

Cash Flows and Other Topics in Capital Budgeting

Learning Objectives

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|  1 Identify guidelines by which we measure cash flows. | Guidelines for Capital Budgeting |
|  2 Explain how a project's benefits and costs—that is, its free cash flows—are calculated. | Calculating a Project's Free Cash Flows |
|  3 Explain the importance of options, or flexibility, in capital budgeting. | Options in Capital Budgeting |
|  4 Understand, measure, and adjust for project risk. | Risk and the investment Decisions |

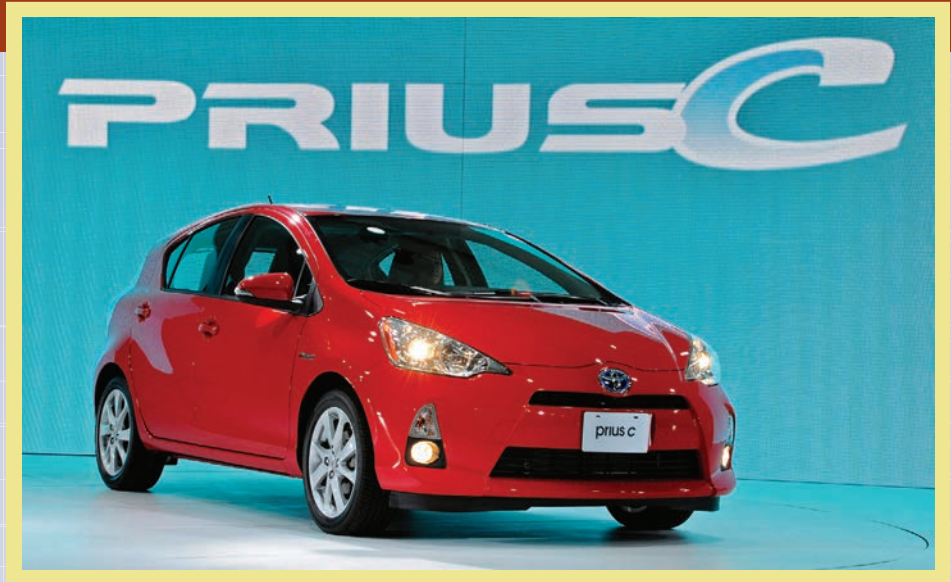
In 2001, when Toyota introduced the first-generation model of its gas-electric hybrid car, the Prius, it seemed more like a little science experiment than real competition for the auto industry. In fact, in 2004, General Motors vice chairman Bob Lutz dismissed hybrids as "an interesting curiosity." But that's all changed. As gas prices climbed to around \$4 a gallon in 2008, suddenly the gas-electric hybrid car seemed to be the way to go. In fact, from its humble beginnings in 2001 through April 2012 Toyota sold a total of 4 million hybrids and today is selling them at a pace of over 1 million per year.

How did Toyota gain leadership in the gas-electric hybrid car market? It started with its capital-budgeting decision to enter the gas-electric hybrid car market with the Prius and a very large investment—in excess of \$1 billion. This action vaulted Toyota into the lead in the hybrid car market and could leave Toyota in great shape for the future if ExxonMobil is right in its forecast that by 2040, hybrids and other advanced vehicles will account for nearly 50 percent of light-duty vehicles on the road, compared to only about 1 percent today.

Still, according to many analysts, the Prius is not yet a big money maker for Toyota. In fact, when the Prius first came out, Toyota had it priced so that it was losing about \$3,000 on each car it sold. For the Prius to be profitable there needed to be enough in the way of sales to cover its fixed costs, and that has finally happened as sales on the Prius have soared.

Toyota's initial decision to introduce the Prius and enter the hybrid car market was a difficult one. Would it simply move Toyota customers from one Toyota car to another, or would it bring new customers to Toyota? Was this a chance to gain a foothold on the new technology of the future, or were hybrid cars simply a fad?

How did Toyota make the decision to go ahead with the Prius and the flexible-fuel car? It used the basic techniques described in the previous chapter; but before it could apply those techniques, Toyota had to come up with the cash-flow forecasts and adjust for the risk associated with the project. That's what we'll be looking at in this chapter.



Guidelines for Capital Budgeting

To evaluate investment proposals, we must first set guidelines by which we measure the value of each proposal. In effect, we are deciding what is and what isn't a relevant cash flow.

b¹ Identify guidelines by which we measure cash flows.

Use Free Cash Flows Rather Than Accounting Profits

We use free cash flows, not accounting profits, as our measurement. The firm receives and is able to reinvest free cash flows, whereas accounting profits are shown when they are earned rather than when the money is actually in hand. Unfortunately, a firm's accounting profits and free cash flows may not be timed to occur together. For example, capital expenses, such as vehicles and plant and equipment, are depreciated over several years, with their annual depreciation subtracted from profits. Free cash flows correctly reflect the timing of benefits and costs—that is, when the money is received, when it can be reinvested, and when it must be paid out.

Think Incrementally

Unfortunately, calculating free cash flows from a project may not be enough. Decision makers must ask, *What new free cash flows will the company as a whole receive if the company takes on a given project?* What if the company does not take on the project? Interestingly, we may find that not all cash flows a firm expects from an investment proposal are incremental in nature. When measuring free cash flows, however, the trick is to think incrementally. In doing so, we will see that only incremental after-tax free cash flows matter. As such, our guiding rule in deciding if a free cash flow is incremental is to look at the company with, versus without, the new project. As you will see in the upcoming sections, this may be easier said than done.

Beware of Cash Flows Diverted from Existing Products

Assume for a moment that we are managers of a firm considering a new product line that might compete with one of our existing products and possibly reduce its sales. In determining the free cash flows associated with the proposed project, we should consider only the incremental sales brought to the company as a whole. New-product sales achieved at the cost



REMEMBER YOUR PRINCIPLES

If we are to make intelligent capital-budgeting decisions, we must accurately measure the timing of a project's benefits and costs, that is, when we receive money and when it leaves our hands. **Principle 1: Cash Flow Is What Matters** speaks directly to this. Remember, it is cash inflows that can be reinvested and cash outflows that involve paying out money.

of losing sales of other products in our line are not considered a benefit. For example, when Quaker Oats introduced Cap'n Crunch's Cozmic Crunch, the product competed directly with the company's Cap'n Crunch and Crunch Berries cereals. (In fact, Cozmic Crunch was almost identical to Crunch Berries, with the shapes changed to stars and moons, along with a packet of orange space dust that turns milk green.) Quaker meant to target the market niche held by Post Fruity Pebbles, but there was no question that sales recorded by Cozmic Crunch bit into—literally cannibalized—Quaker's existing product line.

Remember that we are interested only in the sales dollars to the firm if the project is accepted, as opposed to what the sales dollars would be if the project were rejected. Just moving sales from one product line to a new product line does not bring anything new into the company. But if sales are captured from competitors or if sales that would have been lost to new competing products are retained, then these are relevant incremental free cash flows.

Look for Incidental or Synergistic Effects

Although in some cases a new project may take sales away from a firm's current projects, in other cases a new effort might actually bring new sales to the existing line.

In April 2010, Apple introduced the first-generation iPad. To say the least, the iPad has been extremely successful with total sales since it was introduced easily topping the 100 million mark by the end of 2012. Without question, Apple has made a lot of money on sales of the iPad, but introducing the iPad has also resulted in increased sales of other Apple products. Impressed by the simplicity and elegance of the iPad, many PC users began making the switch to other Apple products. As a result, the introduction of the iPad not only generated iPad sales but also led to increased sales of Macs and iPhones as many new customers switched their user systems to exclusively Apple products. In addition, the ease of use of the iPad also convinced many corporate customers to give Apple products a second look. This is called a *synergistic* effect—the cash flow that comes from the sale of any Apple product that would not have occurred if a customer had not purchased an iPad. Synergistic effects are quite common in the business world.

If you owned a convenience store and were considering adding gas pumps, would you evaluate the project looking only at cash flows from the sale of gas? No. You would look at any new sales to any part of your business that the new gas pumps brought in. No doubt the additional traffic that the gas pumps bring in would increase your convenience-store sales. As such, these cash flows would be considered in evaluating whether or not to install the gas pumps. In effect, you should look at any change in cash flow to the company as a whole that results from the project being evaluated.

Work in Working-Capital Requirements

Many times a new project involves an additional investment in working capital. This may take the form of new inventory to stock a sales outlet, an additional investment in accounts receivable resulting from additional credit sales, or an increased investment in cash to operate cash registers, and more. Working-capital requirements are considered a free cash flow even though they do not leave the company. Generally, working-capital requirements are tied up over the life of the project. When the project terminates, there is usually an offsetting cash inflow as the working capital is recovered, although this offset is not perfect because of the time value of money.

Consider Incremental Expenses

Just as cash inflows from a new project are measured on an incremental basis, expenses, or cash outflows, should also be measured on an incremental basis. For example, if introducing a new product line necessitates training the sales staff, the after-tax cash flow associated with the training program must be considered a cash outflow and charged against the project. Likewise, if accepting a new project dictates that a production facility be reengineered, the cash flows associated with that capital investment should be charged against the project, and they will then be depreciated over the life of the project. Again, any incremental

after-tax cash flow affecting the company as a whole is a relevant cash flow, whether it is flowing in or flowing out.

Remember That Sunk Costs Are Not Incremental Cash Flows

Only cash flows that are affected by the decision making at the moment are relevant in capital budgeting. The manager asks two questions: (1) Will this cash flow occur if the project is accepted? (2) Will this cash flow occur if the project is rejected? Yes to the first question and no to the second equals an incremental cash flow. For example, let's assume you are considering introducing a new taste treat called Puddin' in a Shoe. You would like to do some test-marketing before production. If you are considering the decision to test-market and have not yet done so, the costs associated with the test-marketing are relevant cash flows. Conversely, if you have already test-marketed, the cash flows involved in test-marketing are no longer relevant to the project's evaluation. It's a matter of timing. Regardless of what you might decide about future production, the cash flows allocated to the marketing test have already occurred. Cash flows that have already taken place are often referred to as "sunk costs" because they have been sunk into the project and cannot be undone. As a rule, any cash flows that are not affected by the accept/reject criterion should not be included in capital-budgeting analysis.

Account for Opportunity Costs

Now we will focus on the cash flows that are lost because a given project consumes scarce resources that would have produced cash flows if that project had been rejected. This is the opportunity cost of doing business. For example, a product consumes valuable floor space in a production facility. Although the cash flow is not obvious, the real question remains: What else could be done with this space? The space could have been rented out, or another product could have been stored there. The key point is that opportunity-cost cash flows should reflect the net cash flows that would have been received if the project under consideration were rejected. Again, we are analyzing the cash flows to the company as a whole, with or without the project.

Decide If Overhead Costs Are Truly Incremental Cash Flows

Although we certainly want to include any incremental cash flows resulting in changes from overhead expenses such as utilities and salaries, we also want to make sure that these are truly incremental cash flows. Many times, overhead expenses—heat, light, rent—occur whether a given project is accepted or rejected. There is often not a single, specific project to which these expenses can be allocated. Thus, the question is not whether the project benefits from the overhead costs a firm spends but whether they are incremental cash flows associated with the project and relevant to capital budgeting.

Ignore Interest Payments and Financing Flows

To evaluate new projects and determine cash flows, we must separate the investment decision from the financing decision. Interest payments and other financing cash flows that might result from raising funds to finance a project should not be considered incremental cash flows. If accepting a project means we have to raise new funds by issuing bonds, the interest charges associated with raising funds are not a relevant cash outflow. Why? Because when we discount the incremental cash flows back to the present at the required rate of return, we are implicitly accounting for the cost of raising funds to finance the new project. In essence, the required rate of return reflects the cost of the funds needed to support the project. Managers first determine the desirability of the project and then determine how best to finance it.

Concept Check

1. What is an incremental cash flow? What is a sunk cost? Why must you account for opportunity costs?
2. If Ford introduces a new auto line, might some of the cash flows from that new car line be diverted from existing product lines? How should you deal with this?

FINANCE AT WORK

UNIVERSAL STUDIOS

A major capital-budgeting decision led Universal Studios to build its Islands of Adventure theme park. The purpose of this \$2.6 billion investment by Universal was to get first crack at the tourist's dollar in Orlando, Florida. Although this capital-budgeting decision may, on the surface, seem like a relatively simple one, forecasting the expected cash flows associated with the theme park was, in fact, quite complicated.

To begin with, Universal was introducing a product that competes directly with itself. The original Universal Studios park features rides such as "Back to the Future," Jimmy Neutron's Nicktoon Blast," and "Men in Black Alien Attack." Were there enough tourist dollars to support both theme parks, or would the new Islands of Adventure park simply cannibalize ticket sales from the older Universal Studios park? In addition, what would happen if Disney countered with a new park of its own?

In the case of Universal's Islands of Adventure, we could ask what would happen to attendance at the original Universal Studios park if the new park were not opened versus what the attendance would be with the new park? In addition, would tourist traffic through the Islands of Adventure lead to addi-

tional sales and viewership of Comcast offerings and NBC Universal television and movies? Why do we care? Comcast owns 51 percent of NBC Universal, and Universal Parks and Resorts is owned by NBC Universal.

From Universal's point of view, the objective may have been threefold: to increase its share of the tourist market, to keep from losing market share as tourists look for the latest in technological rides and entertainment, and to promote NBC Universal's ventures such as television and movies. However, for companies in very competitive markets, the evolution and introduction of new products may serve more to preserve market share than to expand it. That explains Universal's proposed quarter of a billion dollar expansion of Harry Potter's Wizarding World to include the Gringotts Bank. After all, when Wizarding World first opened, attendance for the entire park climbed by 52 percent, and the park's hotels, dining, shopping, and all else in the park became more profitable. The bottom line here is that with respect to estimating cash flows, things are many times more complicated than they first appear. As such, we have to dig deep to understand how a firm's free cash flows are affected by the decision at hand.

b² Explain how a project's benefits and costs—that is, its free cash flows—are calculated.

