has key drawbacks. First, estimating a distribution for operating income is not as easy as it sounds, especially for firms in businesses that are changing and volatile. The operating income of firms can vary widely from year to year, depending on the success or failure of individual products. Second, even when we can estimate a distribution, the distribution may not fit the parameters of a normal distribution, and the annual changes in operating income may not reflect the risk of consecutive bad years. This can be remedied by calculating the statistics based on multiple years of data. For Disney, if operating income is computed over rolling two-year periods,<sup>5</sup> the standard deviation will increase and the optimal debt ratio will decrease.

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

#### **Refinements on the Operating Income Approach**

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

**Deleted:** ing of the same observations.

<sup>&</sup>lt;sup>5</sup>By rolling two-year periods, we mean 1988-89, 1989-90 and so on for the rest of the data.

<sup>&</sup>lt;sup>6</sup> Opler, T., M. Saron and S. Titman, 1997, *Designing Capital Structure to Create Stockholder Value*, Journal of Applied Corporate Finance, v10, 21-32.

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

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

With these changes, we can look at different financing mixes for a firm and estimate the optimal debt ratio as that mix that maximizes the firm's value.<sup>6</sup>

#### **Cost of Capital Approach**

In Chapter 4, we estimated the minimum acceptable hurdle rates for equity investors (the cost of equity), and for all investors in the firm (the cost of capital). We defined the *cost of capital* to be the weighted average of the costs of the different components of financing—including debt, equity and hybrid securities—used by a firm to fund its investments. By altering the weights of the different components, firms might be able to change their cost of capital.<sup>7</sup> In the cost of capital approach, we estimate the costs of debt and equity at different debt ratios, use these costs to compute the costs of capital, and look for the mix of debt and equity that yields the lowest cost of capital for the firm. At this cost of capital, we will argue that firm value is maximized.

#### Cost of Capital and Maximizing Firm Value

In chapters 3 and 4, we laid the foundations for estimating the cost of capital for a firm. We argued that the cost of equity should reflect the risk as perceived by the marginal investors in the firm. If those marginal investors are diversified, the only risk that should be priced in should be the risk that cannot be diversified away, captured in a beta (in the CAPM) or betas (in multi factor models). If the marginal investors are not diversified, the cost of equity may reflect some or all of the firm-specific risk in the firm.

<sup>&</sup>lt;sup>7</sup> If capital structure is irrelevant, the cost of capital will be unchanged as the capital structure is altered.

<sup>6</sup> 

The cost of debt is a function of the default risk of the firm and reflects the current cost of long term borrowing to the firm. Since interest is tax deductible, we adjust the cost of debt for the tax savings, using the marginal tax rate, to estimate an after-tax cost. In summary, the cost of capital is a weighted average of the costs of equity and debt, with the weights based upon market values:

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

To understand the relationship between the cost of capital and optimal capital structure, we first have to establish the relationship between firm value and the cost of capital. In Chapter 5, we noted that the value of a project to a firm could be computed by discounting the expected cash flows on it at a rate that reflected the riskiness of the cash flows, and that the analysis could be done either from the viewpoint of equity investors alone or from the viewpoint of the entire firm. In the latter approach, we discounted the cash flows to the firm on the project, that is, the project cash flows prior to debt payments but after taxes, at the project's cost of capital.

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

Cash Flow to Firm = EBIT (1 - t) - (Capital Expenditures - Depreciation) - Depreciation - Depreciatio - Depreciation - Depreciatio - Deprec

Change in Non-cash Working Capital

The value of the firm can then be written as

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

The value of a firm is therefore a function of its cash flows and its cost of capital. In the special case where the cash flows to the firm remain constant as the debt/equity mix is changed, the value of the firm will increase as the cost of capital decreases. If the objective in choosing the financing mix for the firm is the maximization of firm value, this can be accomplished, in this case, by *minimizing the cost of capital*. In the more

general case where the cash flows to the firm themselves change as the debt ratio changes, the optimal financing mix is the one *that maximizes firm value*.

#### The Cost of Capital Approach - Basics

To use the cost of capital approach in its simplest form, where the cash flows are fixed and only the cost of capital changes, we need estimates of the cost of capital at every debt ratio. In making these estimates, the one thing we cannot do is keep the costs of debt and equity fixed, while changing the debt ratio. In addition to being unrealistic in its assessment of risk as the debt ratio changes, this analysis will yield the unsurprising conclusion that the cost of capital is minimized at a 100% debt ratio.

As the debt ratio increases, each of the components in the cost of capital will change. Let us start with the equity component. Equity investors are entitled to the residual earnings and cash flows in a firm, after interest and principal payments have been made. As that firm borrows more money to fund a given level of assets, debt payments will increase, and equity earnings will become more volatile. This higher earnings volatility, in turn, will translate into a higher cost of equity. In the language of the CAPM and multi-factor models, the beta or betas we use for equity should increase as the debt ratio goes up. The debt holders will also see their risk increase as the firm borrows more. Holding operating income constant, a firm that contracts to pay more to debt holders has a greater chance of defaulting, which will result in a higher cost of debt. As an added complication, the tax benefits of interest expenses can be put at risk, if these expenses become greater than the earnings.

The key to using the cost of capital approach is coming up with realistic estimates of the cost of equity and debt at different debt ratios. The optimal financing mix for a firm is trivial to compute if one is provided with a schedule that relates the costs of equity and debt to the debt ratio of the firm. Computing the optimal debt ratio then becomes purely mechanical. To illustrate, assume that you are given the costs of equity and debt at different debt levels for a hypothetical firm and that the after-tax cash flow to this firm is currently \$200 million. Assume also that these cash flows are expected to grow at 3% a year forever, and are unaffected by the debt ratio of the firm. The cost of capital schedule is provided in Table 8.1, along with the value of the firm at each level of debt.

Table 8.1 WACC, Firm Value, and Debt Ratios

D/(D+E)	Cost of Equity	After-tax Cost of Debt	Cost of Capital	Firm Value
0	10.50%	4.80%	10.50%	\$2,747
10%	11.00%	5.10%	10.41%	\$2,780
20%	11.60%	5.40%	10.36%	\$2,799
30%	12.30%	5.52%	10.27%	\$2,835
40%	13.10%	5.70%	10.14%	\$2,885
50%	14.00%	6.10%	10.05%	\$2,922
60%	15.00%	7.20%	10.32%	\$2,814
70%	16.10%	8.10%	10.50%	\$2,747
80%	17.20%	9.00%	10.64%	\$2,696
90%	18.40%	10.20%	11.02%	\$2,569
100%	19.70%	11.40%	11.40%	\$2,452
•	•		•	•

Value of Firm	_Expected Cash flow to firm next year	200(1.03)
value of Philli	(Cost of capital - g)	(Cost of capital - g)

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

Figure 8.2 Cost of Capital and Firm Value as a Function of Leverage

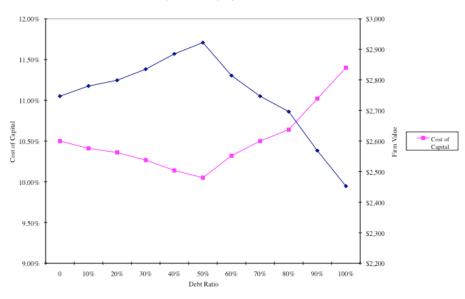


Figure 8.2: Cost of Capital and Firm Value

This illustration makes the choice of an optimal financing mix seem trivial and it obscures some real problems that may arise in its applications. 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 about which there is any certainty about the cost of financing is the current level. Second, the analysis assumes implicitly that the level of cash flows to the firm is unaffected by the financing mix of the firm and consequently by the default risk (or bond rating) for the firm. Although this may be reasonable in some cases, it might not in others. For instance, a firm that manufactures consumer durables (cars, televisions, etc.) might find that its sales and operating income drop if its default risk increases because investors are reluctant to buy its products. We will deal with the computational component of estimating costs of debt, equity and capital first in the standard cost of capital approach and then follow up by examining how to bring in changes in expected cash flows into the analysis in the enhanced cost of capital approach.

# 8.1. Minimizing Cost of Capital and Maximizing Firm Value

- A lower cost of capital will lead to a higher firm value only if
- a. the operating income does not change as the cost of capital declines.
- b. the operating income goes up as the cost of capital goes down.
- c. any decline in operating income is offset by the lower cost of capital.

#### The Standard Cost of Capital Approach

In the standard cost of capital approach, we keep the operating income and cash flows fixed, while changing the cost of capital. Not surprisingly, the optimal debt ratio is the one that minimizes the cost of capital. While the assumptions seem heroic, it is a good starting point for the discussion.

## Steps in computing cost of capital

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

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

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

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

Cost of Equity = Risk-Free Rate +  $\beta_{levered}$  (Risk Premium)

The cost of debt for a firm is a function of the firm's default risk. As firms borrow more, their default risk will increase and so will the cost of debt. If we use bond ratings as the measure of default risk, we can estimate the cost of debt in three steps. First, we estimate a firm's dollar debt and interest expenses at each debt ratio; as firms increase their debt ratio, both dollar debt and interest expenses will rise. Second, at each debt level, we compute a financial ratio or ratios that measure 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 on 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. Although 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 of changing the capital structure, on firm value, 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 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, because 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 8.2: 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 \$16,003 million in interest-bearing debt on its books and we estimated the market value of this debt to be \$14,962 million in chapter 4. Adding the present value of operating leases of \$1,720 million (also estimated in chapter 4) 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 beta for Disney's stock in May 2009, as estimated in Chapter 4, was 0.9011. 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%:

Cost of Equity = Risk-Free Rate + Beta \* (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%.

After-Tax Cost of Debt = Pretax Interest Rate (1 - 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:

Cost of capital = 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%  $\frac{45,193}{(16,682+45,193)} + 3.72\% \frac{16,682}{(16,682+45,193)} = 7.51\%$ 

## 8.2. Market Value, Book Value, and Cost of Capital

Disney had a book value of equity of approximately \$32.7 billion and a book value of debt of \$16 billion. If you held the cost of equity and debt constant and replaced the market value weights in the cost of capital with book value weights, you will end up with

- a. A lower cost of capital
- b. A higher cost of capital

c. The same cost of capital What are the implications for valuation?

#### I. Disney's Cost of Equity and Leverage

The cost of equity for Disney at different debt ratios can be computed using the unlevered beta of the firm, and the debt equity ratio at each level of debt. We use the levered betas that emerge to estimate the cost of equity. The first step in this process is to compute the firm's current unlevered beta, using the current market debt to equity ratio and a tax rate of 38%.

Unlevered Beta = 
$$\frac{\text{Levered Beta}}{\left(1 + (1 - t)\frac{\text{Debt}}{\text{Equity}}\right)} = \frac{0.9011}{\left(1 + (1 - .38)\frac{16,682}{45,193}\right)} = 0.7333$$

Note that this is the bottom-up unlevered beta that we estimated for Disney in Chapter 4, based on its business mix, which should come as no surprise since we computed the levered beta from that value. We compute the levered beta at each debt ratio, using this unlevered beta and Disney's marginal tax rate of 38%:

Levered Beta = 0.7033 (1 + (1 - .38) (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 Table 8.2.

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%

Table 8.2: Levered Beta and Cost of Equity: Disney

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:

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

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.<sup>8</sup> We will also examine whether the full benefits of interest expenses will accrue at higher debt ratios.

## II. 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 4, of linking the rating to the interest coverage ratio, with the ratio defined as:

Interest Coverage Ratio =  $\frac{\text{Earnings before interest and taxes}}{\text{Interest Expenses}}$ 

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 you 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 ratio, including EBITDA/Fixed Charges, to the mix. Third, the interest coverage ratio changes as a firm changes is 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.

<sup>&</sup>lt;sup>8</sup> 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:

Levered Beta = 0.7333 (1 + (1 - 0.38)(40/60) - 0.10 (1 - 0.373) (40/60) = 0.99In the unadjusted approach, the levered beta would have been 1.0364.