Calculating a Project's Free Cash Flows

As we have explained, in measuring cash flows, we will focus our attention on the difference in the firm's after-tax free cash flows *with* versus *without* the project—the project's *free cash flows*. The worth of our decision depends on the accuracy of our cash flow estimates. For this reason, we first examined the question of which cash flows are relevant. Now we will see that, in general, a project's free cash flows will fall into one of three categories: (1) the initial outlay, (2) the annual free cash flows over the project's life, and (3) the terminal free cash flow. Once we have taken a look at these categories, we will take on the task of measuring these free cash flows.

What Goes into the Initial Outlay

The **initial outlay** is the *immediate cash outflow necessary to purchase the asset and put it in operating order*. This amount includes (1) the cost of purchasing the asset and getting it operational, including the purchase price, shipping and installation, and any training costs for employees who will be operating the equipment, and (2) any increases in working-capital requirements. The working capital includes any increases in current assets, less any increase in accounts payable. If we are considering a new sales outlet, there might be additional cash flows associated with making a net investment in working capital in the form of increased accounts receivable, inventory, and cash necessary to operate the outlet. Although these cash flows are not included in the cost of the asset or even shown as an expense on the income statement, they must be included in our analysis. The after-tax cost of expense items incurred as a result of the new investment must also be included as cash outflows—for example, any training expenses that would not have been incurred otherwise.

Finally, if the investment decision is a replacement decision, the cash inflow associated with the selling price of the old asset, in addition to any tax effects resulting from its sale, must be included. It should be stressed that the incremental nature of the cash flow is of great importance. In many cases, if the project is not accepted, then status quo for the firm

initial outlay the immediate cash outflow necessary to purchase the asset and put it in operating order.

will simply not continue. Thus, we must be realistic in estimating what the cash flows to the company would be if the new project were not accepted.

In a replacement decision, the initial outlay is equal to the cost of the new asset, less the amount we received from selling the old asset. Typically, when the old asset is sold there will be a gain or loss from the sale, which means we will have to pay taxes if there is a gain from the sale or a reduction of taxes if there is a loss. Thus the initial outlay is calculated as follows:

$$\text{Initial outlay} = \text{cost of new asset} - \text{sales price of the old asset} +/\text{taxes recovered or paid from a loss or gain on the sale of the old asset}$$

So we need to state the sale of the old asset on an after-tax basis. When it comes to the taxes, there are three possible situations that can result:

1. The old asset is sold for a price above the depreciated value. Here the difference between the old machine's selling price and its depreciated value is considered a taxable gain and is taxed at the marginal corporate tax rate. If, for example, the old machine was originally purchased for \$15,000, had a book value of \$10,000, and was sold for \$17,000, assuming the firm's marginal corporate tax rate is 34 percent, the taxes due from the gain would be $(\$17,000 - \$10,000) \times (0.34)$, or \$2,380.
2. The old asset is sold for its depreciated value. In this case, no taxes result, because there is neither a gain nor a loss in the asset's sale.
3. The old asset is sold for less than its depreciated value. In this case, the difference between the depreciated book value and the salvage value of the asset is a taxable loss and can be used to offset capital gains and thus results in a tax savings. For example, if the depreciated book value of the asset is \$10,000 and it is sold for \$7,000, we have a \$3,000 loss. Assuming the firm's marginal corporate tax rate is 34 percent, the cash inflow from the tax savings is $(\$10,000 - \$7,000) \times (0.34)$, or \$1,020.

What Goes into the Annual Free Cash Flows Over the Project's Life

Annual free cash flows come from operating cash flows (that is, what you've made as a result of taking on the project), changes in working capital, and any capital spending that might take place. In our calculations we'll begin with our pro forma statements and work from there. We will have to make adjustments for interest, depreciation, and working capital, along with any capital expenditures that might occur.

Before we look at the calculations, let's look at the types of adjustments that we're going to have to make to go from operating cash flows to free cash flows. To do this we'll have to make adjustments for:

- ◆ **Depreciation and taxes** Depreciation is a non-cash-flow expense. It occurs because you bought a fixed asset (for example, you built a plant) in an earlier period, and now, through depreciation, you're expensing it over time—but depreciation does not involve a cash flow. That means the firm's net income understates cash flows by this amount. Therefore, we'll want to compensate for this by adding depreciation back into our measure of accounting income when calculating cash flows.

Although depreciation expense is a non-cash expense, it does affect cash flow because it is a tax-deductible expense. The higher the depreciation expense, the lower the firm's profits, which results in lower taxes.

There are a number of different methods for computing depreciation expense. For instance, we could use the Accelerated Cost Recovery System (ACRS) provided by the IRS. However, for our purposes, we will use a simplified straight-line method, where we calculate annual depreciation by taking the project's initial depreciable value and dividing by its depreciable life as follows:

$$\text{Annual depreciation using the simplified straight-line method} = \frac{\text{initial depreciable value}}{\text{depreciable life}}$$

The initial depreciable value is equal to the cost of the asset plus any expenses necessary to get the new asset into operating order.

This is not how depreciation would actually be calculated. The reason we have simplified the calculation is to allow you to focus directly on what should and should not be included in the cash-flow calculations. Moreover, because the tax laws change rather frequently, we are more interested in recognizing the tax implications of depreciation than in understanding the specific depreciation provisions of the current tax laws.

- ◆ **Interest expenses** There's no question that if you take on a new project, you'll have to pay for it somehow—either through internally generated cash or, say, by selling new stocks or bonds. In other words, there's a cost to that money. We recognize this principle when we discount future cash flows back to the present at the required rate of return. Remember, the project's required rate of return is the rate of return that it must earn to justify your taking on the project. It recognizes the risk of the project and the fact that there is an opportunity cost of money. If we discounted the future cash flows back to the present and also subtracted out interest expenses, then we would have double counted the cost of money—accounting for the cost of money once when we subtracted out interest expenses and once when we discounted the cash flows back to the present. Therefore, we want to make sure that cash flows are not lowered by financing costs such as interest payments. That means we'll want to make sure that financing flows (interest expense) are not included.
- ◆ **Changes in net working capital** As we have explained, many projects require an increased investment in working capital. For example, some of the new sales may be credit sales resulting in an increased investment in accounts receivable. Also, in order to produce and sell the product, the firm may have to increase its investment in inventory. On the other hand, some of this increased working-capital investment may be financed by an increase in accounts payable. Because all these potential changes are changes in assets and liabilities, they don't affect accounting income. Thus, if this project brings with it a positive change in net working capital, then it means money is going to be tied up in increased working capital, and this would be a cash outflow. That means we'll have to make sure we account for any changes in working capital that might occur.
- ◆ **Changes in capital spending** From an accounting perspective, the cash flow associated with the purchase of a fixed asset is not an expense. For example, when Marriott spends \$50 million on building a new hotel resort, although there is a significant cash outflow, there is no accompanying expense. Instead, the \$50 million cash outflow creates an annual depreciation expense over the life of the hotel. We'll want to make sure we include any changes in capital spending such as this in our cash-flow calculations.

What Goes into the Terminal Cash Flow

The terminal cash flow is associated with the project's termination and includes the annual free cash flow and salvage value of the project plus or minus any taxable gains or losses associated with its sale. Under the current tax laws, in most cases there will be tax payments associated with the salvage value at termination. This is because the current laws allow all projects to be depreciated to zero. So, if a project has a book value of zero at termination and a positive salvage value, then that salvage value will be taxed. The tax effects associated with the salvage value of the project at termination are determined exactly like the tax effects on the sale of the old machine associated with the initial outlay. The salvage value proceeds are compared with the depreciated value, in this case zero, to determine the tax.

In addition to the salvage value, there may be a cash outlay associated with the project termination. For example, at the close of a strip-mining operation, the mine must be refilled in an ecologically acceptable manner.

Now let's put this all together and measure the project's free cash flows.

Calculating the Free Cash Flows

Free cash-flow calculations can be broken down into three basic parts: cash flows from operations, cash flows associated with working-capital requirements, and capital-spending

cash flows. Let's begin our discussion by looking at how to measure cash flows from operations and then move on to discuss measuring cash flows from working-capital requirements and capital spending.

STEP 1 *Measure the project's change in the firm's after-tax operating cash flows.* An easy way to calculate operating cash flows is to take the information provided on the firm's projected income statement and simply convert the accounting information into cash-flow information. To do this we take advantage of the fact that the difference between the change in sales and the change in costs should be equal to the change in earnings before interest and taxes (EBIT) plus depreciation.

Under this method, the calculation of a project's operating cash flow involves three steps. First, we determine the company's *earnings before interest and taxes (EBIT)* with and without this project. Second, we subtract out the change in taxes. Keep in mind that in calculating the change in taxes, we will ignore any interest expenses. Third, we adjust this value for the fact that depreciation, a non-cash-flow item, has been subtracted out in the calculation of EBIT. We do this by adding back depreciation. Thus, operating cash flows are calculated as follows:

$$\begin{aligned}\text{Operating cash flows} &= \text{change in earnings before interest and taxes (EBIT)} \\ &\quad - \text{change in taxes} \\ &\quad + \text{change in depreciation}\end{aligned}$$

EXAMPLE 11.1

Calculating the operating cash flows

Assume that a new project will annually generate additional revenues of \$1,000,000 and additional fixed and variable costs of \$500,000, while increasing depreciation by \$150,000 per year. If the firm's marginal tax rate is 34 percent, what are the operating cash flows to the firm?

STEP 1: FORMULATE A SOLUTION STRATEGY

The calculation of the operating cash flows based on the firm's earnings before interest and taxes (EBIT) is

$$\text{EBIT} = \text{revenue} - \text{fixed and variable costs} - \text{depreciation}$$

After determining the firm's EBIT, we subtract out the change in taxes. Finally, we adjust this value for the fact that depreciation, a non-cash-flow item, has been subtracted out in the calculation of EBIT. Thus, we add back depreciation to calculate the operating cash flows.

$$\begin{aligned}\text{Operating cash flows} &= \text{change in earnings before interest and taxes} \\ &\quad - \text{change in taxes} \\ &\quad + \text{change in depreciation}\end{aligned}$$

STEP 2: CRUNCH THE NUMBERS

Given this, the firm's net profit after tax, or net income, can be calculated as follows:

Revenue	\$1,000,000
– Fixed and variable costs	500,000
– Depreciation	150,000
= EBIT	\$ 350,000
– Taxes (34%)	119,000
= Net income	\$ 231,000

The operating cash flows are calculated as follows:

$$\begin{aligned}\text{Operating cash flows} &= \text{change in earnings before interest and taxes} \\ &\quad - \text{change in taxes} \\ &\quad + \text{change in depreciation} \\ &= \$350,000 - \$119,000 + \$150,000 = \$381,000\end{aligned}$$

STEP 3: ANALYZE YOUR RESULTS

By converting the firm's accounting information into cash flows, we are able to measure the exact timing of cash flows from operations. In this case it appears that the new project can annually generate \$381,000 operating cash flows to the firm.

STEP 2 *Calculate the cash flows from the change in the firm's net working capital.* As we mentioned earlier in this chapter, many times a new project will involve additional investment in working capital—perhaps new inventory to stock a new sales outlet or simply additional investment in accounts receivable. There also may be some spontaneous short-term financing—for example, increases in accounts payable—that result from the new project. Thus, the change in net working capital is the additional investment in current assets minus any additional short-term liabilities that were generated.

STEP 3 *Calculate the cash flows from the change in the firm's capital spending.* Although there is generally a large cash outflow associated with a project's initial outlay, there may also be additional capital-spending requirements over the life of the project. For example, you may know ahead of time that the plant will need some minor retooling in the second year of the project in order to keep the project abreast of new technological changes that are expected to take place. In effect, we will look at the company with and without the new project, and any changes in capital spending that occur are relevant.

STEP 4 *Putting it together: calculating a project's free cash flows.* Thus, a project's free cash flows are:

$$\begin{aligned}\text{Project's free cash flows} &= \text{change in earnings before interest and taxes (EBIT)} \\ &\quad - \text{change in taxes} \\ &\quad + \text{change in depreciation} \\ &\quad - \text{change in net working capital} \\ &\quad - \text{change in capital spending}\end{aligned}$$

To estimate the changes in EBIT, taxes, depreciation, net working capital, and capital spending, we start with estimates of how many units we expect to sell, what the costs—both fixed and variable—will be, what the selling price will be, and what the required capital investment will be. From there we can put together a pro forma statement that should provide us with the data we need to estimate the project's free cash flows. However, you must keep in mind that our capital-budgeting decision will only be as good as our estimates of the costs and future demand associated with the project. In fact, most capital-budgeting decisions that turn out to be bad decisions are not so because of using a bad decision rule but because the estimates of future demand and costs were inaccurate. Let's look at an example.

EXAMPLE 11.2

Calculating a project's free cash flows

You are considering expanding your product line that currently consists of Lee's Press-on Nails to take advantage of the fitness craze. The new product you are considering introducing is Press-on Abs. You feel you can sell 100,000 of these per year for 4 years (after which time this project is expected to shut down because forecasters predict looking healthy will no longer be in vogue and looking like a couch potato will). The

Press-on Abs would sell for \$6.00 each, with variable costs of \$3.00 for each one produced. Annual fixed costs associated with production would be \$90,000. In addition, there would be a \$200,000 initial capital expenditure associated with the purchase of new production equipment. It is assumed that this initial expenditure will be depreciated, using the simplified straight-line method, down to zero over 4 years. The project will also require a one-time initial investment of \$30,000 in net working capital associated with the inventory. Finally, assume that the firm's marginal tax rate is 34 percent. What are the free cash flows to the firm?

STEP 1: FORMULATE A SOLUTION STRATEGY

In general, a project's free cash flows will fall into one of three categories: (1) the initial outlay, (2) the annual free cash flows over the project's life, and (3) the terminal cash flow. Let's begin by calculating the initial outlay.

STEP 2: CRUNCH THE NUMBERS

Initial Outlay

In this example, the initial outlay is the \$200,000 initial capital expenditure plus the investment of \$30,000 in net working capital, for a total of \$230,000.

Annual Free Cash Flows

Table 11-1 calculates the annual change in earnings before interest and taxes. This calculation begins with the change in sales (Δ Sales) and subtracts the change in fixed and variable costs in addition to the change in depreciation, to arrive at the change in earnings before interest and taxes (Δ EBIT). Depreciation is calculated using the simplified straight-line method, which is simply the depreciable value of the asset (\$200,000) divided by the asset's expected life of 4 years. Taxes are then calculated assuming a 34 percent marginal tax rate. Once we have calculated EBIT and taxes, we don't need to go any further, because these are the only two values from the income statement that we need. In addition, in this example there is not any annual increase in working capital associated with the project under consideration. Also notice that we have ignored any interest payments and financing flows that might have occurred. As mentioned earlier, when we discount the free cash flows back to the present at the required rate of return, we are implicitly accounting for the cost of the funds needed to support the project.

The project's annual change in operating cash flow is calculated in Table 11-2. Remember: *The project's annual free cash flow is simply the change in operating cash flow less any change in net working capital and less any change in capital spending.*

TABLE 11-1 Calculating the Annual Change in Earnings Before Interest and Taxes for the Press-on Abs Project

Δ Sales (100,000 units at \$6.00/unit)	\$ 600,000
Less: Δ Variable costs (variable cost \$3.00/unit)	\$ 300,000
Less: Δ Fixed costs	\$ 90,000
Equals: EBITDA (assuming amortization is 0)	\$ 210,000
Less: Δ Depreciation (\$200,000/4 years)	\$ 50,000
Equals: Δ EBIT	\$ 160,000
Less: Δ Taxes: (taxed at 34%)	\$ 54,400
Equals: Δ Net income	\$ 105,600

TABLE 11-2 Calculating the Annual Change in Operating Cash Flow, Press-on Abs Project

Δ Earnings before interest and taxes (EBIT)	\$160,000
Minus: Δ Taxes	\$ 54,400
Plus: Δ Depreciation	\$ 50,000
Equals: Δ Operating cash flow	\$155,600

Terminal Cash Flow

For this project, the terminal cash flow is quite simple. The only unusual cash flow at the project's termination is the recapture of the net working capital associated with the project. In effect, the investment in inventory of \$30,000 is liquidated when the project is shut down in 4 years.

Keep in mind that in calculating free cash flow we subtract out the change in net working capital, but because the change in net working capital is negative (we are reducing our investment in inventory), we are subtracting a negative number, which has the effect of adding it back in. Thus, working capital was a negative cash flow when the project began and we invested in inventory, but at termination it becomes a positive offsetting cash flow when the inventory was liquidated. The calculation of the terminal free cash flow is illustrated in Table 11-3.

STEP 3: ANALYZE YOUR RESULTS

In this example there are no changes in net working capital and capital spending over the life of the project. This is not the case for all projects that you will consider. For example, on a project where sales increase annually, it is likely that working capital will also increase each year to support a larger inventory and a higher level of accounts receivable. Similarly, on some projects the capital expenditures may be spread out over several years. The point here is that what we are trying to do is look at the firm with this project and without this project and measure the change in cash flows other than any interest payments and financing flows that might occur.

If we were to construct a free cash-flow diagram from this example (Figure 11-1), it would have an initial outlay of \$230,000, the free cash flows during years 1 through 3 would be \$155,600, and the free cash flow in the terminal year would be \$185,600.

TABLE 11-3 Calculating the Terminal Free Cash Flow, Press-on Abs Project

Δ Earnings before interest and taxes (EBIT)	\$160,000
Minus: Δ Taxes	\$ 54,400
Plus: Δ Depreciation	\$ 50,000
Minus: Δ Net working capital	(\$ 30,000)*
Equals: Δ Free cash flow	<u>\$185,600</u>

*Because the change in net working capital is negative (we are reducing our investment in inventory), we are subtracting a negative number, which has the effect of adding it back in.

FIGURE 11-1 Free Cash-Flow Diagram for Press-on Abs

YEAR	0	1	2	3	4
Cash Flow	−\$230,000	155,600	155,600	155,600	185,600

A Comprehensive Example: Calculating Free Cash Flows

Now let's put what we know about capital budgeting together and look at a capital-budgeting decision for a firm in the 34 percent marginal tax bracket with a 15 percent required rate of return or cost of capital. The project we are considering involves the introduction of a new electric scooter line by Raymobile. Our first task is that of estimating cash flows, which is the focus of this section. This project is expected to last 5 years and then, because this is somewhat of a fad product, be terminated. Thus, our first task becomes that of estimating the initial outlay, the annual free cash flows, and the terminal free cash flow. Given the information in Table 11-4, we want to determine the free cash flows associated with the project. Once we have that, we can easily calculate the project's net present value, the profitability index, and the internal rate of return and apply the appropriate decision criteria.

TABLE 11-4 Raymobile Scooter Line Capital-Budgeting Example

Cost of new plant and equipment	\$9,700,000												
Shipping and installation costs	\$ 300,000												
Unit sales													
	<table> <tr> <th>YEAR</th><th>UNITS SOLD</th></tr> <tr> <td>1</td><td>50,000</td></tr> <tr> <td>2</td><td>100,000</td></tr> <tr> <td>3</td><td>100,000</td></tr> <tr> <td>4</td><td>70,000</td></tr> <tr> <td>5</td><td>50,000</td></tr> </table>	YEAR	UNITS SOLD	1	50,000	2	100,000	3	100,000	4	70,000	5	50,000
YEAR	UNITS SOLD												
1	50,000												
2	100,000												
3	100,000												
4	70,000												
5	50,000												
Sales price per unit	\$150/unit in years 1 through 4, \$130/unit in year 5												
Variable cost per unit	\$80/unit												
Annual fixed costs	\$500,000 in years 1–5												
Working-capital requirements	There will be an initial working-capital requirement of \$100,000 just to get production started. Then, for each year, the <i>total</i> investment in net working capital will be equal to 10 percent of the dollar value of sales for that year. Thus, the investment in working capital will increase during years 1 and 2, then decrease in year 4. Finally, all working capital will be liquidated at the termination of the project at the end of year 5.												
The depreciation method	We use the simplified straight-line method over 5 years. It is assumed that the plant and equipment will have no salvage value after 5 years. Thus, annual depreciation is \$2,000,000/year for 5 years.												

To determine the differential annual free cash flows, we first need to determine the annual change in operating cash flow. To do this we will take the change in EBIT, subtract out the change in taxes, and then add in the change in depreciation. This is shown in Section II of Table 11-5. We first determine what the change in sales revenue will be by multiplying the units sold times the sale price. From the change in sales revenue, we subtract out variable costs, which are \$80 per unit. Then, the change in fixed costs is subtracted out, and the result is earnings before interest, taxes, depreciation, and amortization (EBITDA). Subtracting the change in depreciation and amortization, which in this case is assumed to be zero, from EBITDA then leaves us with the change in earnings before interest and taxes (EBIT). From the change in EBIT, we can then calculate the change in taxes, which are assumed to be 34 percent of EBIT.

Using the calculations provided in Section I of Table 11-5, we then calculate the operating cash flow in Section II of Table 11-5. As you recall, the operating cash flow is simply EBIT minus taxes, plus depreciation.

To calculate the annual free cash flows from this project, we subtract the change in net working capital and the change in capital spending from operating cash flow. Thus, the first step becomes determining the change in net working capital, which is shown in Section III of Table 11-5. The change in net working capital generally includes both increases in inventory and increases in accounts receivable that naturally occur as sales increase from the introduction of the new product line. Some of the increase

CAN YOU DO IT?

CALCULATING OPERATING CASH FLOWS

Assume that a new project will generate revenues of \$300,000 annually, and the annual cash expenses, including both fixed and variable costs, will be \$190,000 per year. Depreciation will be \$20,000 per year. In addition, the firm's marginal tax rate is 40 percent. Calculate the operating cash flows.

(The solution can be found on page 357.)

TABLE 11-5 Calculating the Free Cash Flow for Raymobile Scooters

Year	0	1	2	3	4	5
Section I. Calculate the Change in EBIT, Taxes, and Depreciation (This Becomes an Input in the Calculation of Operating Cash Flow in Section II)						
Units sold		50,000	100,000	100,000	70,000	50,000
Sales price		\$ 150	\$ 150	\$ 150	\$ 150	\$ 130
Sales revenue		\$7,500,000	\$15,000,000	\$15,000,000	\$10,500,000	\$6,500,000
Less: Variable costs		4,000,000	8,000,000	8,000,000	5,600,000	4,000,000
Less: Fixed costs		500,000	500,000	500,000	500,000	500,000
Equals: EBITDA		\$3,000,000	\$ 6,500,000	\$ 6,500,000	\$ 4,400,000	\$2,000,000
Less: Depreciation (amortization is assumed to be 0)		2,000,000	2,000,000	2,000,000	2,000,000	2,000,000
Equals: EBIT		\$1,000,000	\$ 4,500,000	\$ 4,500,000	\$ 2,400,000	0
Taxes (@34%)		340,000	1,530,000	1,530,000	816,000	0
Section II. Calculate Operating Cash Flow (This Becomes an Input in the Calculation of Free Cash Flow in Section IV)						
Operating cash flow:						
EBIT		\$1,000,000	\$ 4,500,000	\$ 4,500,000	\$ 2,400,000	\$ 0
Minus: Taxes		340,000	1,530,000	1,530,000	816,000	0
Plus: Depreciation		2,000,000	2,000,000	2,000,000	2,000,000	2,000,000
Equals: Operating cash flows		<u>\$2,660,000</u>	<u>\$ 4,970,000</u>	<u>\$ 4,970,000</u>	<u>\$ 3,584,000</u>	<u>\$2,000,000</u>
Section III. Calculate the Net Working Capital (This Becomes an Input in the Calculation of Free Cash Flow in Section IV)						
Change in net working capital:						
Revenue		\$7,500,000	\$15,000,000	\$15,000,000	\$10,500,000	\$6,500,000
Initial working-capital requirement	\$ 100,000					
Net working-capital needs		750,000	1,500,000	1,500,000	1,050,000	650,000
Liquidation of working capital						650,000
Change in working capital	100,000	650,000	750,000	0	(450,000)	(1,050,000)
Section IV. Calculate Free Cash Flow (Using Information Calculated in Sections II and III, in Addition to the Change in Capital Spending)						
Free cash flow:						
Operating cash flow		\$2,660,000	\$ 4,970,000	\$ 4,970,000	\$ 3,584,000	\$2,000,000
Minus: Change in net working capital	\$ 100,000	650,000	750,000	0	(450,000)	(1,050,000)
Minus: Change in capital spending	10,000,000	0	0	0	0	0
Equals: Free cash flow	<u>\$ (10,100,000)</u>	<u>\$2,010,000</u>	<u>\$ 4,220,000</u>	<u>\$ 4,970,000</u>	<u>\$ 4,034,000</u>	<u>\$3,050,000</u>

in accounts receivable may be offset by increases in accounts payable, but, in general, most new projects involve some type of increase in net working capital. In this example, there is an initial working capital requirement of \$100,000. In addition, for each year the total investment in net working capital will be equal to 10 percent of sales for each year. Thus, the investment in working capital for year 1 is \$750,000 (because sales are estimated to be \$7,500,000). Working capital will already be at \$100,000, so the change in net working capital will be \$650,000. Net working capital will continue to increase during years 1 and 2, then decrease in year 4. Finally, all working capital is liquidated at the termination of the project at the end of year 5.

With the operating cash flow and the change in net working capital already calculated, the calculation of the project's free cash flow becomes easy. All that is missing is the change in capital spending, which in this example will simply be the \$9,700,000 for plant and equipment plus the \$300,000 for shipping and installation. Thus, the change in capital spending becomes \$10,000,000. We then need merely to take operating cash flow and subtract from it both the change in net working capital and the change in capital spending. This is done in Section IV of Table 11-5 with the annual free cash flows given in the last row in that table. A free cash flow diagram for this project is provided in Figure 11-2.

FIGURE 11-2 Free Cash-Flow Diagram for the Raymobile Scooter Line

	$r = 15\%$					
YEAR	0	1	2	3	4	5
Cash Flow	−\$10,100,000	2,010,000	4,220,000	4,970,000	4,034,000	3,050,000

DID YOU GET IT?

CALCULATING OPERATING CASH FLOWS

You were asked to determine the operating cash flows for a project. Operating cash flows are calculated as:

$$\begin{aligned} \text{Operating cash flows} &= \text{change in earnings before interest and taxes (EBIT)} \\ &\quad - \text{change in taxes} \\ &\quad + \text{change in depreciation} \end{aligned}$$

STEP 1 Calculate the change in EBIT

Revenue	\$300,000
− Cash fixed and variable expenses	190,000
− Depreciation	20,000
= EBIT	<u>\$ 90,000</u>

STEP 2 Calculate taxes by multiplying the increase in EBIT times the marginal tax rate of 40 percent

Change in EBIT	\$90,000
Times: Taxes (40%)	= \$36,000

STEP 3 Calculate operating cash flows

$$\begin{aligned} \text{Operating cash flows} &= \text{change in earnings before interest and taxes (EBIT)} \\ &\quad - \text{change in taxes} \\ &\quad + \text{change in depreciation} \\ &= \$90,000 - \$36,000 + \$20,000 = \$74,000 \end{aligned}$$

The operating cash flows of \$74,000 then become an input to the calculation of the free cash flows.

CAN YOU DO IT?