<sup>14</sup> 

To make our estimates of the synthetic rating, we will use the lookup table that we introduced in chapter 4, for large market capitalization firms (since Disney's market capitalization is greater than \$ 5 billion) and continue to use the default spreads that we used in that chapter to estimate the pre-tax cost of debt. Table 8.3 reproduces those numbers:

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	Α	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	В	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	С	15.00%
<0.2	D	20.00%

Table 8.3 Interest Coverage Ratios, Ratings and Default Spreads

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 riskfree 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 table 8.4.

	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

Table 8.4 Disney's Key Operating Numbers

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.<sup>9</sup> 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:

Value of Disney = Current Market Value of Equity + Current Market Value of Debt

= 45,193 + \$16,682 = \$61,875 million

\$ Debt at 10% Debt to Capital Ratio = 10% of \$61,875 = \$6,188 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 pre-tax 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 riskfree rate yields a pre-tax cost of borrowing. Table 8.5 estimates the interest expenses, interest coverage ratios, and bond ratings for Disney at 0% and 10% debt ratios, at the existing level of operating income.

Table 8.5 Effect of Moving to Higher Debt Ratios: Disney

D/(D+E)	0.00%	10.00%
---------	-------	--------

<sup>&</sup>lt;sup>9</sup> The present value of operating leases (\$1,720 million) was multiplied by the pre-tax 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.

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 int. cov	8	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%:

		Iteration 1	Iteration 2
		(Debt @AAA rate)	(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 int. cov	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.<sup>10</sup> 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 Table 8.6.

-							
			Interest				
Debt		Interest	coverage	Bond	Interest rate	Tax	After-tax cost
Ratio	\$ Debt	Expense	ratio	Rating	on debt	Rate	of debt
0%	\$0	\$0	8	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	А	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%

Table 8.6 Disney: Cost of Debt and Debt Ratios

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.

- a. 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 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.
- b. We assume that at every debt level, all existing debt will be refinanced at the new interest rate that will prevail after the capital structure change. For instance, Disney's existing debt, which has a 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 holders might have

<sup>&</sup>lt;sup>10</sup> Because the interest expense rises, it is possible for the rating to drop again. Thus, a third iteration might be necessary in some cases.

<sup>18</sup> 

protective puts that enable them to put their bonds back to the firm and receive face value.<sup>11</sup> 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.<sup>12</sup>

c. 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.

<sup>&</sup>lt;sup>11</sup> 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.

<sup>&</sup>lt;sup>12</sup> 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.

<sup>19</sup> 

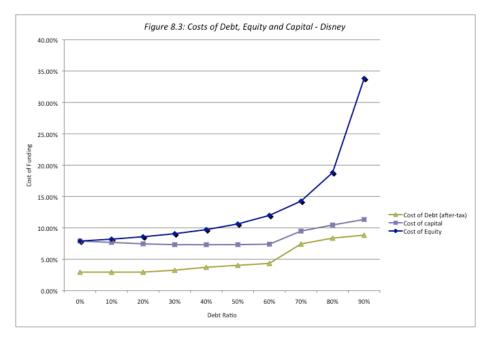
### III. Leverage and Cost of Capital

Now that we have estimated the cost of equity and the cost of debt at each debt level, we can compute Disney's cost of capital. This is done for each debt level in Table 8.7. 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 table 8.10 for the full details of the numbers in this table)

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%

Table 8.7 Cost of Equity, Debt, and Capital, Disney

Note that we are moving in 10% 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%. The optimal cost of capital is shown graphically in figure 8.3. We will stick with the approximate optimal of 40% the rest of this chapter.



To illustrate the robustness of this solution to alternative measures of levered betas, we reestimate the costs of debt, equity, and capital under the assumption that debt bears some market risk; the results are summarized in Table 8.8.

Table 8.8 Costs of Equity.	Debt. and Capital with Deb	t 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%

21

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.<sup>13</sup>

## IV. Firm Value and Cost of Capital

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

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

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):<sup>14</sup>

EBIT $(1 - \text{Tax Rate}) = 6829 (1 - 0.38) =$	\$4,234
+ Depreciation and amortization =	\$1,593
– Capital expenditures =	\$1,628
<ul> <li>Change in noncash working capital</li> </ul>	\$0
Free cash flow to the firm =	\$4,199

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:

<sup>&</sup>lt;sup>13</sup> 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:

Imputed Debt Beta at a C Rating = (3%/6%) \* 0.25 = 0.125

The assumption that 25 percent 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).

<sup>&</sup>lt;sup>14</sup> We will return to do a more careful computation of this cash flow in chapter 12. In this chapter, we are just attempting for an approximation of the value.

<sup>22</sup> 

Value of firm =  $61,875 = \frac{FCFF_0(1+g)}{(Cost of Capital - g)} = \frac{4,199(1+g)}{(.0751 - g)}$ 

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

$$= (61,875*0.0751 - 4199)/(61,875 + 4,199) = 0.0068$$
 or  $0.68\%$ 

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%

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:

Increase in firm value = \$63,665 mil - \$61,875 mil = \$1,790 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.<sup>15</sup> 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:

Cost of financing Disney at existing debt ratio = 61,875 \* 0.0751 = \$4,646.82 million Cost of financing Disney at optimal debt ratio = 61,875 \* 0.0732 = \$4,529.68 million Annual savings in cost of financing = \$4,646.82 million - \$4,529.68 million = \$117.14

### million

Note that most of these savings are implicit rather than explicit and represent the savings next year.<sup>16</sup> The present value of these savings over time can now be estimated using the

<sup>&</sup>lt;sup>15</sup> 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.

<sup>&</sup>lt;sup>16</sup> 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.

new cost of capital of 7.32% and the capped growth rate of 0.68% (based on the implied growth rate);

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

Value of the firm after recapitalization = Existing firm value + PV of Savings

= \$61,875 + \$1,763 = \$63,638 million

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

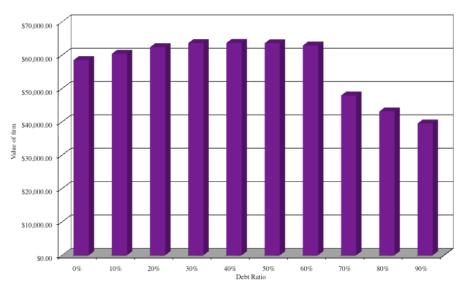


Figure 8.4: Firm Value and Debt Ratios

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 <u>total number of shares outstanding</u>:

Increase in Value per Share = \$1,763/1856.732 = \$0.95

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:

Number of shares after buyback = # Shares before  $-\frac{\text{Increase in Debt}}{\text{Share Price}}$ 

= 
$$1,856.732 - \frac{\text{Increase in Debt}}{\text{Share Price}} = 1537.713 \text{ million shares}$$

Value of firm after recapitalization = \$63,638 million

Debt outstanding after recapitalization = \$24,750 million

Value of Equity after recapitalization = \$38,888 million

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.<sup>17</sup> 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.

## 8.3. Rationality and Stock Price Effects

Assume that Disney does make a tender offer for its shares but pays \$27 per share. What will happen to the value per share for the shareholders who do not sell back?

- a. The share price will drop below the pre-announcement price of \$24.34.
- b. The share price will be between \$24.34 and the estimated value (above) or \$25.30.
- c. The share price will be higher than \$25.30.

Change in Stock Price = \$1,763 million/(- [8068/24.34]) = \$1.16 per share

<sup>&</sup>lt;sup>17</sup> 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:

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

D/(D+E)	0.00%	10.00%	20.00%	30.00%	40.00%	50.00%	60.00%	70.00%	80.00%	90.0
D/E	0.00%	11.11%	25.00%	42.86%	66.67%	100.00%	150.00%	233.33%	400.00%	900.0
\$ Debt	\$0	\$6,188	\$12,375	\$18,563	\$24,750	\$30,938	\$37,125	\$43,313	\$49,500	\$55,
Beta	0.73	0.78	0.85	0.93	1.04	1.19	1.42	1.79	2.55	5.(
Cost of Equity	7.90%	8.20%	8.58%	9.07%	9.72%	10.63%	11.99%	14.26%	18.81%	33.8
EBITDA	\$8,422	\$8,422	\$8,422	\$8,422	\$8,422	\$8,422	\$8,422	\$8,422	\$8,422	\$8,4
Depreciation	\$1,593	\$1,593	\$1,593	\$1,593	\$1,593	\$1,593	\$1,593	\$1,593	\$1,593	\$1,:
EBIT	\$6,829	\$6,829	\$6,829	\$6,829	\$6,829	\$6,829	\$6,829	\$6,829	\$6,829	\$6,8
Interest	\$0	\$294	\$588	\$975	\$1,485	\$2,011	\$2,599	\$5,198	\$6,683	\$7, <u>'</u>
Interest coverage ratio	8	23.24	11.62	7.01	4.60	3.40	2.63	1.31	1.02	0.9
Likely Rating	AAA	AAA	AAA	AA	А	A-	BBB	B-	CCC	CC
Pre-tax cost of debt	4.75%	4.75%	4.75%	5.25%	6.00%	6.50%	7.00%	12.00%	13.50%	13.5
Eff. Tax Rate	38.00%	38.00%	38.00%	38.00%	38.00%	38.00%	38.00%	38.00%	38.00%	34.5
			COST	OF CAPI	FAL CALCULATI	ONS				
D/(D+E)	0.00%	10.00%	20.00%	30.00%	40.00%	50.00%	60.00%	70.00%	80.00%	90.0
D/E	0.00%	11.11%	25.00%	42.86%	66.67%	100.00%	150.00%	233.33%	400.00%	900.0
\$ Debt	\$0	\$6,188	\$12,375	\$18,563	\$24,750	\$30,938	\$37,125	\$43,313	\$49,500	\$55,
Cost of equity	7.90%	8.20%	8.58%	9.07%	9.72%	10.63%	11.99%	14.26%	18.81%	33.8
Cost of debt	2.95%	2.95%	2.95%	3.26%	3.72%	4.03%	4.34%	7.44%	8.37%	8.8
Cost of Capital	7.90%	7.68%	7.45%	7.32%	7.32%	7.33%	7.40%	9.49%	10.46%	11.3

Table 8.9 Cost of Capital Worksheet for Disney

## Capital Structure and Market Timing: A Behavioral Perspective

Inherent in the cost of capital approach is the notion of a trade off, where managers measure the tax benefits of debt against the potential bankruptcy costs. But do managers make financing decisions based on this trade off? Baker and Wurgler (2002) argue that whether managers use debt or equity to fund investments has less to do with the costs and benefits of debt and more to do with market timing.<sup>18</sup> If managers perceive their stock to be over valued, they are more likely to use equity, and if they perceive stock to by under valued, they tend to use debt. The observed debt ratio for a firm is therefore the cumulative result of attempts by managers to time equity and bond markets.

The "market timing" view of capital structure is backed up by surveys that have been done over the last decade by Graham and Harvey, who report that two-thirds of CFOs surveyed consider how much their stock is under or over valued, when issuing equity and are more likely to borrow money, when they feel "interest rates are low".<sup>19</sup> There is also evidence that initial public offerings and equity issues spike when stock prices in a sector surge.

While the evidence offered by behavioral economists for the market-timing hypothesis is strong, it is not inconsistent with a trade off hypothesis. In its most benign form, managers choose a long-term target for the debt ratio, but how they get there will be a function of the timing decisions made along the way. In its more damaging form, market timing can also explain why firms end up with actual debt ratios very different from their target debt ratios. If a sector or a firm goes through an extended period where managers think stock prices are "low" and that interest rates are also "low", they will defer issuing equity and continue borrowing money for that period, thus ending up with debt ratios that are far too high.