CALCULATING FREE CASH FLOWS

Hurley's Hidden Snacks is introducing a new product and has an expected change in EBIT of \$800,000. Hurley's Hidden Snacks has a 40 percent marginal tax rate. This project will also produce \$100,000 of depreciation per year. In addition, this project will also cause the following changes in year 1:

	WITHOUT THE PROJECT	WITH THE PROJECT
Accounts receivable	\$35,000	\$63,000
Inventory	65,000	70,000
Accounts payable	70,000	90,000

What is the project's free cash flow in year 1?
(The solution can be found on page 360.)

Concept Check

1. In general, a project's cash flows will fall into one of three categories. What are these categories?
2. What is a free cash flow? How do we calculate it?
3. Although depreciation is not a cash-flow item, it plays an important role in the calculation of cash flows. How does depreciation affect a project's cash flows?



3 Explain the importance of options, or flexibility, in capital budgeting.

Options in Capital Budgeting

The use of discounted cash-flow decision criteria, such as the *NPV* method, provides an excellent framework within which to evaluate projects. However, what happens if the project being analyzed has the potential to be modified after some future uncertainty has been resolved? For example, if a project that had an expected life of 10 years turns out to be better than anticipated, it may be expanded or continued past 10 years, perhaps going on for 20 years. On the other hand, if its cash flows do not meet expectations, it may not last a full 10 years and be scaled back, abandoned, or sold. In addition, suppose the project were delayed for a year or two. This flexibility is something that the *NPV* and our other decision-making criteria have difficulty dealing with. In fact, the *NPV* may actually understate the value of the project if the future opportunities associated with modifying it have a positive value. It is this value of flexibility that we will be examining using options.

Three of the most common option types that can add value to a capital-budgeting project are (1) the option to delay a project until the future cash flows are more favorable—this option is common when the firm has exclusive rights, perhaps a patent, to a product or technology; (2) the option to expand a project, perhaps in size or even to develop new products that would not have otherwise been feasible; and (3) the option to abandon a project if the future cash flows fall short of expectations.

The Option to Delay a Project

There is no question that the estimated cash flows associated with a project can change over time. In fact, as a result of changing expected cash flows, a project that currently has a negative net present value may have a positive net present value in the future. Let's take another look at the gas-electric hybrid car market we examined in the introduction to this chapter. This time, let's assume that you've developed a high-voltage, nickel-metal hydride battery that can be used to increase the mileage on hybrid cars to up to 150 miles per gallon. However, as you examine the costs of producing this new battery, you realize that it

DID YOU GET IT?

CALCULATING FREE CASH FLOWS

You were asked to determine the free cash flows in year 1 for a new product being introduced by Hurley's Hidden Snacks.

STEP 1 Calculate the change in net working capital.

The change in net working capital equals the increase in accounts receivable and inventory less the increase in accounts payable = \$28,000 – \$5,000 – \$20,000 = \$13,000.

STEP 2 Calculate the change in free cash flows.

$$\begin{aligned}
 \text{Project's free cash flows} &= \text{change in earnings before interest and taxes (EBIT)} \\
 &\quad - \text{change in taxes} \\
 &\quad + \text{change in depreciation} \\
 &\quad - \text{change in net working capital} \\
 &\quad - \text{change in capital spending} \\
 &= \$800,000 - (\$800,000 \times 0.40) + \$100,000 - \$13,000 - \$0 = \$567,000
 \end{aligned}$$

The project's free cash flows represent the "Cash Flow Is What Matters" that we discussed in **Principle 1**.

is still relatively expensive to manufacture and that, given the costs, the market for a car using this battery is quite small right now. Does that mean that the rights to the high-voltage, nickel-metal hydride battery have no value? No, they have value because you may be able to improve on this technology in the future and make the battery even more efficient and less expensive. They also have value because oil prices might rise even further, which would lead to a bigger market for super-fuel-efficient cars. In effect, the ability to delay this project with the hope that technological and market conditions will change, making this project profitable, lends value to the project.

Another example of the option to delay a project until the future cash flows are more favorable involves a firm that owns the oil rights to some oil-rich land and is considering an oil-drilling project. Suppose after all of the costs and the expected oil output are considered, the project has a negative net present value. Does that mean the firm should give away its oil rights or that those oil rights have no value? Certainly not. There is a chance that in the future oil prices could rise to the point that this negative *NPV* project could become a positive *NPV* project. It is this ability to delay development that provides value. Thus, the value in this seemingly negative *NPV* project is provided by the option to delay it until the future cash flows are more favorable.

The Option to Expand a Project

Just as we saw with the option to delay a project, the estimated cash flows associated with a project can change over time, making it valuable to expand a project. Again, this flexibility to adjust production to demand has value. For example, a firm might deliberately build a production plant with excess capacity so that if the product has more-than-anticipated demand, the firm can simply increase production. Alternatively, taking on this project might provide the firm with a foothold in a new industry and lead to other products that would not have otherwise been feasible. This reasoning has led many firms to expand into e-businesses, hoping to gain know-how and expertise that will lead to other profitable projects down the line. It also provides some of the rationale for research and development expenditures to explore new markets.

Let's go back to our example of the gas-electric hybrid car and examine the option to expand that project. One of the reasons that most of the major automobile firms are introducing gas-electric hybrid cars is that they feel if gas prices keep moving beyond the \$2 to \$3 per gallon price, these hybrids may become the future of the industry, and the only way to gain the know-how and expertise to produce a hybrid is to do it. As the cost of technology declines and the demand increases—perhaps pushed on by increases in gas prices—then the companies will be ready to expand into full-fledged production. This strategy becomes clear when you look at Honda, which first introduced the Insight in 2000, and Toyota, which introduced the Prius in 2001.

When hybrids were first introduced, analysts estimated that Honda was losing about \$8,000 on each Insight it sold, whereas Toyota was losing about \$3,000 per car, but both firms hoped to break even in a few years. Still, these projects made sense because they allowed these automakers to gain the technological and production expertise to profitably produce a gas-electric hybrid car. And, as mentioned in the chapter introduction, with predictions that hybrids will account for half of the light-duty vehicles on the road by 2040, it is a big market they're looking at. Moreover, the technology Honda and Toyota developed with the Insight and Prius may have profitable applications for other cars or in other areas. In effect, it is the option of expanding production in the future that brings value to this project.

The Option to Abandon a Project

The option to abandon a project as the estimated cash flows associated with it change over time also has value. Again, it is this flexibility to adjust to new information that provides the value. For example, a project's sales in the first year or two might not live up to expectations, with the project being barely profitable. The firm might then decide to liquidate the project and sell the plant and all of the equipment. That liquidated value may be more than the value of keeping the project going.

Again, let’s go back to our example of the gas-electric hybrid car and, this time, examine the option to abandon that project. If after a few years the cost of gas falls dramatically while the cost of technology remains high, the gas-electric hybrid car might not become profitable. At that point the manufacturer might decide to abandon the project and sell the technology, including all the patent rights to it. In effect, the original project, the gas-electric hybrid car, may not be of value, but the technology that has been developed might be. As a result, the value of abandoning the project and selling the technology might be more than the value of keeping the project running. Again, it is the value of flexibility associated with the possibility of modifying the project in the future—in this case abandoning the project—that can produce positive value.

Options in Capital Budgeting: The Bottom Line

Because of the potential to be modified in the future after some future uncertainty has been resolved, we may find that a project with a negative net present value based upon its expected free cash flows is a “good” project and should be accepted. This demonstrates the value of options. In addition, we may find that a project with a positive net present value may be of more value if its acceptance is delayed. Options also explain the logic that drives firms to take on negative NPV projects that allow them to enter new markets. The option to abandon a project explains why firms hire employees on a temporary basis rather than permanently, why they lease rather than buy equipment, and why they enter into contracts with suppliers on an annual basis rather than long term.

Concept Check

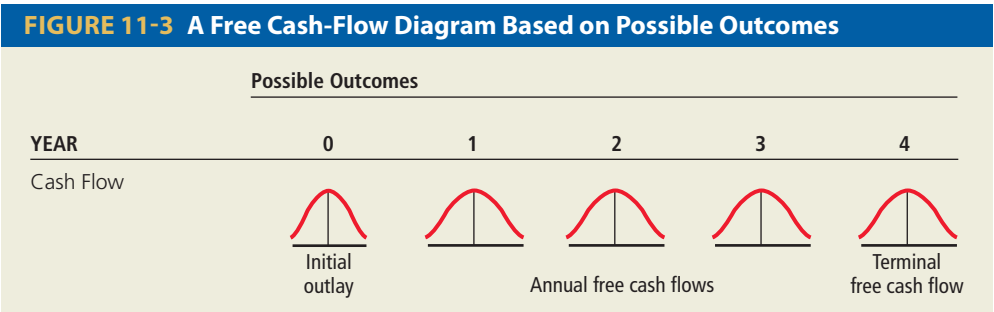
- 1. Give an example of an option to delay a project. Why might this be of value?
- 2. Give an example of an option to expand a project. Why might this be of value?
- 3. Give an example of an option to abandon a project. Why might this be of value?

b4 Understand, measure, and adjust for project risk.

Risk and the Investment Decisions

Up to this point we have ignored risk in capital budgeting; that is, we have discounted expected cash flows back to the present and ignored any uncertainty that there might be surrounding that estimate. In reality, the future cash flows associated with the introduction of a new sales outlet or a new product are estimates of what is *expected* to happen in the future, not necessarily what will happen. For example, when Coca-Cola decided to replace Classic Coke with “New Coke,” you can bet that the expected cash flows it based its decision on were nothing like the cash flows it realized. As a result, it didn’t take Coca-Cola long to re-introduce Classic Coke. Other famous failures that didn’t produce the cash flows that were expected include Bic disposable underwear, Thirsty Dog! beef-flavored bottled water for dogs, and Coors Rocky Mountain Spring Water. The cash flows we have discounted back to the present so far have only been our best estimate of the expected future cash flows. A cash-flow diagram based on the possible outcomes of an investment proposal rather than the expected values of these outcomes appears in Figure 11-3.

In this section, we assume that we do not know beforehand what cash flows will actually result from a new project. However, we do have expectations concerning the possible outcomes



and are able to assign probabilities to these outcomes. Stated another way, although we do not know what the cash flows resulting from the acceptance of a new project will be, we can formulate the probability distributions from which the flows will be drawn. As we learned in Chapter 6, risk occurs when there is some question about the future outcome of an event.

In the remainder of this chapter, we assume that although future cash flows are not known with certainty, the probability distribution from which they are derived can be estimated. Also, because we have illustrated that the dispersion of possible outcomes reflects risk, we are prepared to use a measure of dispersion, or variability, later in the chapter when we quantify risk.

In the pages that follow, remember that there are only two basic issues that we address: (1) What is risk in terms of capital-budgeting decisions, and how should it be measured? and (2) How should risk be incorporated into a capital-budgeting analysis?

What Measure of Risk Is Relevant in Capital Budgeting?

Before we begin our discussion of how to adjust for risk, it is important to determine just what type of risk we are to adjust for. In capital budgeting, a project's risk can be looked at on three levels. First, there is the **project standing alone risk**, which is a *project's risk ignoring the fact that much of this risk will be diversified away*. Second, we have the project's **contribution-to-firm risk**, which is the *amount of risk that the project contributes to the firm as a whole; this measure considers the fact that some of the project's risk will be diversified away as the project is combined with the firm's other projects and assets, but it ignores the effects of the diversification of the firm's shareholders*. Finally, there is **systematic risk**, which is the *risk of the project from the viewpoint of a well-diversified shareholder; this measure takes into account that some of a project's risk will be diversified away as the project is combined with the firm's other projects, and, in addition, some of the remaining risk will be diversified away by shareholders as they combine this stock with other stocks in their portfolios*. Graphically, this is shown in Figure 11-4.

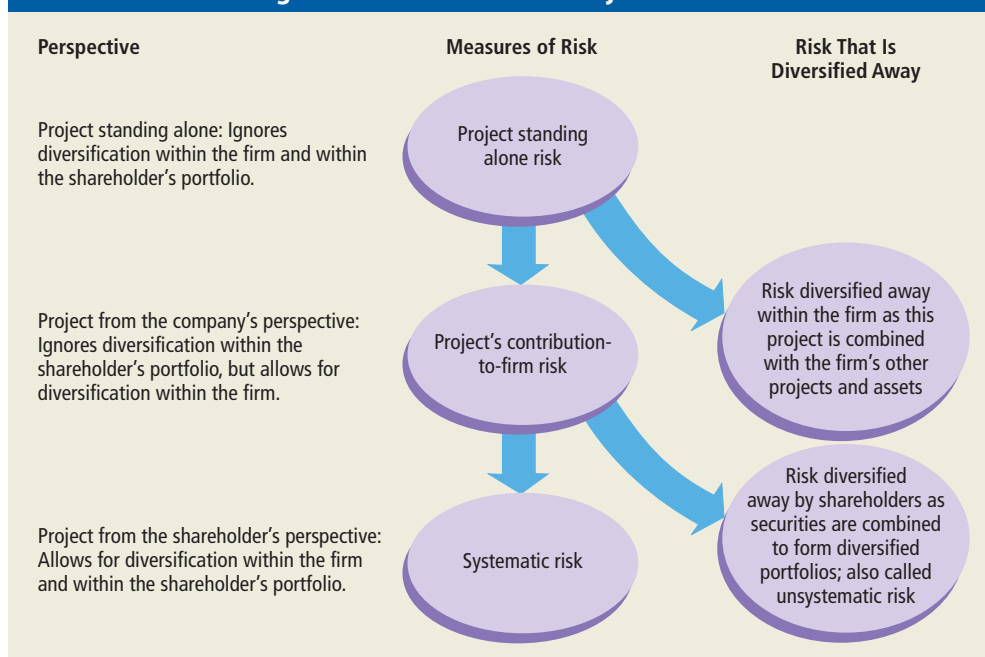
Should we be interested in the project standing alone risk? The answer is no. Perhaps the easiest way to understand why not is to look at an example. Let's take the case of research and development projects at Johnson & Johnson. Each year Johnson & Johnson takes on hundreds of new R&D projects, knowing that they have only about a 10 percent probability of being successful. If they are successful, the profits can be enormous; if they fail, the investment is lost. If the company has only one project, and it is an R&D project, the company would have a 90 percent chance of failure. Thus, if we look at these R&D projects individually and measure their stand-alone risk, we would have to judge them to be enormously risky. However, if we

project standing alone risk a project's risk ignoring the fact that much of this risk will be diversified away.

contribution-to-firm risk the amount of risk that the project contributes to the firm as a whole; this measure considers the fact that some of the project's risk will be diversified away as the project is combined with the firm's other projects and assets but ignores the effects of diversification of the firm's shareholders.

systematic risk the risk of the project from the viewpoint of a well-diversified shareholder; this measure takes into account that some of a project's risk will be diversified away as the project is combined with the firm's other projects, and, in addition, some of the remaining risk will be diversified away by shareholders as they combine this stock with other stocks in their portfolios.