Given the pull of market timing, it is not only impractical to tell managers to ignore the market but may potentially cost stockholders money in the long term. One

<sup>&</sup>lt;sup>19</sup> Graham, John R., and Campbell R. Harvey, 2001, The theory and practice of corporate finance: Evidence from the field, Journal of Financial Economics 60, 187-243.



<sup>&</sup>lt;sup>18</sup> Baker, Malcolm, and Jeffrey Wurgler, 2002, Market timing and capital structure, Journal of Finance, v 57, 1-32.

solution is for firms to compute their optimal debt ratios and then allow managers to make judgments on the timing of debt and equity issues, based on their views on the pricing of the stock and interest rates. If the market timing does not work, the costs should be small because the firm will converge on the optimal at some point in time. If the market timing works, stockholders will gain from the timing.

#### **Constrained** versions

The cost of capital approach that we have described is unconstrained, because our only objective is to minimize the cost of capital. There are several reasons why a firm may choose not to view the debt ratio that emerges from this analysis as optimal. First, the firm's default risk at the point at which the cost of capital is minimized may be high

enough to put the firm's survival at jeopardy. Stated in terms of bond ratings, the firm may have a below-**investment grade rating**. Second, the optimal debt ratio was computed using the operating income from the most recent financial

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

year. To the extent that operating income is volatile and can decline, firms may want to curtail their borrowing. In this section, we consider ways we can bring each of these considerations into the cost of capital analysis.

## Bond Rating Constraint

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

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

Cost of Rating Constraint = Maximum Firm Value without Constraints – Maximum Firm Value with Constraints

If Disney insisted on maintaining a AA rating, its constrained optimal debt ratio would be 30%. The cost of preserving the constraint can then be measured as the difference between firm value at 40%, the unconstrained optimal, and at 30%, the constrained optimal.

Cost of AA Rating Constraint = Value at 40% Debt – Value at 30% Debt = \$63,651 - \$63,596 = \$55 million

In this case, the rating constraint has a very small cost. The loss in value that can accrue from having an unrealistically high rating constraint can be viewed as the cost of being too conservative when it comes to debt policy. A AAA rating constraint at Disney would restrict them at 20% debt ratio and the concurrent cost would be higher:

Cost of AAA rating constraint = Value at 40% Debt – Value at 20% Debt

= \$63,651 - \$62,371 = \$1,280 million

Disney's management would then have to weigh off this lost value against what they perceive to be the benefits of a AAA rating.

## 8.4. Agency Costs and Financial Flexibility

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

a. These costs are not considered in the cost of capital approach.

- These costs are fully captured in the cost of capital through the costs of equity and debt, which increase as you borrow more money.
- c. These costs are partially captured in the cost of capital through the costs of equity and debt, which increase as you borrow more money.

Sensitivity Analysis

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

The determinants of the optimal debt ratio for a firm can be divided into variables specific to the firm, and macroeconomic variables. Among the variables specific to the

firm that affect its optimal debt ratio are the tax rate, the firm's capacity to generate operating income, and its cash flows. In general, the tax benefits from debt increase as the tax rate goes up. In relative terms, firms with higher tax rates will have higher optimal debt ratios than will firms with lower tax rates, other things being equal. It also follows that a firm's optimal debt ratio will increase as its tax rate increases. Firms that generate higher operating income and cash flows as a percent of firm market value also can sustain much more debt as a proportion of the market value of the firm, because debt payments can be covered much more easily by prevailing cash flows.

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

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

#### Illustration 8.3: Sensitivity Analysis on Disney's Optimal Debt Ratio

In the base case, in Illustration 8.2, we used Disney's operating income in 2008 to find the optimal debt ratio. We could argue that Disney's operating income is subject to large swings, depending on the vagaries of the economy and the fortunes of the entertainment business, as shown in Table 8.10.

Year		EBIT	% Change in EBIT
	1987	756	
	1988	848	12.17%
	1989	1177	38.80%

Table 8.10 Disney's Operating Income History: 1987–2008

1990	1368	16.23%
1991	1124	-17.84%
1992	1287	14.50%
1993	1560	21.21%
1994	1804	15.64%
1995	2262	25.39%
1996	3024	33.69%
1997	3945	30.46%
1998	3843	-2.59%
1999	3580	-6.84%
2000	2525	-29.47%
2001	2832	12.16%
2002	2384	-15.82%
2003	2713	13.80%
2004	\$4,048	49.21%
2005	\$4,107	1.46%
2006	\$5,355	30.39%
2007	\$6,829	27.53%
2008	\$7,404	8.42%

There are several ways of using the information in such historical data to modify the analysis. One approach is to look at the firm's performance during previous downturns. In Disney's case, the operating income in 2002 dropped by 15.82% as the firm struggled with the aftermath of the terrorist attacks of September 11, 2001, and the resultant downturn in leisure travel. In 2000, Disney's self-inflicted wounds from overinvestment in the Internet business and poor movies caused operating income to plummet almost 30%. A second approach is to obtain a statistical measure of the volatility in operating income so that we can be more conservative in choosing debt levels for firms with more volatile earnings. In Disney's case, the standard deviation in percentage changes in operating income is 19.80%. Table 8.11 illustrates the impact of lower operating income on the optimal debt level.

EBITDA drops by	EBITDA	Optimal Debt ratio
0%	\$8,319	40%
5%	\$7,903	40%
10%	\$7,487	40%
15%	\$7,071	40%
20%	\$6,655	30%

Table 8.11 Effects of Operating Income on Optimal Debt Ratio

The optimal debt ratio stays at 40% until EBITDA declines by 20%, matching Disney's worst year on record. This would suggest that Disney has excess debt capacity, even with conservative estimates of operating income.

## In Practice: EBIT versus EBITDA

In recent years, analysts have increasingly turned to using EBITDA as a measure of operating cash flows for a firm. It may therefore seem surprising that we focus on operating income or EBIT far more than EBITDA when computing the optimal capital structure. The interest coverage ratios, for instance, are based on operating income and not EBITDA. Although it is true that depreciation and amortization are noncash expenses and should be added back to cash flows, it is dangerous for a firm with ongoing operations to depend on the cash flows generated by these items to service debt payments. After all, firms with high depreciation and amortization expenses usually have high ongoing capital expenditures. If the cash inflows from depreciation and amortization are redirected to make debt payments, the reinvestment made by firms will be insufficient to generate future growth or to maintain existing assets.

In summary, then, a firm with high EBITDA and low EBIT that borrows money based on the former can find itself in trouble, one way or the other. If it uses the substantial depreciation charges to pay interest expenses, rather than make capital expenditures, it will put its growth prospects at risk.

## **Enhanced Cost of Capital Approach**

A key limitation of the standard cost of capital approach is that it keeps operating income fixed, while bond ratings vary. In effect, we are ignoring indirect bankruptcy costs, when computing the optimal debt ratio. In the enhanced cost of capital approach, we bring these indirect bankruptcy costs into the expected operating income. As the rating of the company declines, the operating income is adjusted to reflect the loss in operating income that will occur when customers, suppliers, and investors react.

To quantify the distress costs, we have tie the operating income to a company's bond rating. Put another way, we have to quantify how much we would expect the operating income to decline if a firm's bond rating drops from AA to A or from A to BBB. This will clearly vary across sectors and across time.

- Across sectors, the different effects of distress on operating income will reflect how much customers, suppliers and employees in that sector react to the perception of default risk in a company. As we noted in chapter 7, indirect bankruptcy costs are likely to be highest for firms that produce long-lived assets, where customers are dependent upon the firm for parts and service.
- Across time, the indirect costs of distress will vary depending how easy it is to access financial markets and sell assets. In buoyant markets (in 1999 or 2006), the effect of a ratings downgrade on operating income are likely to be much smaller than in a market in crisis.

While getting agreement on these broad principles is easy, we are still faced with the practical question of how best to estimate the impact of declining ratings on operating income. We would suggest looking at the track record of other firms in the same sector that have been down graded by ratings agencies in the past, and the effects that the down grading has had on operating income in subsequent years.

Once we link operating income to the bond rating, we can then modify the cost of capital approach to deliver the optimal debt ratio. Rather than look for the debt ratio that delivers the lowest cost of capital (the decision rule in the standard approach), we look for the debt ratio that delivers the highest firm value, through a combination of high earnings and low cost of capital.

#### Illustration 8.4: Disney- Enhanced Cost of Capital Approach

In illustration 8.3, we estimated an optimal debt ratio of 40% for Disney in the standard cost of capital approach. In making this estimate, we kept Disney's operating income fixed at \$6,829 million as Disney's ratings moved from AAA (at a 20% debt ratio) to well below investment grade. As shown in Table 8.12, once a company's rating drops below A (that is, below investment grade), distress costs occur in the form of a percentage decrease in earnings.

Rating	Drop in EBITDA
A or higher	No effect
A-	2.00%
BBB	10.00%
BB+ to B	20.00%

Table 8.12: Operating Income and Bond Rating

B-	25.00%
C to CCC	40.00%
D	50.00%

The result of this enhancement to the cost of capital approach can be seen in Table 8.13,

where we compute the costs of capital, operating income and firm values at different debt ratios for Disney:

Debt Ratio	Bond Rating	Cost of Capital	Firm Value (G)
0%	AAA	7.90%	\$58,522
10%	AAA	7.68%	\$60,384
20%	AAA	7.45%	\$62,368
30%	A+	7.42%	\$62,707
40%	CCC	9.18%	\$24,987
50%	С	12.77%	\$17,569
60%	С	14.27%	\$15,630
70%	C	15.77%	\$14,077
80%	С	17.27%	\$12,804
90%	С	18.77%	\$11,743

Table 8.13: Firm Value, Cost of capital and Debt ratios: Enhanced Cost of Capital

As long as the bond ratings remain investment grade, Disney's value remains intact. Its value, in fact, achieves its highest level at an A+ rating and a debt ratio of 30%. But as soon as the rating drops below investment grade, the distress costs begin to take effect, and Disney's value drops precipitously. Thus, the debt ratio of 40% that seemed optimal under the unmodified cost of capital approach now appears to be imprudent. The optimal debt ratio is now 30%, which means that Disney can borrow an additional \$1.9 billion (to get from its existing dollar debt of \$16,682 million to its optimal debt of \$18,563 million).

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

#### **Extensions of the Cost of Capital Approach**

The cost of capital approach, which works so well for manufacturing firms that are publicly traded, can be adapted to compute optimal debt ratios for cyclical firms, family group companies, private firms or even for financial service firms, such as banks and insurance companies.

### Cyclical and Commodity Firms

A key input that drives the optimal capital structure is the current operating income. If this income is depressed, either because the firm is a cyclical firm or because there are firm-specific factors that are expected to be temporary, the optimal debt ratio that will emerge from the analysis will be much lower than the firm's true optimal. For example, automobile manufacturing firms will have very low debt ratios if the optimal debt ratios had been computed based on the operating income in 2008, which was a recession year for these firm, and oil companies would have had very high optimal debt ratios, with 2008 earnings, because high oil prices during the year inflated earnings.

When evaluating a firm with depressed current operating income, we must first decide whether the drop in income is temporary or permanent. If the drop is temporary, we must estimate the **normalized operating income** for the firm, i.e., the income that the firm would generate in a normal year, rather than what it made in the most recent years. Most analysts normalize earnings by taking the average earnings over a period of time (usually five years). Because this holds the scale of the firm fixed, it may not be appropriate for firms that have changed in size over time. The right way to normalize income will vary across firms:

a. For <u>cyclical firms</u>, whose current operating income may be overstated (if the economy is booming) or understated (if the economy is in recession), the operating income can be estimated using the average operating margin over an entire economic cycle (usually 5 to 10 years)

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

b. For <u>commodity firms</u>, we can also estimate the normalized operating income by making an assumption about the normalized price of the commodity. With an oil company, for instance, this would translate into making a judgment about the

normal oil price per barrel. This normalized commodity price can then be used, in conjunction with production, to generate normalized revenues and earnings.