FIGURE 11-4 Looking at Three Measures of a Project's Risk



consider the effect of the diversification that comes about from taking on several hundred independent R&D projects a year, all with a 10 percent chance of success, we can see that each R&D project does not add much risk to Johnson & Johnson. In short, because much of a project's risk is diversified away within the firm, the project standing alone risk is an inappropriate measure of the meaningful level of risk of a capital-budgeting project.

Should we be interested in the project's contribution-to-firm risk? Once again, at least in theory, the answer is no, provided investors are well diversified and there are no bankruptcy costs. From our earlier discussion of risk in Chapter 6, we saw that as shareholders, if we combined an individual security with other securities to form a diversified portfolio, much of the risk of the individual security would be diversified away. In short, all that affects the shareholders is the systematic risk of the project and, as such, it is all that is theoretically relevant for capital budgeting.

Measuring Risk for Capital-Budgeting Purposes with a Dose of Reality—Is Systematic Risk All There Is?

According to the capital asset pricing model (CAPM) we discussed in Chapter 6, systematic risk is the only relevant risk for capital-budgeting purposes. However, reality complicates this somewhat. In many instances a firm will have undiversified shareholders, including owners of small corporations. Because they are not diversified, for those shareholders the relevant measure of risk is the project's contribution-to-firm risk.

The possibility of bankruptcy also affects our view of what measure of risk is relevant. As you recall in developing the CAPM, we made the assumption that bankruptcy costs were zero. Because the project's contribution-to-firm risk reflects risk that the firm faces, that is, the risk that may lead to bankruptcy, this may be an appropriate measure of risk: Quite obviously, there is a cost associated with bankruptcy. First, if a firm fails, its assets, in general, cannot be sold for their true economic value. Moreover, the amount of money actually available for distribution to stockholders is further reduced by liquidation and legal fees that must be paid. Finally, the opportunity cost associated with the delays related to the legal process further reduces the funds available to the shareholder. Therefore, because costs are associated with bankruptcy, reducing the chance of a bankruptcy has a very real value associated with it.

The indirect costs of bankruptcy also affect other areas of the firm, including production, sales, and the quality and efficiency of management. For example, firms with a higher probability of bankruptcy may have a more difficult time recruiting and retaining quality managers because jobs with that firm are viewed as being less secure. Suppliers may be less willing to sell to the firm on credit. Finally, customers may lose confidence and fear that the firm is cutting corners in terms of quality and/or will not be around to honor a warranty or supply spare parts for products in the future. As a result, as the probability of bankruptcy increases, an eventual bankruptcy can become self-fulfilling as potential customers and suppliers flee. The end result is that because a project's contribution-to-firm risk affects the probability of bankruptcy for the firm, it may be a relevant risk measure for capital budgeting.

Finally, problems in measuring a project's systematic risk make its implementation extremely difficult. It is much easier talking about a project's systematic risk than measuring it.

Given all this, what risk measure do we use? The answer is that we will give consideration to both systematic risk and contribution-to-firm risk measures. We know in theory systematic risk is correct. We also know that bankruptcy costs and undiversified shareholders violate the assumptions of the theory, which makes the concept of a project's contribution-to-firm risk a relevant measure. Still, the concept of systematic risk holds value for capital-budgeting decisions because that is the risk that shareholders are compensated for assuming. Therefore, we will concern ourselves with both the project's contribution-to-firm risk and the project's systematic risk and not try to make any specific allocation of importance between the two for capital-budgeting purposes.

Incorporating Risk into Capital Budgeting

Because different investment projects do in fact contain different levels of risk, let's now look at the risk-adjusted discount rate, which is based on the notion that investors require higher rates of return on more risky projects.

Risk-Adjusted Discount Rates

The use of **risk-adjusted discount rates** is based on the concept that investors demand higher returns for more risky projects. This is the basic principle behind Principle 3 and the CAPM and is illustrated graphically in Figure 11-5.

As we know from **Principle 3**, the expected rate of return on any investment should include compensation for delaying consumption equal to the risk-free rate of return, plus compensation for any risk taken on. Under the risk-adjusted discount rate approach, if the risk associated with the investment is greater than the risk involved in a typical endeavor, the discount rate is adjusted upward to compensate for this added risk. Once the firm determines the appropriate required rate of return for a project with a given level of risk, the cash flows are discounted back to the present at the risk-adjusted discount rate. Then the normal capital-budgeting criteria are applied, except in the case of the *IRR*. For the *IRR*, the hurdle rate with which the project's *IRR* is compared now becomes the risk-adjusted discount rate. Expressed mathematically, the *NPV* using the risk-adjusted discount rate becomes

$$\begin{aligned} \text{Risk-adjusted } NPV &= \left[\begin{array}{l} \text{present value of all the} \\ \text{future annual free cash} \\ \text{flows discounted back} \\ \text{to present at the risk-adjusted} \\ \text{rate of return} \end{array} \right] - \left[\begin{array}{l} \text{the initial cash outlay} \end{array} \right] \\ &= \frac{FCF_1}{(1 + k^*)^1} + \frac{FCF_2}{(1 + k^*)^2} + \cdots + \frac{FCF_n}{(1 + k^*)^n} - IO \end{aligned} \quad (11-1)$$

where FCF_t = the annual free cash flow expected in time period t

IO = the initial cash outlay

k^* = the risk-adjusted discount rate

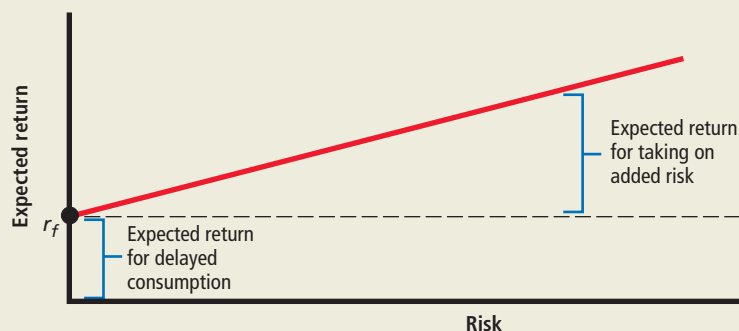
n = the project's expected life

The logic behind the risk-adjusted discount rate stems from the idea that if the level of risk associated with a project is different from that of the typical project, then managers must incorporate the shareholders' probable reaction to this new endeavor into the decision-making process. For example, if the project has more risk than a typical project, then a higher required rate of return should apply. Otherwise, marginal projects will lower the firm's share price—that is, reduce shareholders' wealth. This will occur as the market raises its required rate of return on the firm to reflect the addition of the more risky project, because the incremental cash flows resulting from it might not be large enough to offset this risk. By the same logic, if the project has less than normal risk, a reduction in the required rate of return is appropriate. Thus, the risk-adjusted discount method attempts to apply more stringent standards—that is, require a higher rate of return—to projects that will increase the firm's risk level. This risk-adjusted financial decision rule can be summarized as follows:

risk-adjusted discount rate a method of risk adjustment when the risk associated with the investment is greater than the risk involved in a typical endeavor. Using this method, the discount rate is adjusted upward to compensate for this added risk.

REMEMBER YOUR PRINCIPLES
Principle All the methods used to compensate for risk in capital budgeting find their roots in **Principle 3: Risk Requires a Reward**. In fact, the risk-adjusted discount method puts this concept directly into play.

FIGURE 11-5 The Risk–Return Relationship



FINANCIAL DECISION TOOLS

Name of Tool	Formula	What It Tells You
Risk-adjusted net present value (<i>NPV</i>)	The present value of all the future annual free cash flows minus the initial cash outlay discounted back to present at the risk-adjusted discount rate: $= \frac{FCF_1}{(1 + k^*)^1} + \frac{FCF_2}{(1 + k^*)^2} + \cdots + \frac{FCF_n}{(1 + k^*)^n} - IO$	• What the <i>NPV</i> would be if the project's cash flows were discounted back to present at the appropriate (risk-adjusted) discount rate • The amount of wealth that is created if the project is accepted • If the risk-adjusted <i>NPV</i> is positive, then wealth is created and the project should be accepted.

EXAMPLE 11.3**Risk-adjusted discount rates**

A toy manufacturer is considering introducing a line of fishing equipment with an expected life of 5 years. In the past, the firm has been quite conservative in its investment in new products, sticking primarily to standard toys. In this context, the introduction of a line of fishing equipment is considered an abnormally risky project. Management thinks that the normal required rate of return for the firm of 10 percent is not sufficient. Instead, the minimum acceptable rate of return on this project should be 15 percent. The initial outlay would be \$110,000, and the expected cash flows are as follows:

YEAR	EXPECTED FREE CASH FLOW
1	\$30,000
2	30,000
3	30,000
4	30,000
5	30,000

What is the *NPV* using the risk-adjusted discount rate? Should the project be accepted?

STEP 1: FORMULATE A SOLUTION STRATEGY

The *NPV* using the risk-adjusted discount rate can be calculated using equation (11-1) as follows:

$$NPV = \left[\begin{array}{l} \text{present value of all the} \\ \text{future annual free cash} \\ \text{flows discounted back} \\ \text{to present at the risk-adjusted} \\ \text{rate of return} \end{array} \right] - \left[\begin{array}{l} \text{the initial cash outlay} \end{array} \right]$$

$$= \frac{FCF_1}{(1 + k^*)^1} + \frac{FCF_2}{(1 + k^*)^2} + \cdots + \frac{FCF_n}{(1 + k^*)^n} - IO$$

where FCF_t = the annual free cash flow expected in time period t

IO = the initial cash outlay

k^* = the risk-adjusted discount rate

n = the project's expected life

STEP 2: CRUNCH THE NUMBERS

The present value of the future free cash flows discounted to the present at 15 percent is \$100,560. The initial outlay on this project is \$110,000. Substituting into equation (11-1), we compute the *NPV* issue as follows:

$$NPV = \left[\begin{array}{l} \text{present value of all the} \\ \text{future annual free cash} \\ \text{flows discounted back} \\ \text{to present at the risk-adjusted} \\ \text{rate of return} \end{array} \right] - \left[\begin{array}{l} \text{the initial cash outlay} \end{array} \right]$$

$$= \$100,560 - \$110,000 = -\$9,435$$

STEP 3: ANALYZE YOUR RESULTS

The risk-adjusted NPV is $-\$9,435$, thus the project should be rejected. If the normal required rate of return of 10 percent had been used as the discount rate, the project would have had a positive NPV of $\$3,724$.

In practice, when the risk-adjusted discount rate is used, projects are generally grouped according to purpose, or risk class; then the discount rate preassigned to that purpose or risk class is used. For example, a firm with a required rate of return of 12 percent might use the following rate-of-return categorization:

PROJECT	REQUIRED RATE OF RETURN (%)
Replacement decision	12
Modification or expansion of existing product line	15
Project unrelated to current operations	18
Research and development operations	25

The purpose of this categorization of projects is to make their evaluation easier, but it also introduces a sense of arbitrariness into the calculations that makes the evaluation less meaningful. The trade-offs involved in the preceding classification are obvious: Time and effort are minimized but only at the cost of precision.

Measuring a Project's Systematic Risk

When we initially talked about systematic risk or the beta, we were talking about measuring it for the entire firm. As you recall, although we could estimate a firm's beta using historical data, we did not have complete confidence in our results. As we will see, estimating the appropriate level of systematic risk for a single project is even more fraught with difficulties. To truly understand what it is we are trying to do and the difficulties we will encounter, let's step back a bit and examine systematic risk and the risk adjustment for a project.

What we are trying to do is use the CAPM to determine the level of risk and the appropriate risk–return trade-offs for a particular project. We then take the expected return on this project and compare it to the required return suggested by the CAPM to determine whether the project should be accepted. If the project appears to be a typical one for the firm, using the CAPM to determine the appropriate risk–return trade-offs and then judging the project against them may be a warranted approach. But if the project is not a typical project, what do we do? Historical data generally do not exist for a new project. In fact, for some capital investments—for example, a truck or a new building—historical data would not have much meaning. What we need to do is make the best of a bad situation. We either (1) fake it—that is, use historical accounting data, if available, to substitute for historical price data in estimating systematic risk—or (2) attempt to find a substitute firm in the same industry as the capital-budgeting project and use the substitute firm's estimated systematic risk as a proxy for the project's systematic risk.

Using Accounting Data to Estimate a Project's Beta

When we are dealing with a project that is identical to the firm's other projects, we need only estimate the level of systematic risk for the firm and use that estimate as a proxy for the

project's risk. Unfortunately, when projects are not typical of the firm, this approach does not work. For example, when Altria, which owns Philip Morris, the tobacco company, and Ste. Michelle Wine Estates, introduces a new dessert wine, this new product most likely carries with it a different level of systematic risk than what is typical for Altria as a whole.