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

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

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

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

Aracruz Celulose, the Brazilian pulp and paper manufacturing firm, reported operating income of 574 million BR on revenues of 3,696 million R\$ in 2008. This was significantly lower than its operating income of R\$ 1,011 million in 2007 and R\$ 1,074 million in 2006. We estimated the optimal debt ratio for Aracruz based on the following information:

- In 2008, Aracruz had depreciation of R\$ 973 million and capital expenditures amounted to R\$ 1,502 million.
- Aracruz had debt outstanding of R\$ 9,834 million with a dollar cost of debt of 8.50%.
- The corporate tax rate in Brazil is estimated to be 34%.
- Aracruz had 588.29 million shares outstanding, trading at 15.14 \$R per share. The beta of the stock, estimated from the beta of the sector and Aracruz's debt ratio, is 1.74.

In Chapter 4, we estimated Aracruz's current US dollar cost of capital to be 12.84%, using an equity risk premium of 9.95% for Brazil and Aracruz's current debt ratio of 52.47%:

Current \$ Cost of Equity = 3.5% + 1.74 (9.95%) = 20.82% Current \$ Cost of Debt = 8.5% (1-.34) = 5.61%

Current \$ Cost of Capital = 20.82% (1-.5247) + 5.61% \*.5247 = 12.84%We made three significant changes in applying the cost of capital approach to Aracruz as opposed to Disney:

- The operating income at Aracruz is a function of the price of paper and pulp in global markets. We computed Aracruz's average pretax operating margin between 2004 and 2008 to be 27.24%. Applying this average margin to 2008 revenues of \$R 3,697 million generates a normalized operating income of R\$ 1,007 million. We will compute the optimal debt ratio using this normalized value.
  - In Chapter 4, we noted that Aracruz's synthetic rating of BB+, based on the interest coverage ratio, is higher than its actual rating of BB and attributed the difference to Aracruz being a Brazilian company, exposed to country risk. Because we compute the cost of debt at each level of debt using synthetic ratings, we run the risk of understating the cost of debt. To account for Brazilian country risk, we add the country default spread for Brazil (2.50%) to Aracruz's company default spread in assessing the dollar cost of debt:
    - \$ Cost of Debt = US T Bond Rate + Default Spread<sub>Country</sub>+Default Spread<sub>Company</sub>
    - Aracruz has a market value of equity of about \$4.4 billion (8.9 billion R\$). We used the interest coverage ratio/rating relationship for smaller companies to estimate synthetic ratings at each level of debt. In practical terms, the rating that we assign to Aracruz for any given interest coverage ratio will generally be lower than the rating that Disney, a much larger company, would have had with the same ratio.

Using the normalized operating income, we estimated the costs of equity, debt and capital in Table 8.14 for Aracruz at different debt ratios.

Debt	Beta	Cost of	Bond	Interest rate	Tax	Cost of Debt	WACC	Firm
Ratio		Equity	Rating	on debt	Rate	(after-tax)		Value (G)
0%	1.01	13.52%	AAA	7.25%	34.00%	4.79%	13.52%	R\$ 17,424
10%	1.08	14.26%	A-	9.00%	34.00%	5.94%	13.42%	R\$ 17,600
20%	1.17	15.17%	B-	14.50%	34.00%	9.57%	14.05%	R\$ 16,511
30%	1.29	16.36%	CC	18.00%	33.83%	11.91%	15.03%	R\$ 15,062
40%	1.53	18.75%	С	21.00%	21.75%	16.43%	17.82%	R\$ 11,994
50%	1.87	22.13%	D	26.00%	14.05%	22.35%	22.24%	R\$ 9,012
60%	2.34	26.79%	D	26.00%	11.71%	22.95%	24.49%	R\$ 7,975

Table 8.14 Aracruz Celulose: Cost of Capital, Firm Value, and Debt Ratios

70%	3.12	34.55%	D	26.00%	10.04%	23.39%	26.74%	R\$ 7,140
80%	4.68	50.08%	D	26.00%	8.78%	23.72%	28.99%	R\$ 6,452
90%	9.36	96.66%	D	26.00%	7.81%	23.97%	31.24%	R\$ 5,875

The optimal debt ratio for Aracruz using the normalized operating income is 10%, well below its current debt ratio of 52.48%. However, the cost of capital at the optimal is higher than its current cost of capital, at first sight, a puzzling result. The reason for the divergence is that the interest expenses that we compute for Aracruz, using the estimated interest rates are dramatically higher than the current interest expenses. For instance, at a 50% debt ratio (roughly equal to their current debt ratio), the interest expenses of R\$ 1,968 million is more than 12 times higher than the current interest expense of R\$ 155 million and are more than double the normalized operating income. Given how much Aracruz owes currently (almost R\$ 10 billion), we do not see how interest expenses can stay as low as the current numbers.

The conclusion that we would draw about Aracruz is that it is dangerously over levered, at its existing debt ratio. The interest expenses on the current debt will be too high to be serviced from operations, even if operating income reverts back to normalized levels. If operating income does not bounce back quickly, the situation becomes even more dire.

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

## Companies that are part of a group

When a company is part of a family group, the logic of minimizing cost of capital does not change but the mechanics can be skewed by two factors.

The first is that the cost of debt may be more reflective of the credit standing of the group to which the firm belongs, rather than its own financial strength. Put another way, a distressed company that is part of a healthy family group of companies may be able to borrow more money at a lower rate than an otherwise similar stand-alone company. This can, at least artificially, increase its optimal debt ratio. Conversely, a healthy company that is part of distressed group may find its cost of debt and capital affected by perceptions about the group; in this

case, the optimal debt ratio will be lower for this company than for an independent company.

• The second is that rather than optimizing the mix of debt and equity for individual companies, the controllers of the family group of companies may view their objective as finding a mix of debt and equity that maximizes the value of the group of companies. Thus, our assessments of the capital structures of individual companies may not be particularly meaningful.

There is one final factor to consider. The consolidated operating income of the entire family group should be more stable than the earnings of the individual companies that comprise the group, reflecting diversification over multiple businesses. Consequently, the optimal debt computed for the family group will be higher than the aggregate of the optimal debt for individual companies in the group.

### Illustration 8.6: Applying the Cost of Capital Approach to Tata Chemicals

As we noted in earlier chapters, Tata Chemicals is part of the Tata Group, a family controlled group with diverse holdings across the spectrum. To assess the optimal capital structure for Tata Chemicals, we started with the current mix of debt and equity and cost of capital in rupees.

• Cost of equity= Risk free Rate + Beta (Equity Risk Premium for India)

=4% + 0.945 (10.51%) = 13.93%

- Pre-tax Cost of debt = (Riskfree Rate + Default Spread<sub>India</sub> + Default Spread<sub>Tata Chemicals</sub> = 4% + 3% + 3% = 10%
- Cost of capital = 13.93% (1-.34) + 10% (1-.3399) (.34) = 11.44%

In 2008, Tata Chemicals generated operating income (EBIT) of Rs 6,268 million, after depreciation charges of Rs 1,582 million. We estimated the costs of equity, debt and capital at debt ratios ranging from 0% to 90% in table 8.15:

Debt		Cost of	Bond	Interest rate	Tax	Cost of Debt		Firm
Ratio	Beta	Equity	Rating	on debt	Rate	(after-tax)	WACC	Value (G)
0%	0.70	11.39%	AAA	8.25%	33.99%	5.45%	11.39%	Rs 79,626
10%	0.75	11.93%	A+	9.25%	33.99%	6.11%	11.35%	Rs 80,084
20%	0.82	12.61%	BB	12.00%	33.99%	7.92%	11.67%	Rs 76,586
30%	0.90	13.48%	B-	15.50%	33.99%	10.23%	12.51%	Rs 68,768
40%	1.01	14.64%	CC	19.00%	33.99%	12.54%	13.80%	Rs 59,257
50%	1.23	16.98%	С	22.00%	24.43%	16.63%	16.80%	Rs 44,637

Table 8.15: Costs of debt, equity and capital: Tata Chemicals

60%	1.58	20.64%	D	27.00%	16.59%	22.52%	21.77%	Rs 31,272
70%	2.11	26.19%	D	27.00%	14.22%	23.16%	24.07%	Rs 27,325
80%	3.17	37.28%	D	27.00%	12.44%	23.64%	26.37%	Rs 24,189
90%	6.33	70.56%	D	27.00%	11.06%	24.01%	28.67%	Rs 21,638

Note that we have made allowances for the fact that Tata Chemicals is an Indian company in out computations. When computing the cost of equity, we added the country risk premium for India to the mature market premium to arrive at a total equity risk premium of 10.51%. For the cost of debt at each debt ratio, we added the default spread for Tata Chemicals at that debt ratio to the default spread for India (3%) to arrive at the total cost of debt.

The optimal debt ratio, based on this calculation, is 10% debt and the cost of capital at that ratio is 11.35%. At its existing debt ratio of 34%, Tata Chemicals looks over levered though its current cost of capital is only slightly higher at 11.44%. However, it is not clear how much of this additional debt can be attributed to the reputation effects of being part of a well-regarded and profitable family group of companies.

#### **Private Firms**

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

To analyze the optimal debt ratio for a private firm, we make the following adjustments. First, we estimate the value of the private firm by looking at how publicly traded firms in the same business are priced by the market. Thus, if publicly traded firms in the business have market values that are roughly three times revenues, we would multiply the revenues of the private firm by this number to arrive at an estimated value. Second, we continue to estimate the costs of debt for a private firm using a synthetic

bond rating, based on interest coverage ratios, but we will require much higher interest coverage ratios to arrive at the same rating, to reflect the fact that banks are likely to be more conservative in assessing default risk at small, private firms. Finally, we will use total betas to capture total risk, rather than just market risk, to estimate the cost of equity.

#### Illustration 8.7: Applying the Cost of Capital Approach to a Private Firm: Bookscape

Bookscape, a private firm, has neither a market value for its equity nor a rating for its debt. In Chapter 4, we assumed that Bookscape would have a debt to capital ratio of 34.84%, similar to that of publicly traded book companies, and that the tax rate for the firm is 40%. We computed a cost of capital based on that assumption. We also used a total beta of 2.91 to measure the additional risk that the owner of Bookscape is exposed to because of his lack of diversification.

Cost of equity = Risk-Free Rate + Total Beta \* Risk Premium

$$= 3.5\% + 2.91 * 6\% = 20.94\%$$

Pretax Cost of Debt = 6% (based on synthetic rating of A)

Cost of Capital = 20.94% (0.6516) + 6% (1 - 0.40)(0.3484) = 14.90%

To estimate the optimal capital structure for Bookscape, we made the following assumptions:

• Although Bookscape has no conventional debt outstanding, it does have one large operating lease commitment. Given that the operating lease has 25 years to run and that the lease commitment is \$750,000 for each year, the present value of the operating lease commitments is computed using Bookscape's pretax cost of debt of 6%:

Present value of Operating Lease Commitments (in thousands)

= \$750 (PV of annuity, 6%, 25 years) = \$9,587

Note that Bookscape's pretax cost of debt is based on their synthetic rating of A, which we estimated in Chapter 4.

42

Bookscape had operating income before taxes of \$3 million in the most recent financial year, after depreciation charges of \$400,000 and operating lease expenses of \$750,000. Because we consider the present value of operating lease expenses to be debt, we add back the imputed interest expense on the present value of lease expenses to the EBIT to arrive at an adjusted EBIT. For the rest of the analysis, operating lease

commitments are treated as debt and the interest expense estimated on the present value of operating leases is treated as the interest expense:

Adjusted EBIT (in '000s) = EBIT + Pretax Cost of Debt \* PV of Operating Lease Expenses = \$3,000 + 0.06 \* \$9,587 = \$3,575

• To estimate the market value of equity, we looked at publicly traded book retailers and computed an average price to earnings ratio of 10 for these firms. Applying this multiple of earnings to Bookscape's net income of \$1.5 million in 2008 yielded an estimate of Bookscape's market value of equity.

Estimated Market Value of Equity (in '000s) = Net Income for Bookscape \* Average PE for Publicly Traded Book Retailers = 1,500 \* 10 = \$15,000

This estimate of the market value of equity result in a debt ratio of 38.99%:

Debt ratio =  $\frac{\text{Debt}}{\text{Debt} + \text{Equity}} = \frac{\$9,587}{\$9,587 + \$15,000} = 38.99\%$ 

The interest rates at different levels of debt will be estimated based on a synthetic bond rating. This rating will be assessed using Table 8.16, which summarizes ratings and default spreads over the long-term bond rate as a function of interest coverage ratios for small firms that are rated by S&P as of January 2009.

Interest Coverage Ratio: Small market cap(<\$5 billion)	Rating	Typical Default
> 12.5	AAA	1.25%
9.50–12.50	AA	1.75%
7.50–9.50	A+	2.25%
6.00–7.50	Α	2.50%
4.50-6.00	А-	3.00%
4.00-4.50	BBB	3.50%
3.50-4.00	BB+	4.25%
3.00-3.50	BB	5.00%
2.50-3.00	B+	6.00%
2.00-2.50	В	7.25%
1.50-2.00	B-	8.50%
1.25–1.50	CCC	10.00%
0.80-1.25	CC	12.00%
0.50–0.80	С	15.00%
< 0.65	D	20.00%

Table 8.16: Interest Coverage Ratios, Rating, and Default Spreads: Small Firms

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

• The tax rate used in the analysis is 40%, and the long-term bond rate at the time of this analysis was 3.5% and the equity risk premium is 6%.

Based on this information and using the same approach used for Disney, the cost of capital and firm value are estimated for Bookscape at different debt ratios. The information is summarized in Table 8.17.

				Interest		Cost of		
Debt		Cost of	Bond	rate on	Tax	Debt (after-	Cost of	Firm Value
Ratio	Beta	Equity	Rating	debt	Rate	tax)	capital	(G)
0%	1.98	15.38%	AAA	4.75%	40.00%	2.85%	15.38%	\$20,701.79
10%	2.11	16.18%	AAA	4.75%	40.00%	2.85%	14.84%	\$21,728.94
20%	2.28	17.17%	AAA	4.75%	40.00%	2.85%	14.30%	\$22,858.84
30%	2.49	18.44%	А	6.00%	40.00%	3.60%	13.99%	\$23,572.02
40%	2.77	20.14%	A-	6.50%	40.00%	3.90%	13.64%	\$24,403.93
50%	3.17	22.51%	BB	8.50%	40.00%	5.10%	13.81%	\$24,000.23
60%	3.76	26.08%	В	10.75%	40.00%	6.45%	14.30%	\$22,861.61
70%	4.75	32.02%	B-	12.00%	40.00%	7.20%	14.65%	\$22,128.00
80%	6.73	43.90%	CC	15.50%	40.00%	9.30%	16.22%	\$19,282.19
90%	13.20	82.73%	CC	15.50%	37.03%	9.76%	17.06%	\$18,039.01

Table 8.17 Costs of Capital and Firm Value for Bookscape

The firm value is maximized (and the cost of capital is minimized) at a debt ratio of 40%.

At its existing debt ratio of 38.99%, Bookscape is at its optimal.

## In Practice: Optimal Debt Ratios for Private Firms

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

- Increasing debt increases default risk and expected bankruptcy costs much more substantially for small private firms than for larger publicly traded firms. This is partly because the owners of private firms may be exposed to unlimited liability, and partly because the perception of financial trouble on the part of customers and suppliers can be much more damaging to small, private firms.
- Increasing debt yields a much smaller advantage in terms of disciplining managers in the case of privately run firms, because the owners of the firm tend to be the top managers as well.
- Increasing debt generally exposes small private firms to far more restrictive bond covenants and higher agency costs than it does large publicly traded firms.

• The loss of flexibility associated with using excess debt capacity is likely to weigh much more heavily on small, private firms than on large, publicly traded firms, due to the former's lack of access to public markets.

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

# 8.5. Going Public: Effect on Optimal Debt Ratio

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

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

#### Financial Service firms

There are several problems in applying the cost of capital approach to financial service firms, such as banks and insurance companies. The first is that the interest coverage ratio spreads, which are critical in determining the bond ratings, have to be estimated separately for financial service firms; applying manufacturing company spreads will result in absurdly low ratings for even the safest banks and very low optimal debt ratios. Furthermore, the relationship between interest coverage ratios and ratings tend to be much weaker for financial service firms than it is for manufacturing firms. The second is a measurement problem that arises partly from the difficulty in estimating the debt on a financial service company's balance sheet. Given the mix of deposits, repurchase agreements, short-term financing, and other liabilities that may appear on a financial service firm's balance sheet, one solution is to focus only on long-term debt, defined tightly, and to use interest coverage ratios defined using only long-term interest expenses. The third problem is that financial service firms are regulated and have to meet capital ratios that are defined in terms of book value. If, in the process of moving to an

optimal market value debt ratio, these firms violate the book capital ratios, they could put themselves in jeopardy.

While we could try to adapt the cost of capital approach to come up with optimal debt ratios for banks and other financial service companies, the results are very sensitive to how we define debt and the relationship we assume between bond ratings and operating income. An alternative and more effective approach is to use the regulatory capital ratios, usually determined in terms of book equity, as the basis for determining how much equity a financial service firm needs to raise to not only continue operating, but to do so without putting itself at peril. As a simple example, consider a bank with \$ 100 million in loans outstanding and a book value of equity of \$ 6 million. Furthermore, assume that the regulatory requirement is that equity capital be maintained at 5% of loans outstanding. Finally, assume that this bank wants to increase its loan base by \$ 50 million to \$ 150 million and to augment its equity capital ratio to 7% of loans outstanding. The amount of equity that the bank will have to raise to fund its expansion is computed below:

Loans outstanding after Expansion	= \$ 150 million
Equity/Capital ratio desired	= 7%
Equity after expansion	= \$10.5 million
Existing Equity	= \$ 6.0 million
New Equity needed	= \$4.5 million

As we look at more complex financial service firms that operate in multiple businesses with different risk levels, there are two challenges that we will face in putting this approach into practice:

- a. <u>Different regulatory capital requirements for different businesses</u>: When a firm operates in different businesses, the regulatory capital restrictions can vary across businesses. In general, the capital requirements will be higher in riskier businesses and lower in safer businesses. Hence, the equity that a firm has to raise to fund expansion will depend in large part of which businesses are being expanded.
- b. <u>Regulatory vs Risk-based capital ratios</u>: The regulatory capital ratios represent a floor on what a firm has to invest in equity, to keep its operations going and not a ceiling. It

is possible that the firm's own assessment of risk in a business can lead it to hold more equity than required by the regulatory authorities.

As a final twist, it is worth nothing that banking regulators consider preferred stock as part of equity, when computing regulatory ratios.

In general, there are three strategies that a financial service firm can follow when it comes to the use of leverage:

- a. <u>The Regulatory minimum strategy</u>: In this strategy, financial service firms try to stay with the bare minimum equity capital, as required by the regulatory ratios. In the most aggressive versions of this strategy, firms exploit loopholes in the regulatory framework to invest in those businesses where regulatory capital ratios are set too low (relative to the risk of these businesses). The upside of this strategy is that the returns on equity in good times will exceptionally high, since the equity capital is kept low. The downside of this strategy is that the risk in the investments ultimately will manifest itself and the absence of equity to cover losses will put the firm's existence in jeopardy.
- b. The Self-regulatory strategy: The objective for a bank raising equity is not to meet regulatory capital ratios but to ensure that losses from the business can be covered by the existing equity. In effect, financial service firms can assess how much equity they need to hold by evaluating the riskiness of their businesses and the potential for losses. Having done so, they can then check to also make sure that they meet the regulatory requirements for capital. The upside of this strategy is that it forces the firm to both assess risk in its businesses and to make the trade off between risk and return, when entering new businesses. The downside is that it is more data intensive, and errors in assessing risk will affect the firm's value.
- c. <u>Combination strategy</u>: In this strategy, the regulatory capital ratios operate as a floor for established businesses, with the firm adding buffers for safety where needed. In new or evolving businesses, the firm makes its own assessments of risk that may be very different from those made by the regulatory authorities.

We would argue that the responsibility for maintaining enough equity has to rest ultimately with the management of the firm and not with the regulatory authorities. A

bank that blames the laxness of regulatory oversight for its failures is not a well-managed bank.

#### Illustration 8.8: Deutsche Bank's Capital Mix

The financial crisis of 2008 centered on financial service firms and can at least partially be traced to the inadequacy of equity capital at these firms, relative to the riskiness of the investments. Thus, investment banks, insurance companies and banks that had vast holdings of risky securities, some based on real estate and some on leveraged loans, had too little equity capital to cover the losses from these investments.

While many US banks, including Wells Fargo, JP Morgan and Bank of America, were tagged as under capitalized and had to raise billions in fresh equity to bridge the gap, Deutsche Bank has generally been much more conservative in its use of equity capital. In October 2008, it raised its Tier 1 Capital Ratio to 10%, well above the Basel 1 regulatory requirement of 6%. While its loss of 4.8 billion Euros in the last quarter of 2008 did reduce equity capital, Deutsche Bank was confident (at least as of the first part of 2009) that it could survive without fresh equity infusions or government bailouts. In fact, Deutsche Bank reported net income of 1.2 billion Euros for the first quarter of 2009 and a Tier 1 capital ratio of 10.2%.

While Deutsche Bank looks safe for the moment in terms of having adequate equity, it is possible that significant losses on its leveraged loans and securities can create a deficit. In 2009, US banking regulators applied an "extreme stress test" to US banks, where they assumed a significant economic downturn and continued losses in the housing market. Deutsche Bank emerged intact from the stress test, with no need for additional equity even under dire circumstances. In contrast. Commerzbank, another German bank, will face an equity shortfall of 4.28 billion Euros to get back to a 4% Tier 1 ratio, under this dire scenario.

#### In Practice: Value at Risk – A Risk Management Tool?

In its most general form, the Value at Risk (VaR) measures the potential loss in value of a risky asset or portfolio over a defined period for a given confidence interval. Thus, if the VaR on an asset is \$ 100 million at a one-week, 95% confidence level, there is a only a 5% chance that the value of the asset will drop more than \$ 100 million over any given week. In its adapted form, the measure is sometimes defined more narrowly as

the possible loss in value from "normal market risk" as opposed to all risk, requiring that we draw distinctions between normal and abnormal risk as well as between market and non-market risk. While Value at Risk can be used by any entity to measure its risk exposure, it is used most often by commercial and investment banks to capture the potential loss in value of their traded portfolios from adverse market movements over a specified period; this can then be compared to their available capital and cash reserves to ensure that the losses can be covered without putting the firms at risk.

Taking a closer look at Value at Risk, there are three key aspects to using it as a risk measure:

- 1. To estimate the probability of the loss, with a confidence interval, we need to define the probability distributions of individual risks, the correlation across these risks and the effect of such risks on value. In fact, simulations are widely used to measure the VaR for asset portfolio.
- 2. The focus in VaR is clearly on downside risk and potential losses. Its use in banks reflects their fear of a liquidity crisis, where a low-probability catastrophic occurrence creates a loss that wipes out the capital and creates a client exodus.
- There are three key elements of VaR a specified level of loss in value, a fixed time period over which risk is assessed and a confidence interval. The VaR can be specified for an individual asset, a portfolio of assets or for an entire firm.

While the use of VAR has increased in the last decade, its weakness is its dependence upon historical data and, at least in some forms, its assumption that returns are normally distributed. As a consequence, it has been argued that unusual events of large magnitude, exactly the risks that banks should be worrying about, are not factored in adequately into capital ratios.