To get a better approximation of the systematic risk level on this project, it would be great if we could estimate the level of systematic risk for the wine division and use that as a proxy for the project's systematic risk. Unfortunately, historical stock price data are available only for the company as a whole, and as you recall, historical stock return data are generally used to estimate a firm's beta. Thus, we are forced to use accounting return data rather than historical stock return data for the division to estimate the division's systematic risk. To estimate a project's beta using accounting data we need only run a time-series regression of the division's return on assets (net income/total assets) on the market index (the S&P 500). The regression coefficient from this equation would be the project's accounting beta and would serve as an approximation for the project's true beta, or measure of systematic risk. Alternatively, a multiple regression model based on accounting data could be developed to explain betas. The results of this model could then be applied to firms that are not publicly traded to estimate their betas.

How good is the accounting beta technique? It certainly is not as good as a direct calculation of the beta. In fact, the correlation between the accounting beta and the beta calculated on historical stock return data is only about 0.6. However, better luck has been experienced with multiple regression models used to predict betas. Unfortunately, in many cases there may not be any realistic alternative to the calculation of the accounting beta. Because adjusting for a project's risk is so important, the accounting beta method is much preferred to doing nothing.

The Pure Play Method for Estimating Beta

Whereas the accounting beta method attempts to directly estimate a project's or division's beta, the **pure play method** attempts to identify publicly traded firms that are engaged solely in the same business as the project or division. Once the proxy or pure play firm is identified, its systematic risk is determined and then used as a proxy for the project's or division's level of systematic risk. What we are doing is *looking for a publicly traded firm with a project like ours and using that firm's required rate of return to judge our project*. In doing so we are presuming that the systematic risk and the capital structure of the proxy firm are identical to those of the project.

In using the pure play method it should be noted that a firm's capital structure is reflected in its beta. When the capital structure of the proxy firm is different from that of the project's firm, some adjustment must be made for this difference. Although not a perfect approach, it does provide some insights about the level of systematic risk a project might have.

Examining a Project's Risk through Simulation

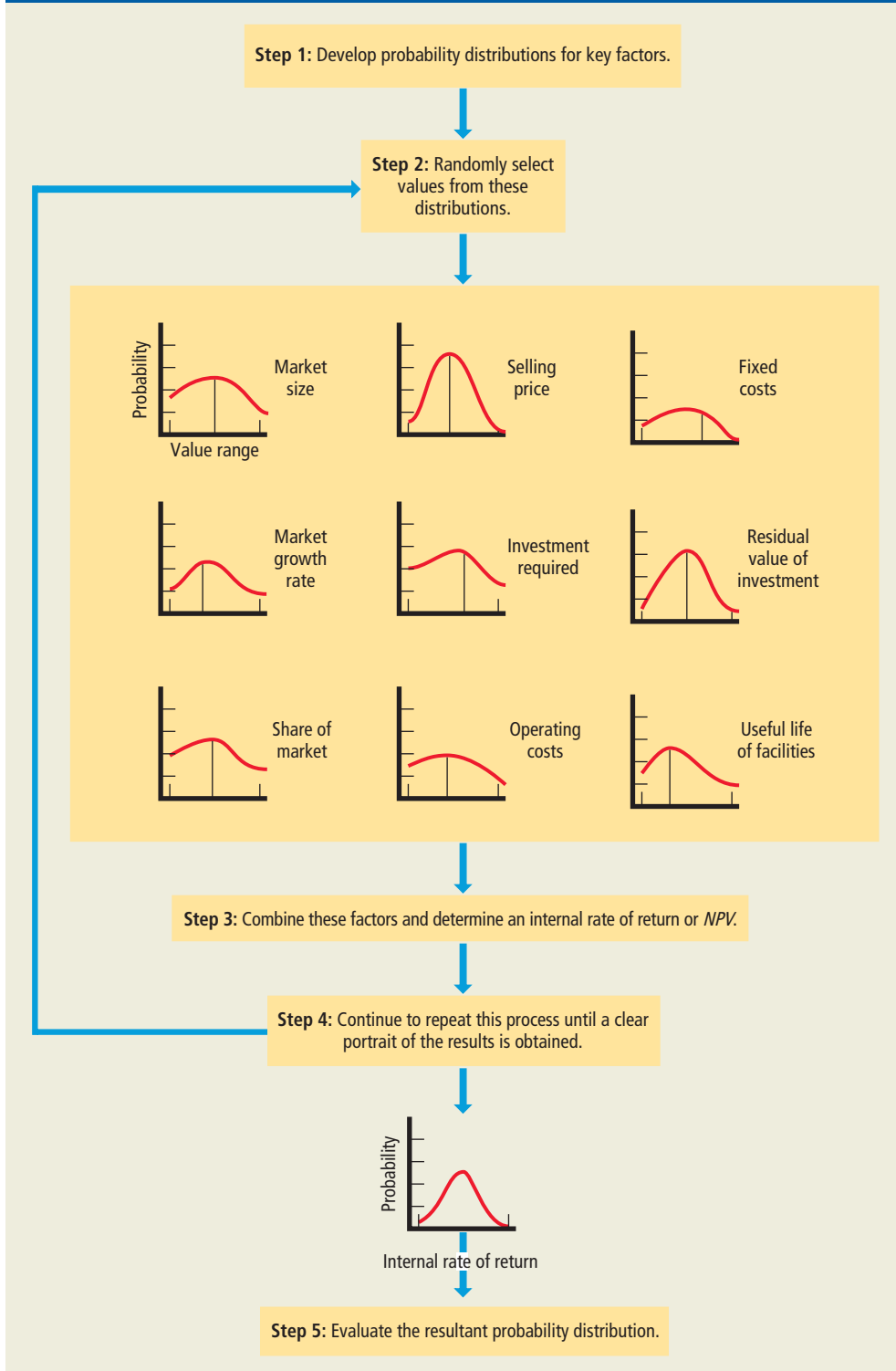
Another method for evaluating risk in the investment decision is through the use of **simulation**. The risk-adjusted discount rate approach provided us with a single value for the risk-adjusted NPV, whereas a simulation approach gives us a probability distribution for the investment's NPV or IRR. Simulation *involves the process of imitating the performance of the project under evaluation. This is done by randomly selecting observations from each of the distributions that affect the outcome of the project and continuing with this process until a representative record of the project's probable outcome is assembled*.

The easiest way to develop an understanding of the computer simulation process is to follow through an example simulation for an investment project evaluation. Suppose a chemical producer is considering an extension to its processing plant. The simulation process is portrayed in Figure 11-6. First, the probability distributions are determined for all the factors that affect the project's returns. In this case, let us assume there are nine such variables:

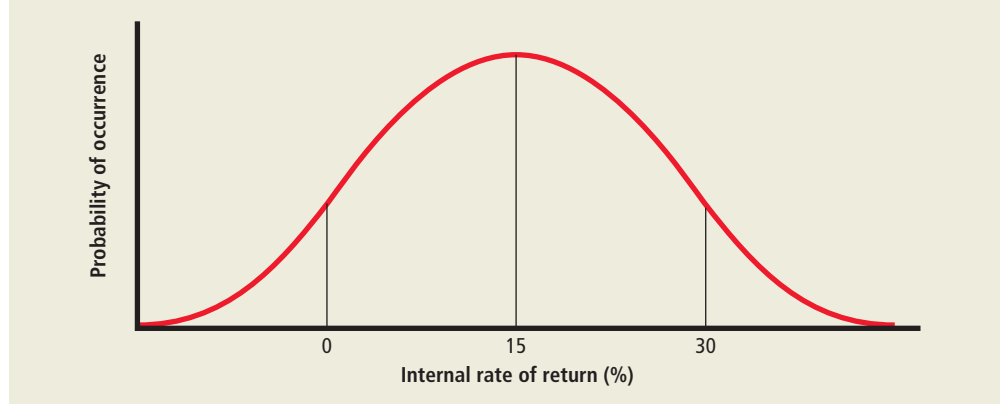
1. Market size
2. Selling price
3. Market growth rate
4. Share of market (which results in physical sales volume)

pure play method a method for estimating a project's or division's beta that attempts to identify publicly traded firms engaged solely in the same business as the project or division.

simulation a method for dealing with risk where the performance of the project under evaluation is estimated by randomly selecting observations from each of the distributions that affect the outcome of the project and continuing with this process until a representative record of the project's probable outcome is assembled.

FIGURE 11-6 Capital-Budgeting Simulation

5. Investment required
6. Residual value of investment
7. Operating costs
8. Fixed costs
9. Useful life of facilities

FIGURE 11-7 Output from Simulation

Then the computer randomly selects one observation from each of the probability distributions, according to its chance of actually occurring in the future. These nine observations are combined, and an *NPV* or *IRR* figure is calculated. This process is repeated as many times as desired, until a representative distribution of possible future outcomes is assembled. Thus, the inputs to a simulation include all the principal factors affecting the project's profitability, and the simulation output is a probability distribution of net present values or internal rates of return for the project. The decision maker bases the decision on the full range of possible outcomes. The project is accepted if the decision maker feels that enough of the distribution lies above the normal cutoff criteria ($NPV \geq 0$ or $IRR \geq$ required rate of return).

Suppose the output from the simulation of a chemical producer's project is as shown in Figure 11-7. This output provides the decision maker with the probability of different outcomes occurring in addition to the range of possible outcomes. Sometimes called **scenario analysis**, it *identifies the range of possible outcomes under the worst, best, and most likely cases*. The firm's management then examines the distribution to determine the project's level of risk and makes the appropriate decisions.

You'll notice that although the simulation approach helps us to determine the amount of total risk a project has, it does not differentiate between systematic and unsystematic risk. However, it does provide important insights about the total risk level of a given investment project. Now we will look briefly at how the simulation approach can be used to perform sensitivity analysis.

Conducting a Sensitivity Analysis Through Simulation

Sensitivity analysis involves *determining how the distribution of possible net present values or internal rates of return for a particular project is affected by a change in one particular input variable*. This is done by changing the value of one input variable while holding all other input variables constant. The distribution of possible net present values or internal rates of return that is generated is then compared with the distribution of possible returns generated before the change was made to determine the effect of the change. For this reason sensitivity analysis is commonly called *what-if analysis*.

For example, the chemical producer that is considering a possible expansion to its plant may wish to determine the effect of a more pessimistic forecast of the anticipated market growth rate. After the more pessimistic forecast replaces the original forecast in the model, the simulation is rerun. The two outputs are then compared to determine how sensitive the results are to the revised estimate of the market growth rate.

Concept Check

1. Is a project's standing alone risk the appropriate level of risk for capital budgeting? Why or why not?
2. What problems are associated with using systematic risk as the measure for risk in capital budgeting?

scenario analysis a simulation approach for gauging a project's risk under the worst, best, and most likely outcomes. The firm's management examines the distribution of the outcomes to determine the project's level of risk and then makes the appropriate adjustment.

sensitivity analysis a method for dealing with risk where the change in the distribution of possible net present values or internal rates of return for a particular project resulting from a change in one particular input variable is calculated. This is done by changing the value of one input variable while holding all other input variables constant.

3. What is the most commonly used method for incorporating risk into the capital-budgeting decision? How is this technique related to Principle 3?
4. Explain how simulations work.
5. What is a scenario analysis? What is a sensitivity analysis? When would you perform a sensitivity analysis?

Chapter Summaries

Identify guidelines by which we measure cash flows. (pgs. 345–347)



SUMMARY: In this chapter, we examined the measurement of the incremental cash flows associated with a firm's investment proposals and methods used to evaluate those proposals. Relying on **Principle 1: Cash Flow Is What Matters** we focused only on the incremental, or differential, after-tax cash flows attributed to an investment proposal. Care is taken to beware of cash flows diverted from existing products, look for incidental or synergistic effects, consider working-capital requirements, consider incremental expenses, ignore sunk costs, account for opportunity costs, examine overhead costs carefully, and ignore interest payments and financing flows.

Explain how a project's benefits and costs—that is, its free cash flows—are calculated. (pgs. 348–358)



SUMMARY: To measure a project's benefits, we use the project's free cash flows:

$$\begin{aligned} \text{Project's free cash flows} &= \text{project's change in operating cash flows} \\ &\quad - \text{change in net working capital} \\ &\quad - \text{change in capital spending} \end{aligned}$$

We can rewrite this, inserting our calculation for the project's change in operating cash flows, to get

$$\begin{aligned} \text{Project's free cash flows} &= \text{change in earnings before interest and taxes} \\ &\quad - \text{change in taxes} \\ &\quad + \text{change in depreciation} \\ &\quad - \text{change in net working capital} \\ &\quad - \text{change in capital spending} \end{aligned}$$

KEY TERMS

Initial outlay, page 348 The immediate cash outflow necessary to purchase the asset and put it in operating order.

Explain the importance of options, or flexibility, in capital budgeting. (pgs. 358–360)



SUMMARY: There are several complications related to the capital-budgeting process. First, we examined capital rationing and the problems it can create by imposing a limit on the dollar size of the capital budget. Although capital rationing does not, in general, maximize shareholders' wealth, it does exist. The goal of maximizing shareholders' wealth remains, but it is now subject to a budget constraint.

Understand, measure, and adjust for project risk. (pgs. 360–369)



SUMMARY: Options, or flexibility, can make it worthwhile to pursue projects that would otherwise be rejected or make projects undertaken more valuable. Three of the most common types of options that can add value to a capital-budgeting project are (1) the option to delay a project until the

future cash flows are more favorable (this option is common when the firm has an exclusive right, perhaps a patent, to a product or technology); (2) the option to expand a project, perhaps in size or even to introduce new products that would not have otherwise been feasible; and (3) the option to abandon a project if its future cash flows fall short of expectations.

There are three types of capital-budgeting risk: the project standing alone risk, the project's contribution-to-firm risk, and the project's systematic risk. In theory, systematic risk is the appropriate risk measure, but bankruptcy costs and the issue of undiversified shareholders also give weight to considering a project's contribution-to-firm risk as the appropriate risk measure. Both measures of risk are valid, and we avoid making any specific allocation of the importance between the two.

The risk-adjusted discount rate relies on **Principle 3: Risk Requires a Reward** and involves an upward adjustment of the discount rate to compensate for risk. This method is based on the concept that investors demand higher returns for riskier projects. Thus, projects are evaluated using the appropriate, or risk-adjusted, discount rate.