# V 8.6. Bankruptcy Costs and Debt Ratios

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

- a. True
- b. False
- Explain.

#### **Determinants of Optimal Debt Ratio**

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

#### Firm-Specific Factors

The optimal debt ratios that we compute will vary across firms. There are three firm specific factors that contribute to these differences – the tax rate of the firm, its capacity to generate cash flows to cover debt payments and uncertainty about future income.

#### a. Firm's Tax Rate:

40%

50%

50%

60%

In general, the tax benefits from debt increase as the tax rate goes up. In relative terms, firms with higher tax rates will have higher optimal debt ratios than do firms with lower tax rates, other things being equal. It also follows that a firm's optimal debt ratio will increase as its tax rate increases. We can illustrate this by computing the optimal debt ratios for Disney, Aracruz, Tata Chemicals and Bookscape, holding all else constant and just changing the tax rate in Table 8.18.

			Tata	
Tax Rate	Disney	Aracruz	Chemicals	Bookscape
0%	0%	0%	0%	0%
10%	0%	0%	0%	20%
20%	20%	0%	0%	20%
30%	30%	10%	0%	40%

10%

20%

10%

20%

40%

50%

Table 8.18: Tax Rates and Optimal Debt Ratios

At a 0% tax rate, the optimal debt ratio is zero for all four firms. Without the benefits that accrue from taxes, the rationale for using debt disappears. As the tax rate increases, the optimal debt ratios increase for all three firms but at different rates. For Disney, the optimal debt ratio climbs to 60%, if the tax rate increases to 50%. The effect of changing tax rates is more muted for Aracruz and Tata Chemicals, but the optimal debt ratio is higher at higher tax rates. For Bookscape, however, the optimal continues to increase and reaches 50% when the tax rate is 50%.

#### b. Pretax Returns on the Firm (in Cash Flow Terms)

The most significant determinant of the optimal debt ratio is a firm's earnings capacity. In fact, the operating income as a percentage of the market value of the firm (debt plus equity) is usually good indicator of the optimal debt ratio. When this number is high (low), the optimal debt ratio will also be high (low). A firm with higher pretax earnings can sustain much more debt as a proportion of the market value of the firm, because debt payments can be met much more easily from prevailing earnings. Disney, for example, has operating income of \$6,829 million, which is 11% of the market value of the firm of \$61,875 million in the base case, and an optimal debt ratio of 40%. Increasing the operating income to 15% of the firm value will increase the optimal debt ratio to 60%. In contrast, the normalized operating income (R\$ 1007 million) at Aracruz is 5.37% of the value of the firm (R\$18,741 million), leading to a much lower optimal debt ratio of 10% for the firm.

#### c. Variance in Operating Income

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

#### **Macroeconomic Factors**

Should macroeconomic conditions affect optimal debt ratios? In purely mechanical terms, the answer is yes. In good economic times, firms will generate higher earnings and be able to service more debt. In recessions, earnings will decline and with it the capacity to service debt. That is why prudent firms borrow based on normalized earnings rather than current earnings. Holding operating income constant,

macroeconomic variables can still affect optimal debt ratios. In fact, both the level of risk-free rate and the magnitude of default spreads can affect optimal debt ratios.

#### a. Level of Rates

As interest rates decline, the conventional wisdom is that debt should become cheaper and more attractive for firms. Though this may seem intuitive, the effect is muted by the fact that lower interest rates also reduce the cost of equity. In fact, changing the risk-free rate has a surprisingly small effect on the optimal debt ratio as long as interest rates move within a normal range.<sup>20</sup> When interest rates exceed normal levels, optimal debt ratios do decline partly because we keep operating income fixed. The higher interest payments at every debt ratio reduce bond ratings and affect the capacity of firms to borrow more.

#### b. Default Spreads

The default spreads for different ratings classes tend to increase during recessions and decrease during economic booms. Keeping other things constant, as the spreads increase (decrease) optimal debt ratios decrease (increase), for the simple reason that higher spreads penalize firms that borrow more money and have lower ratings. In fact, the default spreads on corporate bonds declined between 2002 and 2007, leading to higher optimal debt ratios for all firms. In 2008, as the economy slowed and the market entered crisis mode, default spreads widened again, leading to lower optimal debt ratios.

There is another factor to consider. The same factors that cause default spreads to increase and decrease also play a role in determining equity risk premiums. Hence, the question of how much changing default spreads affect optimal debt ratios cannot be answered without looking at how much equity risk premiums also change. If equity risk premiums increase more than default spreads do, debt will become a more attractive choice relative to equity.

#### **Adjusted Present Value Approach**

In the adjusted present value (APV) approach, we begin with the value of the firm without debt. As we add debt to the firm, we consider the net effect on value by considering both the benefits and the costs of borrowing. The value of the levered firm

 $<sup>^{20}</sup>$  The normal range for long-term interest rates in the United States for the past forty years has been between 4 and 8 percent. There was a short period between 1978 and 1982 when long-term interest rates were much higher and a short period in the last couple of years, where long term rates dropped below 3%.

<sup>52</sup> 

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 APV Approach

In the APV approach, we assume that the primary benefit of borrowing is a tax benefit and that the most significant cost of borrowing is the added risk of bankruptcy. To estimate the value of the firm with these assumptions, we proceed in three steps. We begin by estimating the value of the firm with no leverage. We then consider the present value of the interest tax savings generated by borrowing a given amount of money. Finally, we evaluate the effect of borrowing the amount on the probability that the firm will go bankrupt and the expected cost of bankruptcy.

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

Value of Unlevered Firm =  $FCFF_1 / (\rho_u - g)$ 

where  $FCFF_1$  is the expected after-tax operating cash flow to the firm in the next period,  $\rho_u$  is the unlevered cost of equity, and *g* is the expected growth rate. The inputs needed for this valuation are the expected cash flows, growth rates, and the unlevered cost of equity. To estimate the latter, we can draw on our earlier analysis and compute the unlevered beta of the firm:

$$\beta_{\text{unlevered}} = \frac{\beta_{Current}}{\left(1 + (1 - t)\frac{Debt}{Equity}\right)}$$

where  $\beta_{unlevered}$  = unlevered beta of the firm,  $\beta_{current}$  = current equity beta of the firm, t = tax rate for the firm, and D/E = current debt/equity ratio. This unlevered beta can then be used to arrive at the unlevered cost of equity. Alternatively, we can take the current market value of the firm as a given and back out the value of the unlevered firm by subtracting out the tax benefits and adding back the expected bankruptcy cost from the existing debt.

Current Firm Value = Value of Unlevered firm + PV of Tax Benefits – Expected Bankruptcy Costs

Value of Unlevered Firm = Current Firm Value – PV of Tax Benefits + Expected Bankruptcy Costs

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

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

= Tax Rate \* Debt

 $= t_{\rm c} D$ 

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

Step 3: Estimate the expected bankruptcy costs as a result of the debt: The third step is to evaluate the effect of the given level of debt on the default risk of the firm and on expected **bankruptcy costs**. In theory, at least, this

**Bankruptcy Costs:** The costs associated with going bankruptcy. It includes both direct costs (from going bankrupt) and indirect costs (arising from the perception that a firm may go bankrupt).

requires the estimation of the probability of default with the additional debt and the direct and indirect cost of bankruptcy. If  $\pi_a$  is the probability of default after the additional debt and *BC* is the present value of the bankruptcy cost, the present value of expected bankruptcy cost can be estimated.–

PV of Expected Bankruptcy Cost = Probability of Bankruptcy \* PV of Bankruptcy Cost =  $\pi_{a}BC$ 

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

8.19, extracted from an annually updated study by Altman, summarizes the probability

of default over ten years by bond rating class.<sup>21</sup>

Rating	Likelihood of Default
AAA	0.07%
AA	0.51%
A+	0.60%
А	0.66%
A-	2.50%
BBB	7.54%
BB	16.63%
B+	25.00%
В	36.80%
B-	45.00%
CCC	59.01%
CC	70.00%
С	85.00%
D	100.00%

Table 8.19 Default Rates by Bond Rating Classes

Source: Altman (2008).

The other 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. Studies that have looked at the direct cost of bankruptcy conclude that they are small relative to firm value.<sup>22</sup> The indirect costs of bankruptcy can be substantial, but the costs vary widely across firms. Shapiro and Titman speculate that the indirect costs could be as large as 25 to 30% of firm value but provide no direct evidence of the costs.<sup>23</sup>

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

Value of Levered Firm =  $FCFF_1/(\rho_u - g) + t_c D - \pi_a BC$ 

<sup>&</sup>lt;sup>21</sup> Altman, E.I., 2008, *The Default Experience of U.S. Bonds*, Working Paper, Salomon Center, New York University. This study estimated default rates over ten years only for some of the ratings classes. We extrapolated the rest of the ratings.

<sup>&</sup>lt;sup>22</sup> See Warner, J.N., 1977, *Bankruptcy Costs: Some Evidence*, Journal of Finance, v32, 337-347. In this study of railroad bankruptcies, the direct cost of bankruptcy seems to be about 5 percent.

<sup>&</sup>lt;sup>23</sup> See Shapiro, A., 1989, Modern Corporate Finance, Macmillan, New York; Titman, S., 1984, The Effect of Capital Structure on a Firm's Liquidation Decision, Journal of Financial Economics, v13, 1371-51.

<sup>55</sup> 

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.

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

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

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

(In the bankruptcy analysis, firms filing for bankruptcy would be tagged with a 1 and firms that survive would be categorized as 0).

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

Illustration 8.9: Using the APV Approach to Calculate Optimal Debt Ratio for Disney in early 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.

Current Market Value of Disney = Value of Equity + Value of Debt = \$45,193 + \$16,682 = \$61,875 million

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%.

PV of Tax Savings from Existing Debt = Existing Debt \* Tax Rate

= \$16,682 \* 0.38 = \$6,339 million

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.

PV of Expected Bankruptcy Cost = Probability of Default \* Bankruptcy Cost

= 0.66% \* (0.25 \* 61,875) =\$ 102 million

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

Value of Disney as an Unlevered Firm

= Current Market Value - PV of Tax Savings + Expected Bankruptcy Costs

= \$61,875 - \$6,339 + \$102

# = \$55,638 million

The next step in the process is to estimate the tax savings in Table 8.20 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.

	0		•
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

*Table 8.20 Tax Savings From Debt (t<sub>c</sub>D): Disney* 

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. Table 8.21 summarizes these probabilities and the expected bankruptcy cost, computed based on the levered firm value:

Table 8.21 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%	А	0.66%	\$107
50%	A-	2.50%	\$421
60%	В	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:

Expected Bankruptcy Cost = (Unlevered firm value + Tax Savings) (.25) (.0066)

#### = (55,638+\$9,405) (.25) (0.0066) = \$ 107 million

The value of the levered firm is estimated in Table 8.22 by aggregating the effects of the tax savings and the expected bankruptcy costs.

					Expected	Value of
Debt		Tax	Unlevered	Tax	Bankruptcy	Levered
Ratio	\$ Debt	Rate	Firm Value	Benefits	Cost	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

Table 8.22 Value of Disney with Leverage

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.

#### Benefits and Limitations of the APV Approach

The advantage of the APV approach is that it separates the effects of debt into different components and allows an analyst to use different discount rates for each component. In this approach, 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 APV approach ignore the expected bankruptcy costs, leading them to the conclusion that firm value increases as firms borrow money. Not surprisingly, they conclude that the optimal debt ratio for a firm is 100% debt.

In general, with the same assumptions, the APV and the cost of capital conclusions give identical answers. However, the APV approach is more practical when firms are evaluating the feasibility of adding a dollar amount of debt, whereas the cost of capital approach is easier when firms are analyzing debt proportions.<sup>24</sup>

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

#### **Comparative Analysis**

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

# **Comparing to Industry Average**

Firms sometimes choose their financing mixes by looking at the average debt ratio of other firms in the industry in which they operate. For instance, table 8.23 compares the debt ratios at Disney, Aracruz and Tata Chemicals to other firms in their industries. We define these comparable firms as US entertainment companies for Disney, emerging market paper companies for Aracruz and emerging market chemical companies for Tata Chemicals.

				Book Deb	ot Ratio	Market D	ebt Ratio
Company	Book Debt	Market	Comparable group	Average	Median	Average	Median
	Ratio	Debt Ratio		_		-	
Disney	32.89%	26.96%	US Entertainment	47.76%	43.59%	36.90%	37.83%
			companies				
Aracruz	91.01%	52.47%	Emerging Market	38.11%	40.74%	33.75%	34.22%
			Paper companies				
Tata	42.95%	34.02%	Emerging Market	33.88%	34.76%	25.56%	21.34%
Chemicals			chemical companies				

Table 8.23: Comparison to Industry Averages

Source: Value Line & Capital IQ.

<sup>&</sup>lt;sup>24</sup> Inselbag, I. and H. Kaufold, 1997, *Two DCF Approaches and Valuing Companies under Alternative Financing Strategies*, Journal of Applied Corporate Finance, v10(1), 115-122.

Based on this comparison, Disney is operating at a debt ratio lower than those of other firms in the industry in both market and book value terms, whereas Aracruz and Tata Chemicals have debt ratios much higher than the averages for their sector.

The underlying assumptions in this comparison are that firms within the same industry are **comparable** and that, on average, these firms are operating at or close to their optimal. Both assumptions can be questioned, however. Firms within the same industry can have different product mixes, different amounts of operating risk, different tax rates, and different project returns. In fact, most do. For instance, Disney is considered part of the

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

61

entertainment industry, but its mix of businesses is very different from that of Lion's Gate, which is primarily a movie company, or Liberty Media, which is primarily a cable broadcasting company. Furthermore, Disney's size and risk characteristics are very different from that of Westwood One, which is also considered part of the same industry group. The other problem is that, as we noted in Chapter 4, both Disney and Tata Chemicals are multi-business companies and picking a sector to compare these firms is difficult to do.

There is a data set online that summarizes market value and book value debt ratios, by industry, in addition to other relevant characteristics.

#### **Controlling for Differences between Firms**

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

Debt Ratio =  $\alpha_0 + \alpha_1$  Tax Rate +  $\alpha_2$  Pretax Returns +  $\alpha_3$  Variance in Operating Income

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

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



# Sticking with Industry Averages: A Behavioral Perspective

The pull of industry averages on the debt ratios of individual firms in the industry is too strong to be ignored. While it may make little sense from a fundamental standpoint to mimic the behavior of other firms in the sector, there are two reasons that have been offered for why it appeals to managers.

a. <u>Herd migration</u>: Patel, Zeckhauser and Hendricks (1991) use the behavior of birds and wildebeest to explain why companies stick close to industry averages.<sup>25</sup> They note that the same "safety in numbers" that induces animals to travel in groups also influences managers when they make financing choices. Put another way, a manager who chooses to take on a significant amount of debt, simply because other firms in the sector have also done so, is unlikely to be fired even if that debt turns out to be too high, in hindsight. In fact, if analysts follow the same herd mentality, they are likely to punish firms that deviate from the herd, even if that deviation can be justified on intrinsic grounds. Looking across 182 firms in ten sectors, they find evidence of herd behavior in seven of the ten sectors.

<sup>&</sup>lt;sup>25</sup> Patel, J., R. Zeckhauser, and D. Hendricks, 1991, "The Rationality Struggle: Illustrations from Financial Markets," American Economic Review Papers and Proceedings, pp. 232-236. American Economic Review Papers and Proceedings, 1991, pp. 232-236.

b. <u>Following the leader</u>: A variant of this theme, with its roots in the natural sciences as well, is that firms in a business tend to follow the leader. In this model, success and reputation lead to a firm being anointed the leader for a sector. When this firm chooses a financing mix, presumably based upon its fundamentals, other firms in that sector then imitate the leader, hoping to imitate its success

Whatever the reasons may be, there is no denying the fact that managers look at industry averages and practices on capital structure for guidance. Consequently, it does make sense to check the optimal debt ratios that emerge from the cost of capital and APV approaches against industry averages and to adjust them towards peer group ratios.

#### Illustration 8.10: Estimating Disney's Debt Ratio Using the Cross-Sectional Approach

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

To look at the determinants of debt ratios within the entertainment industry, we regressed debt ratios of the 80 firms in the industry against two variables—the effective tax rate and the EBITDA as a percent of the market value of the firm. Based on our earlier discussion of the determinants of capital structure, we would expect firms with higher operating cash flows (EBITDA) as a percent of firm value to borrow more money. We would also expect higher tax rates to lead to more benefits from debt and higher debt ratios. The results of the regression are reported, with *t*-statistics in brackets below the coefficients:

Debt to Capital = 0.049 + 0.543 (Effective tax rate) + 0.692 (EBITDA/Firm Value) (1.07) (4.10<sup>a</sup>) (4.08<sup>a</sup>)

The dependent variable is the market debt to capital ratio, and the regression has an  $R^2$  of 40%. Although there is statistical significance, it is worth noting that the predicted debt ratios will have substantial standard errors associated with them. Even so, if we use the current values for these variables for Disney in this regression, we get a predicted debt ratio:

 $DFR_{\text{Disnev}} = 0.049 + 0.543 (0.372) + 0.692 (0.1735) = 0.3710 \text{ or } 37.10\%$ 

At its existing debt ratio of 27%, Disney is significantly under levered. Thus, relative to the industry in which it operates and its specific characteristics, Disney could potentially borrow more.

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

- The expected growth rate in EPS (G<sub>EPS</sub>) as a proxy for growth assets. Firms with a higher percentage of value from growth assets should have less debt.
- Closely held shares as a percent of shares outstanding (CLSH) as a measure of how much separation there is between managers and stockholders (and hence as a proxy for debt as a disciplinary mechanism).
- EBITDA as a percent of enterprise value (E/V) as a measure of the cash flow generating capacity of a firm
- Intangible assets as a percentage of total assets (Intangible %); firms that derive more of their value from intangible assets face bigger agency costs (with lenders) and should borrow less.

The results of the regression from early 2009 are presented below.<sup>26</sup>

 $DFR = 0.327 - 0.064 \text{ Intangible } \% - 0.138 \text{ CLSH} + 0.026 \text{ E/V} - 0.878 \text{ G}_{\text{EPS}}$   $(25.45^{\text{a}}) \quad (2.16^{\text{a}}) \qquad (2.88^{\text{a}}) \qquad (1.25) \qquad (12.6^{\text{a}})$ 

where *DFR* is debt as a percentage of the market value of the firm (debt + equity). The  $R^2$  for this regression is only 13%. If we plug in the values for Disney in 2009 into this regression, we get a predicted debt ratio:

 $DFR_{\text{Disney}} = 0.327 - 0.064 (0.24) - 0.138 (0.077) + 0.0.26 (0.1735) - 0.878 (0.065)$ = 0.2891 or 28.91%

<sup>&</sup>lt;sup>26</sup> This regression has about 2000 publicly traded companies in the United States, with information available on both debt ratios and the independent variables.

Based on the debt ratios of other firms in the market and Disney's financial characteristics, we would expect Disney to have a debt ratio of 28.91%. Because its actual debt ratio is 27%, Disney is slightly under levered.

# 8.7. Optimal Debt Ratios Based on Comparable Firms

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

- a. a debt ratio similar to the optimal debt ratio from the cost of capital approach.
- b. a debt ratio higher than the optimal debt ratio from the cost of capital approach.
- c. a debt ratio lower than the optimal debt ratio from the cost of capital approach.
- d. any of the above, depending on . . .

Explain.

There is a data set online that summarizes the latest debt ratio regression across the entire market.

# **Selecting the Optimal Debt Ratio**

Using the different approaches for estimating optimal debt ratios, we come up with different estimates of the right financing mix for Disney, Aracruz and Tata Chemicals. Table 8.24 summarizes our estimates:

Table 8.24 Summary of Predicted Debt Ratios

	Disney	Aracruz	Tata Chemicals
Actual Debt Ratio	27%	52.58%	34.02%
Optimal			
I. Operating income	50.00%	—	-
II. Standard Cost of capital	40.00%	10.00%	10.00%
III. Enhanced Cost of Capital	30.00%	10.00%	10.00%
IV. APV	50.00%	20.00%	10.00%
V. Comparable			
To industry	37.10%	34.22%	21.34%
To market	28.91%	_	-

Although there are differences in the estimates across the different approaches, a few consistent conclusions emerge: Disney, at its existing debt ratio, is under levered, relative

to every estimate of the optimal debt ratio, though it looks less under levered relative to the rest of the market, than it does relative to its own fundamentals or to the sector. Aracruz and Tata Chemicals are both over levered, relative to every estimate of the optimal debt ratio.

With Bookscape, we will stick with the conclusion that we drew earlier, based upon the cost of capital approach. The firm at its existing debt ratio is very close to its optimal and has the right amount of debt.

# Conclusion

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

- The first approach is based on operating income. Using historical data or forecasts, we develop a distribution of operating income across both good and bad scenarios. We then use a predefined acceptably probability of default to specify the maximum borrowing capacity.
- The second approach is the cost of capital—the weighted average of the costs of equity, debt, and preferred stock, where the weights are market value weights and the costs of financing are current costs. The objective is to minimize the cost of capital, which also maximizes the value of the firm. We also considered an enhanced version of this approach, where the cash flows also change as the debt ratio changes, and the optimal debt ratio is the one that delivers the highest firm value, rather than the lowest cost of capital.
- The APV approach estimates the value of the firm at different levels of debt by adding the present value of the tax benefits from debt to the unlevered firm's value, and then subtracting out the present value of expected bankruptcy costs. The optimal debt ratio is the one that maximizes firm value.
- The final approach is to compare a firm's debt ratio to similar firms. Although comparisons of firm debt ratios to an industry average are commonly made, they are generally not very useful in the presence of large differences among firms within the same industry. A cross-sectional regression of debt ratios against underlying financial variables brings in more information from the general population of firms and can be used to predict debt ratios for a large number of firms.

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

## Live Case Study

# The Optimal Financing Mix

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

Key Questions

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

# Framework for Analysis

- 1. Cost of Capital Approach
  - What is the current cost of capital for the firm?
  - What happens to the cost of capital as the debt ratio is changed?
  - At what debt ratio is the cost of capital minimized and firm value maximized? (If they are different, explain.)
  - What will happen to the firm value if the firm moves to its optimal?
  - What will happen to the stock price if the firm moves to the optimal and stockholders are rational?

#### 2. Building Constraints into the Process

- What rating does the company have at the optimal debt ratio? If you were to impose a rating constraint, what would it be? Why? What is the optimal debt ratio with this rating constraint?
- How volatile is the operating income? What is the "normalized" operating income of this firm, and what is the optimal debt ratio of the firm at this level of income?
- 3. Relative Analysis
  - Relative to the industry to which this firm belongs, does it have too much or too little in debt? (Do a regression, if necessary.)

• Relative to the rest of the firms in the market, does it have too much or too little in debt? (Use the market regression, if necessary.)

# Getting Information about Optimal Capital Structure

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

Online sources of information:

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

# **Problems and Questions**

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

Assets		Liabilities	
Fixed assets	\$4,000	Debt	\$2,500
Current assets	\$1,000	Equity	\$2,500
T 1.11.1	1 1 1 0 11		

In addition, you are provided the following information:

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

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

- The stock currently has a beta of 1.2. The riskfree rate is 8%.
- The tax rate for this firm is 40%.
  - a. What is the debt/equity ratio for this firm in book value terms? In market value terms?
  - b. What is the debt/(debt + equity) ratio for this firm in book value terms? In market value terms?
  - c. What is the firm's after-tax cost of debt?
  - d. What is the firm's cost of equity?
  - e. What is the firm's current cost of capital?