The simulation method is used to provide information about the location and shape of the distribution of possible outcomes of the project. Decisions can be based directly on this method or used as an input to make decisions using the risk-adjusted discount rate method.

KEY TERMS

Project standing alone risk, page 361 A project's risk ignoring the fact that much of this risk will be diversified away.

Contribution-to-firm risk, page 361 The amount of risk that the project contributes to the firm as a whole; this measure considers the fact that some of the project's risk will be diversified away as the project is combined with the firm's other projects and assets but ignores the effects of diversification of the firm's shareholders.

Systematic risk, page 361 The risk of a project from the viewpoint of a well-diversified shareholder. This measure takes into account that some of the project's risk will be diversified away as the project is combined with the firm's other projects, and, in addition, some of the remaining risk will be diversified away by shareholders as they combine this stock with other stocks in their portfolios.

Risk-adjusted discount rate, page 363 A method of risk adjustment when the risk associated with the investment is greater than the risk involved in a typical endeavor. Using this method, the discount rate is adjusted upward to compensate for this added risk.

Pure play method, page 366 A method for estimating a project's or division's beta that

attempts to identify publicly traded firms engaged solely in the same business as the project or division.

Simulation, page 366 A method for dealing with risk where the performance of the project under evaluation is estimated by randomly selecting observations from each of the distributions that affect the outcome of the project and continuing with this process until a representative record of the project's probable outcome is assembled.

Scenario analysis, page 368 A simulation approach for gauging a project's risk under the worst, best, and most likely outcomes. The firm's management examines the distribution of the outcomes to determine the project's level of risk and then makes the appropriate adjustment.

Sensitivity analysis, page 368 A method for dealing with risk where the change in the distribution of possible net present values or internal rates of return for a particular project resulting from a change in one particular input variable is calculated. This is done by changing the value of one input variable while holding all other input variables constant.

KEY EQUATIONS

$$\begin{aligned} \text{Risk-adjusted } NPV &= \left[\begin{array}{l} \text{present value of all the} \\ \text{future annual free cash} \\ \text{flows discounted back} \\ \text{to present at the risk-adjusted} \\ \text{rate of return} \end{array} \right] - \left[\begin{array}{l} \text{the initial cash outlay} \end{array} \right] \\ &= \frac{FCF_1}{(1 + k^*)^1} + \frac{FCF_2}{(1 + k^*)^2} + \cdots + \frac{FCF_n}{(1 + k^*)^n} - IO \end{aligned}$$

Review Questions

All Review Questions are available in [MyFinanceLab](#).

- 11-1.** Why do we focus on cash flows rather than accounting profits in making our capital-budgeting decisions? Why are we interested only in incremental cash flows rather than total cash flows?
- 11-2.** If depreciation is not a cash-flow expense, does it affect the level of cash flows from a project in any way? Why?
- 11-3.** If a project requires an additional investment in working capital, how should this be treated when calculating the project's cash-flows?
- 11-4.** How do sunk costs affect the determination of cash flows associated with an investment proposal?
- 11-5.** In the preceding chapter we examined the payback period capital-budgeting criterion. Often this capital-budgeting criterion is used as a risk-screening device. Explain the rationale behind its use.
- 11-6.** Use the concept of real options to explain why large restaurant chains often introduce new concept restaurants that have negative *NPVs*.
- 11-7.** Explain how simulation works. What is the value in using a simulation approach?

Study Problems

All Study Problems are available in [MyFinanceLab](#).

11-1. (Relevant cash flows) Captins' Cereal is considering introducing a variation of its current breakfast cereal, Crunch Stuff. The new cereal will be similar to the old with the exception that it will contain sugarcoated marshmallows shaped in the form of stars and will be called Crunch Stuff n' Stars. It is estimated that the sales for the new cereal will be \$25 million; however, 20 percent of those sales will be former Crunch Stuff customers who have switched to Crunch Stuff n' Stars but who would not have switched if the new product had not been introduced. What is the relevant sales level to consider when deciding whether to introduce Crunch Stuff n' Stars?



11-2. (Consideration of sunk and opportunity costs) Hewlett-Packard has designed a new type of printer that produces professional-quality photos. These new printers took 2 years to develop, with research and development running at \$10 million after taxes over that period. Now all that's left is an investment of \$22 million after taxes in new production equipment. It is expected that this new product line will bring in free cash flows of \$5 million per year for each of the next 10 years. In addition, if Hewlett-Packard goes ahead with the new line of printers, the current production facility for the old printers that are to be replaced with this new line could be sold to a competitor, generating \$3 million after taxes.

- How should the \$10 million of research and development be treated?
- How should the \$3 million from the sale of the existing production facility for the old printers be treated?
- Given the information above, what are the cash flows associated with the new printers?

11-3. (Capital gains tax) The J. Harris Corporation is considering selling one of its old assembly machines. The machine, purchased for \$30,000 5 years ago, had an expected life of 10 years and an expected salvage value of zero. Assume Harris uses simplified straight-line depreciation (depreciation of \$3,000 per year) and could sell this old machine for \$35,000. Also assume Harris has a 34 percent marginal tax rate.



- What would be the taxes associated with this sale?
- If the old machine were sold for \$25,000, what would be the taxes associated with this sale?
- If the old machine were sold for \$15,000, what would be the taxes associated with this sale?
- If the old machine were sold for \$12,000, what would be the taxes associated with this sale?

11-4. (Calculating free cash flows) Racin' Scooters is introducing a new product and has an expected change in EBIT of \$475,000. Racin' Scooters has a 34 percent marginal tax rate. The project will also produce \$100,000 of depreciation per year. In addition, the project will also cause the following changes in year 1:

	WITHOUT THE PROJECT	WITH THE PROJECT
Accounts receivable	\$45,000	\$63,000
Inventory	65,000	80,000
Accounts payable	70,000	94,000

What is the project's free cash flow in year 1?

11-5. (Calculating free cash flows) Spartan Stores is expanding operations with the introduction of a new distribution center. Not only will sales increase but investment in inventory will decline due to increased efficiencies in getting inventory to showrooms. As a result of this new distribution center, Spartan expects a change in EBIT of \$900,000. While inventory is expected to drop from \$90,000 to \$70,000, accounts receivables are expected to climb as a result of increased credit sales from \$80,000 to \$110,000. In addition, accounts payable are expected to increase from \$65,000 to \$80,000. This project will also produce \$300,000 of depreciation per year, and Spartan Stores is in the 34 percent marginal tax rate. What is the project's free cash flow in year 1?

11-6. (Calculating operating cash flows) Assume that a new project will annually generate revenues of \$2,000,000. Cash expenses including both fixed and variable costs will be \$800,000, and depreciation will increase by \$200,000 per year. In addition, let's assume that the firm's marginal tax rate is 34 percent. Calculate the operating cash flows.

11-7. (Calculating free cash flows) At present, Solartech Skateboards is considering expanding its product line to include gas-powered skateboards; however, it is questionable how well they will be received by skateboarders. While you feel there is a 60 percent chance you will sell 10,000 of these per year for 10 years (after which time this project is expected to shut down because solar-powered skateboards will become more popular), you also recognize that there is a 20 percent chance that you will only sell 3,000 and also a 20 percent chance you will sell 13,000. The gas skateboards would sell for \$100 each and have a variable cost of \$40 each. Regardless of how many you sell, the annual fixed costs associated with production would be \$160,000. In addition, there would be a \$1,000,000 initial expenditure associated with the purchase of new production equipment. It is assumed that this initial expenditure will be depreciated using the simplified straight-line method down to zero over 10 years. Because of the number of stores that will need inventory, the working-capital requirements are the same regardless of the level of sales, and this project will require a one-time initial investment of \$50,000 in net working capital, and that working-capital investment will be recovered when the project is shut down. Finally, assume that the firm's marginal tax rate is 34 percent.

- What is the initial outlay associated with the project?
- What are the annual free cash flows associated with the project for years 1 through 9 under each sales forecast? What are the expected annual free cash flows for years 1 through 9?
- What is the terminal cash flow in year 10 (that is, what is the free cash flow in year 10 plus any additional cash flows associated with the termination of the project)?
- Using the expected free cash flows, what is the project's *NPV* given a 10 percent required rate of return? What would the project's *NPV* be if 10,000 skateboards were sold?

11-8. (Calculating free cash flows) You are considering new elliptical trainers and you feel you can sell 5,000 of these per year for 5 years (after which time this project is expected to shut down when it is learned that being fit is unhealthy). The elliptical trainers would sell for \$1,000 each and have a variable cost of \$500 each. The annual fixed costs associated with production would be \$1,000,000. In addition, there would be a \$5,000,000 initial expenditure associated with the purchase of new production equipment. It is assumed that this initial expenditure will be depreciated using the simplified straight-line method down to zero over 5 years. This project will also require a one-time initial investment of \$1,000,000 in net working capital associated with inventory, and that working-capital investment will be recovered when the project is shut down. Finally, assume that the firm's marginal tax rate is 34 percent.

- What is the initial outlay associated with this project?
- What are the annual free cash flows associated with this project for years 1 through 4?
- What is the terminal cash flow in year 5 (that is, what is the free cash flow in year 5 plus any additional cash flows associated with the termination of the project)?
- What is the project's *NPV* given a 10 percent required rate of return?

11-9. (New project analysis) The Chung Chemical Corporation is considering the purchase of a chemical analysis machine. Although the machine being considered will result in an increase in earnings before interest and taxes of \$35,000 per year, it has a purchase price of \$100,000, and it would cost an additional \$5,000 to properly install the machine. In addition, to properly operate the machine, inventory must be increased by \$5,000. This machine has an expected life of 10 years, after which it will have no salvage value. Also, assume simplified straight-line depreciation and that this machine is being depreciated down to zero, a 34 percent marginal tax rate, and a required rate of return of 15 percent.

- What is the initial outlay associated with this project?
- What are the annual after-tax cash flows associated with this project for years 1 through 9?

- c. What is the terminal cash flow in year 10 (what is the annual after-tax cash flow in year 10 plus any additional cash flows associated with the termination of the project)?
- d. Should this machine be purchased?

11-10. (*New project analysis*) Raymobile Motors is considering the purchase of a new production machine for \$500,000. The purchase of this machine will result in an increase in earnings before interest and taxes of \$150,000 per year. To operate this machine properly, workers would have to go through a brief training session that would cost \$25,000 after taxes. It would cost \$5,000 to install the machine properly. Also, because the machine is extremely efficient, its purchase would necessitate an increase in inventory of \$30,000. This machine has an expected life of 10 years, after which it will have no salvage value. Assume simplified straight-line depreciation and that this machine is being depreciated down to zero, a 34 percent marginal tax rate, and a required rate of return of 15 percent.

- a. What is the initial outlay associated with this project?
- b. What are the annual after-tax cash flows associated with this project for years 1 through 9?
- c. What is the terminal cash flow in year 10 (what is the annual after-tax cash flow in year 10 plus any additional cash flows associated with the termination of the project)?
- d. Should the machine be purchased?

11-11. (*New project analysis*) Garcia's Truckin' Inc. is considering the purchase of a new production machine for \$200,000. The purchase of this machine will result in an increase in earnings before interest and taxes of \$50,000 per year. To operate the machine properly, workers would have to go through a brief training session that would cost \$5,000 after taxes. It would cost \$5,000 to install the machine properly. Also, because this machine is extremely efficient, its purchase would necessitate an increase in inventory of \$20,000. This machine has an expected life of 10 years, after which it will have no salvage value. Finally, to purchase the new machine, it appears that the firm would have to borrow \$100,000 at 8 percent interest from its local bank, resulting in additional interest payments of \$8,000 per year. Assume simplified straight-line depreciation and that the machine is being depreciated down to zero, a 34 percent marginal tax rate, and a required rate of return of 10 percent.

- a. What is the initial outlay associated with this project?
- b. What are the annual after-tax cash flows associated with this project for years 1 through 9?
- c. What is the terminal cash flow in year 10 (what is the annual after-tax cash flow in year 10 plus any additional cash flows associated with the termination of the project)?
- d. Should the machine be purchased?

11-12. (*Calculating free cash flows*) Vandelay Industries is considering a new project with a 4-year life with the following cost and revenue data. This project will require an investment of \$140,000 in new equipment. This new equipment will be depreciated down to zero over 4 years using the simplified straight-line method and has no salvage value. This new project will generate additional sales revenue of \$112,000 while additional operating costs, excluding depreciation, will be \$68,000. Vandelay's marginal tax rate is 35 percent. What is the project's free cash flow in year 1?

11-13. (*Calculating free cash flows*) Doublemeat Palace is considering a new plant for a temporary customer, and its finance department has determined the following characteristics. The company owns much of the plant and equipment to be used for the product. This equipment was originally purchased for \$90,000; however, if the project is not undertaken, this equipment will be sold for \$50,000 after taxes; in addition, if the project is not accepted, the plant used for the project could be sold for \$105,000 after taxes—the plant originally cost \$40,000. The rest of the equipment will need to be purchased at a cost of \$150,000. This new equipment will be depreciated by the straight-line method over the project's 3-year life, after which it will have zero salvage value. No change in net operating working capital would be required, and management expects revenues resulting from this new project to be \$234,000 per year for 3 years, while increased operating expenses, excluding depreciation, are expected to be \$82,000 per year over the project's 3-year life. The average tax rate is 25 percent and the marginal tax rate is 30 percent. The required rate of return for this project is 8 percent. What is the project's NPV?

11-14. (*Comprehensive problem*) Traid Winds Corporation, a firm in the 34 percent marginal tax bracket with a 15 percent required rate of return or cost of capital, is considering a new project. This project involves the introduction of a new product. The project is expected to last 5 years and then, because this is somewhat of a fad product, be terminated. Given the following information, determine the free cash flows associated with the project, the project's net present value, the profitability index, and the internal rate of return. Apply the appropriate decision criteria.