2. Now assume that Plastico is considering a project that requires an initial investment of \$100 million and has the following projected income statement (depreciation for the project is expected to be \$5 million a year forever.):

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

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

- a. Evaluate this project from the equity investors' standpoint. Does it make sense?
- b. Evaluate this project from the firm's standpoint. Does it make sense?
- c. In general, when would you use the cost of equity as your discount rate/benchmark?
- d. In general, when would you use the cost of capital as your benchmark?
- e. Assume, for economies of scale, that this project is going to be financed entirely with debt. What would you use as your cost of capital for evaluating this project?

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

• *Option 1*: Issue \$1 billion in new stock and repurchase half of its outstanding debt. This will make it an AAA-rated firm (AAA rated debt is yielding 11% in the marketplace).

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

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

- a. What is the cost of equity under each option?
- b. What is the after-tax cost of debt under each option?
- c. What is the cost of capital under each option?
- d. What would happen to (i) the value of the firm; (ii) the value of debt and equity; and (iii) the stock price under each option if you assume rational stockholders?
- e. From a cost of capital standpoint, which of the three options would you pick, or would you stay at your current capital structure?
- f. What role (if any) would the variability in Plastico's income play in your decision?
- g. How would your analysis change (if at all) if the money under the three options were used to take new investments (instead of repurchasing debt or equity)?

- h. What other considerations (besides minimizing the cost of capital) would you bring to bear on your decision?
- i. Intuitively, why doesn't the higher rating in option 1 translate into a lower cost of capital?
- 4. Plastico is interested in how it compares with its competitors in the same industry.

	Plastico	Competitors
Debt/Equity Ratio	50%	25%
Variance in EBITDA	20%	40%
EBITDA/MV of firm	25%	15%
Tax rate	40%	30%
R&D/sales	2%	5%

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

b. You have also run a regression of debt/equity ratios against these variables for all the firms on the NYSE and have come up with the following regression equation:
D/E = 0.10 - 0.5 (Variance in EBITDA) + 2.0 (EBITDA/MV) + 0.4 (Tax Rate) + 2.5 (R&D/Sales)

(All inputs to the regression were in decimals, i.e., 20% was inputted as 0.20.)

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

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

- Your stock has a beta of 1.5 and the riskfree rate is 8%.
- Your marginal tax rate is 46%.

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

- a. Given the marginal costs and benefits of borrowing the \$100 million, should you go ahead with it ?
- b. What is your best estimate of the weighted average cost of capital with and without the \$100 million in borrowing ?
- c. If you borrow the \$100 million, what will the price per share be after the borrowing?
- d. Assume that you have a project that requires an investment of \$100 million. It has expected before-tax revenues of \$50 million and costs of \$30 million a year in perpetuity. Is this a desirable project by your criteria? Why or why not?
- e. Does it make a difference in your decision if you were told that the cash flows from the project in **d** are certain?

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

- There are 100,000 shares outstanding at \$20/share. The stock has a beta of 1.15.
- The company has \$500,000 in long-term debt outstanding and is currently rated

BBB. The current market interest rate is 10% on BBB bonds and 6% on treasury bonds.

• The company's marginal tax rate is 40%.

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

Additional Debt*	New Rating	Interest Rate
\$500,000	BB	10.5
\$1,000,000	В	11.5
\$1,500,000	В-	13.5
\$2,000,000	С	15

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

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

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

c.What is the WACC before and after the additional debt?

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

Revenues/year	\$1,000,000
Cost of goods sold	\$400,000 (includes depreciation of
	\$100,000)
EBIT	\$600,000
Debt payments	\$100,000 (all interest payments)
Taxable Income	\$500,000
Tax	\$ <u>200,000</u>
After-tax profit	\$300,000

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

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

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

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

- a. What is the firm's optimal debt ratio?
- b. Assuming that the firm restructures by repurchasing stock with debt, what will the value of the stock be after the restructuring?

8. GenCorp, an automotive parts manufacturer, currently has \$25 million in outstanding debt and has 10 million shares outstanding. The book value per share is \$10, and the market value is \$25.

The company is currently rated A, its bonds have a yield to maturity of 10%, and the current beta of the stock is 1.06. The riskfree rate is 8% now, and the company's tax is 40%.

- a. What is the company's current weighted average cost of capital?
- b. The company is considering a repurchase of 4 million shares at \$25 per share with new debt. It is estimated that this will push the company's rating down to a B (with a yield to maturity of 13%). What will the company's WACC be after the stock repurchase?

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

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

The firm's income statement is as follows:

Revenues	\$250
Cost of Goods Sold (cogs)	\$175
Depreciation	\$25
EBIT	\$50
Long-term interest	\$10
EBT	\$40
Taxes	\$16
Net Income	\$24

The firm currently has 100 shares outstanding, selling at a market price of \$5 per share and the

bonds are selling at par. The firm's current beta is 1.12, and the riskfree rate is 7%.

- a. What is the firm's current cost of equity?
- b. What is the firm's current cost of debt?
- c. What is the firm's current weighted average cost of capital?
- a. Assume that management of Herbert's is considering doing a debt-equity swap (i.e., borrowing enough money to buy back seventy shares of stock at \$5 per share). It is

believed that this swap will lower the firm's rating to C and raise the interest rate on the company's debt to 15%.

- d. What is the firm's new cost of equity?
- e. What is the effective tax rate (for calculating the after-tax cost of debt) after the swap?
- f. What is the firm's new cost of capital?

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

Liability		Assets	
Long-term bonds	\$1.000	Fixed assets	\$1,700
Equity	\$1.000	Current assets	\$300
Total	\$1.000	Total	\$1,000

The firm's income statement looks as follows:

Revenues	\$1,000
Cost of Goods Sold (COGS)	\$400
Depreciation	\$100
EBIT	\$500
Long-term interest expense	\$100
EBT	\$400
Taxes	\$200
Net income	\$200

The firm's bonds are all twenty-year bonds with a coupon rate of 10% that are selling at 90% of face value (the yield to maturity on these bonds is 11%). The stocks are selling at a P/E ratio of 9 and have a beta of 1.25. The riskfree rate is 6%.

- a. What is the firm's current cost of equity?
- b. What is the firm's current after-tax cost of debt?
- c. What is the firm's current weighted average cost of capital?

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

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



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

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

EBIT	\$150 million
Interest expenses	\$20 million
Taxable income	\$130 million
Taxes	\$52 million
Net income	\$78 million

The current riskfree rate is 8%.

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

12. You have been asked by JJ Corporation, a California-based firm that manufacturers and services digital satellite TV systems, to evaluate its capital structure. They currently have 70 million shares outstanding trading at \$10 per share. In addition, the company has 500,000 convertible bonds, with a coupon rate of 8%, trading at \$1000 per bond. JJ is

rated BBB and the interest rate on BBB straight bonds is currently 10%. The beta for the company is 1.2, and the current risk-free rate is 6%. The tax rate is 40%.

- a. What is the firm's current debt/equity ratio?
- b. What is the firm's current weighted average cost of capital?

JJ Corporation is proposing to borrow \$250 million and use it for the following purposes:

- Buy back \$100 million worth of stock.
- Pay \$100 million in dividends.
- Invest \$50 million in a project with a NPV of \$25 million.

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

- c. What will the firm's cost of equity be after this additional borrowing?
- d. What will the firm's weighted average cost of capital be after this additional borrowing?
- e. What will the value of the firm be after this additional borrowing?

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

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

14. Upjohn, another major pharmaceutical company, is also considering whether it should borrow more. It has \$664 million in book value of debt outstanding and 173 million shares outstanding at \$30.75 per share. The company has a beta of 1.17, and faces a tax rate of 36%. The Treasury bond rate is 6.50%.

- a. If the interest expense on the debt is \$55 million, the debt has an average maturity of ten years, and the company is currently rated AA– (with a market interest rate of 7.50%), estimate the market value of the debt.
- b. Estimate the current cost of capital.
- c. It is estimated that if Upjohn moves to its optimal debt ratio, and no growth in firm value is assumed, the value per share will increase by \$1.25. Estimate the cost of capital at the optimal debt ratio.

15. Bethlehem Steel, one of the oldest and largest steel companies in the United States, is considering the question of whether it has any excess debt capacity. The firm has \$527 million in market value of debt outstanding and \$1.76 billion in market value of equity. The firm has earnings before interest and taxes of \$131 million and faces a corporate tax

rate of 36%. The company's bonds are rated BBB, and the cost of debt is 8%. At this rating, the firm has a probability of default of 2.30%, and the cost of bankruptcy is expected to be 30% of firm value.

- a. Estimate the unlevered value of the firm.
- b. Estimate the levered value of the firm, using the APV 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%.

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

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

The direct and indirect bankruptcy costs are estimated to be 25% of the firm value.

Estimate the optimal debt ratio of the firm, based on levered firm value.

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

	Actual	Optimal	Change
Debt ratio	4.42%	60.00%	55.58%
Beta for the stock	1.95	3.69	1.74
Cost of equity	18.61%	28.16%	9.56%
Bond rating	A-	B+	
After-tax cost of debt	5.92%	6.87%	0.95%

Cost of capital			18.04%	15.38%	-2.66%
Firm value	(with	no	\$3,343 million	\$3,921 million	\$578 million
growth)					
Stock price			\$39.50	\$46.64	\$7.14

This analysis was based on the 1995 EBIT of \$420 million and a tax rate of 36.90%.

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

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

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

- a. Estimate the current debt ratio for UAL.
- b. Estimate the current cost of capital.
- c. Based on 1995 operating income, the optimal debt ratio is computed to be 30%, at which point the rating will be BBB, and the market interest rate is 8.12%.
- d. Would the fact that 1995 operating income for airlines was depressed alter your analysis in any way? Explain why.

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

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

- c. Estimate the beta of the stock at 70% debt, using the conventional levered beta calculation. Reestimate the beta, on the assumption that C rated debt has a beta of 0.60. Which one would you use in your cost of capital calculation?
- d. Estimate the cost of capital at 70% debt.
- e. What will happen to firm value if Intel moves to a 70% debt ratio?
- f. What general lessons on capital structure would you draw for other growth firms?

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

- a. Estimate the unlevered value of the firm.
- b. Value the firm, if it increases its leverage to 50%. At that debt ratio, its bond rating would be BBB and the probability of default would be 2.30%.
- c. Assume now that NYNEX is considering a move into entertainment, which is likely to be both more profitable and riskier than the phone business. What changes would you expect in the optimal leverage?

21. A small, private firm has approached you for advice on its capital structure decision. It is in the specialty retailing business, and it had an EBIT last year of \$500,000.

- The book value of equity is \$1.5 million, but the estimated market value is \$6 million.
- The firm has \$1 million in debt outstanding and paid an interest expense of \$80,000 on the debt last year. (Based on the interest coverage ratio, the firm would be rated AA, and would be facing an interest rate of 8.25%.)
- The equity is not traded, but the average beta for comparable traded firms is 1.05, and their average debt/equity ratio is 25%.
  - a. Estimate the current cost of capital for this firm.
  - b. Assume now that this firm doubles it debt from \$1 million to \$2 million and that the interest rate at which it can borrow increases to 9%. Estimate the new cost of capital and the effect on firm value.

c. You also have a regression that you have run of debt ratios of publicly traded firms against firm characteristics:
 DBTFR = 0.15 + 1.05 (EBIT/Firm Value) - 0.10 (Beta)

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

- d. What are some of the concerns you might have in extending the approaches used by large publicly traded firms to estimate optimal leverage to smaller firms?
- e. 22. XCV Inc., which manufactures automobile parts for assembly, is considering the costs and the benefits of leverage. The CFO notes that the return on equity of the firm, which is only 12.75% now based on the current policy of no leverage, could be increased substantially by borrowing money. Is this true? Does it follow that the value of the firm will increase with leverage? Why or why not?