Cost of new plant and equipment	\$14,800,000												
Shipping and installation costs	\$ 200,000												
Unit sales													
	<table> <tr> <th>YEAR</th><th>UNITS SOLD</th></tr> <tr> <td>1</td><td>70,000</td></tr> <tr> <td>2</td><td>120,000</td></tr> <tr> <td>3</td><td>120,000</td></tr> <tr> <td>4</td><td>80,000</td></tr> <tr> <td>5</td><td>70,000</td></tr> </table>	YEAR	UNITS SOLD	1	70,000	2	120,000	3	120,000	4	80,000	5	70,000
YEAR	UNITS SOLD												
1	70,000												
2	120,000												
3	120,000												
4	80,000												
5	70,000												
Sales price per unit	\$300/unit in years 1 through 4, \$250/unit in year 5												
Variable cost per unit	\$140/unit												
Annual fixed costs	\$700,000 per year in years 1–5												
Working-capital requirements	There will be an initial working-capital requirement of \$200,000 just to get production started. For each year, the total investment in net working capital will be equal to 10 percent of the dollar value of sales for that year. Thus, the investment in working capital will increase during years 1 and 2, then decrease in year 4. Finally, all working capital is liquidated at the termination of the project at the end of year 5.												
The depreciation method	Use the simplified straight-line method over 5 years. Assume that the plant and equipment will have no salvage value after 5 years.												

11-15. (Comprehensive problem) The Shome Corporation, a firm in the 34 percent marginal tax bracket with a 15 percent required rate of return or cost of capital, is considering a new project. The project involves the introduction of a new product. This project is expected to last 5 years and then, because this is somewhat of a fad product, be terminated. Given the following information, determine the free cash flows associated with the project, the project's net present value, the profitability index, and the internal rate of return. Apply the appropriate decision criteria.

Cost of new plant and equipment	\$6,900,000												
Shipping and installation costs	\$ 100,000												
Unit sales													
	<table> <tr> <th>YEAR</th><th>UNITS SOLD</th></tr> <tr> <td>1</td><td>80,000</td></tr> <tr> <td>2</td><td>100,000</td></tr> <tr> <td>3</td><td>120,000</td></tr> <tr> <td>4</td><td>70,000</td></tr> <tr> <td>5</td><td>70,000</td></tr> </table>	YEAR	UNITS SOLD	1	80,000	2	100,000	3	120,000	4	70,000	5	70,000
YEAR	UNITS SOLD												
1	80,000												
2	100,000												
3	120,000												
4	70,000												
5	70,000												
Sales price per unit	\$250/unit in years 1 through 4, \$200/unit in year 5												
Variable cost per unit	\$130/unit												
Annual fixed costs	\$300,000 per year in years 1–5												
Working-capital requirements	There will be an initial working-capital requirement of \$100,000 just to get production started. For each year, the total investment in net working capital will be equal to 10 percent of the dollar value of sales for that year. Thus, the investment in working capital will increase during years 1 through 3, then decrease in year 4. Finally, all working capital is liquidated at the termination of the project at the end of year 5.												
The depreciation method	Use the simplified straight-line method over 5 years. Assume that the plant and equipment will have no salvage value after 5 years.												

11-16. (Real options) Hurricane Katrina brought unprecedented destruction to New Orleans and the Mississippi gulf coast in 2005. Notably, the burgeoning casino gambling industry along the Mississippi coast was virtually wiped out overnight. GCC Corporation owns one of the oldest casinos in the Biloxi, Mississippi, area, and its casino was damaged but not destroyed by the tidal surge from the storm. The reason was that it had been located several blocks back from the beach on higher ground. However, since the competitor casinos were completely destroyed and will have to rebuild from scratch, GCC believes that it is likely to have a number of good opportunities. You have been hired to provide GCC with strategic advice. What have you learned about real options that will help you develop a strategy for GCC?



11-17. (Real options and capital budgeting) You have come up with a great idea for a Tex-Mex-Thai fusion restaurant. After doing a financial analysis of this venture, you estimate that the initial outlay will be \$6 million. You also estimate that there is a 50 percent chance that this new restaurant will be well received and will produce annual cash flows of \$800,000 per year forever (a perpetuity), while there is a 50 percent chance of it producing a cash flow of only \$200,000 per year forever (a perpetuity) if it isn't received well.

- What is the *NPV* of the restaurant if the required rate of return you use to discount the project cash flows is 10 percent?
- What are the real options that this analysis may be ignoring?
- Explain why the project may be worthwhile even though you have just estimated that its *NPV* is negative.

11-18. (Real options and capital budgeting) Go-Power Batteries has developed a high-voltage nickel-metal hydride battery that can be used to power a hybrid automobile. It can sell the technology immediately to Toyota for \$10 million, or alternatively, Go-Power Batteries can invest \$50 million in a plant and produce the batteries for itself and sell them. Unfortunately, given the current size of the market for hybrids, the present value of the cash flows from such a plant would be only \$40 million, implying that the plant has a negative expected *NPV* of –\$10 million. What are the real options that are being ignored in this analysis? Can you come up with a compelling reason why Go-Power should keep the technology rather than sell it to Toyota?

11-19. (Risk-adjusted NPV) The Hokie Corporation is considering two mutually exclusive projects. Both require an initial outlay of \$10,000 and will operate for 5 years. Project A will produce expected cash flows of \$5,000 per year for years 1 through 5, whereas project B will produce expected cash flows of \$6,000 per year for years 1 through 5. Because project B is the riskier of the two projects, the management of Hokie Corporation has decided to apply a required rate of return of 15 percent to its evaluation but only a 12 percent required rate of return to project A. Determine each project's risk-adjusted net present value.



11-20. (Risk-adjusted discount rates and risk classes) The G. Wolfe Corporation is examining two capital-budgeting projects with 5-year lives. The first, project A, is a replacement project; the second, project B, is a project unrelated to current operations. The G. Wolfe Corporation uses the risk-adjusted discount rate method and groups projects according to purpose, and then it uses a required rate of return or discount rate that has been preassigned to that purpose or risk class. The expected cash flows for these projects are given here:

	PROJECT A	PROJECT B
Initial investment	–\$250,000	–\$400,000
Cash inflows:		
Year 1	\$130,000	\$135,000
Year 2	40,000	135,000
Year 3	50,000	135,000
Year 4	90,000	135,000
Year 5	130,000	135,000

The purpose/risk classes and preassigned required rates of return are as follows:

PURPOSE	REQUIRED RATE OF RETURN
Replacement decision	12%
Modification or expansion of existing product line	15
Project unrelated to current operations	18
Research and development operations	20

Determine each project's risk-adjusted net present value.

Mini Case

This Mini Case is available in MyFinanceLab.

It's been 2 months since you took a position as an assistant financial analyst at Caledonia Products. Although your boss has been pleased with your work, he is still a bit hesitant about unleashing you without supervision. Your next assignment involves both the calculation of the cash flows associated with a new investment under consideration and the evaluation of several mutually exclusive projects. Given your lack of tenure at Caledonia, you have been asked not only to provide a recommendation but also to respond to a number of questions aimed at judging your understanding of the capital-budgeting process. The memorandum you received outlining your assignment follows:

To: The Assistant Financial Analyst
 From: Mr. V. Morrison, CEO, Caledonia Products
 Re: Cash Flow Analysis and Capital Rationing

We are considering the introduction of a new product. Currently we are in the 34 percent marginal tax bracket with a 15 percent required rate of return or cost of capital. This project is expected to last 5 years and then, because this is somewhat of a fad product, be terminated. The following information describes the new project:

Cost of new plant and equipment	\$7,900,000												
Shipping and installation costs	\$ 100,000												
Unit sales	<table> <tr> <th>YEAR</th><th>UNITS SOLD</th></tr> <tr> <td>1</td><td>70,000</td></tr> <tr> <td>2</td><td>120,000</td></tr> <tr> <td>3</td><td>140,000</td></tr> <tr> <td>4</td><td>80,000</td></tr> <tr> <td>5</td><td>60,000</td></tr> </table>	YEAR	UNITS SOLD	1	70,000	2	120,000	3	140,000	4	80,000	5	60,000
YEAR	UNITS SOLD												
1	70,000												
2	120,000												
3	140,000												
4	80,000												
5	60,000												
Sales price per unit	\$300/unit in years 1 through 4, \$260/unit in year 5												
Variable cost per unit	\$180/unit												
Annual fixed costs	\$200,000 per year in years 1–5												
Working-capital requirements	There will be an initial working-capital requirement of \$100,000 just to get production started. For each year, the total investment in net working capital will be equal to 10 percent of the dollar value of sales for that year. Thus, the investment in working capital will increase during years 1 through 3, then decrease in year 4. Finally, all working capital is liquidated at the termination of the project at the end of year 5.												
The depreciation method	Use the simplified straight-line method over 5 years. Assume that the plant and equipment will have no salvage value after 5 years.												

- Should Caledonia focus on cash flows or accounting profits in making its capital-budgeting decisions? Should the company be interested in incremental cash flows, incremental profits, total free cash flows, or total profits?

- b. How does depreciation affect free cash flows?
- c. How do sunk costs affect the determination of cash flows?
- d. What is the project's initial outlay?
- e. What are the differential cash flows over the project's life?
- f. What is the terminal cash flow?
- g. Draw a cash-flow diagram for this project.
- h. What is its net present value?
- i. What is its internal rate of return?
- j. Should the project be accepted? Why or why not?
- k. In capital budgeting, risk can be measured from three perspectives. What are those three measures of a project's risk?
- l. According to the CAPM, which measurement of a project's risk is relevant? What complications does reality introduce into the CAPM view of risk, and what does that mean for our view of the relevant measure of a project's risk?
- m. Explain how simulation works. What is the value in using a simulation approach?
- n. What is sensitivity analysis and what is its purpose?

Appendix 11A

The Modified Accelerated Cost of Recovery System

To simplify our computations we have used straight-line depreciation throughout this chapter. However, firms use accelerated depreciation for calculating their taxable income. In fact, the modified accelerated cost recovery system (MACRS) has been used since 1987. Under the MACRS the depreciation period is based on the asset depreciation range (ADR) system, which groups assets into classes by asset type and industry and then determines the actual number of years to be used in depreciating the asset. In addition, the MACRS restricts the amount of depreciation that may be taken in the year an asset is acquired or sold. These limitations have been called averaging conventions. The two primary conventions, or limitations, may be stated as follows:

1. *Half-Year Convention:* Personal property, such as machinery, is treated as having been placed in service or disposed of at the midpoint of the taxable year. Thus, a half-year of depreciation generally is allowed for the taxable year in which property is placed in service and in the final taxable year. As a result, a 3-year property class asset has a depreciation calculation that spans 4 years, with only a half a year's depreciation in the first and fourth years. In effect, it is assumed the asset is in service for 6 months during both the first and last year.
2. *Mid-Month Convention:* Real property, such as buildings, is treated as being placed in service or disposed of in the middle of the month. Accordingly, a half-month of depreciation is allowed for the month the property is placed in service and also for the final month of service.

Using the MACRS results in a different percentage of the asset being depreciated each year; these percentages are shown in Table 11A-1.

TABLE 11A-1 Percentages for Property Classes

Recovery Year	3-Year	5-Year	7-Year	10-Year	15-Year	20-Year
1	33.3%	20.0%	14.3%	10.0%	5.0%	3.8%
2	44.5	32.0	24.5	18.0	9.5	7.2
3	14.8	19.2	17.5	14.4	8.6	6.7
4	7.4	11.5	12.5	11.5	7.7	6.2
5		11.5	8.9	9.2	6.9	5.7
6		5.8	8.9	7.4	6.2	5.3
7			8.9	6.6	5.9	4.9
8			4.5	6.6	5.9	4.5
9				6.5	5.9	4.5
10				6.5	5.9	4.5
11				3.3	5.9	4.5
12					5.9	4.5
13					5.9	4.5
14					5.9	4.5
15					5.9	4.5
16					3.0	4.5
17						4.5
18						4.5
19						4.5
20						4.5
21						1.7
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

TABLE 11A-2 MACRS Demonstrated

Year	Depreciation Percentage	Annual Depreciation
1	20.0%	\$ 2,400
2	32.0	3,840
3	19.2	2,304
4	11.5	1,380
5	11.5	1,380
6	5.8	696
	<u>100.0%</u>	<u>\$12,000</u>

To demonstrate the use of the MACRS, assume that a piece of equipment costs \$12,000 and has been assigned to a 5-year class. Using the percentages in Table 11A-1 for a 5-year class asset, the depreciation deductions would be calculated as shown in Table 11A-2.

Note that the averaging convention that allows for the half-year of depreciation in the first year results in a half-year of depreciation beyond the fifth year, or in year 6.

What Does All This Mean?

Depreciation, while an expense, is not a cash-flow item. However, depreciation expense lowers the firm's taxable income, which in turn reduces the firm's tax liability and increases its cash flow. Throughout our calculations in Chapter 11 we used a simplified straight-line depreciation method to keep the calculations simple, but in reality you would use the MACRS method. The advantage of accelerated depreciation is that you end up with more depreciation expense (a non-cash item) in the earlier years and less depreciation expense in the latter years. As a result, you have less taxable profits in the early years and more taxable profits in the latter years. This reduces taxes in the earlier years when the present values are greatest, while increasing taxes in the latter years when the present values are smaller. In effect, the MACRS allows you to postpone paying taxes. Regardless of whether you use straight-line or accelerated depreciation (MACRS), the *total* depreciation is the same—it is just the timing of when the depreciation is expensed that changes.

Most corporations prepare two sets of books, one for calculating taxes for the IRS in which they use the MACRS, and one for their stockholders in which they use straight-line depreciation. For capital-budgeting purposes, only the set of books used to calculate taxes is relevant.

Study Problems

All Study Problems are available in [MyFinanceLab](#).

11A-1. (Depreciation) Compute the annual depreciation for an asset that costs \$250,000 and is in the 5-year property class. Use the MACRS in your calculation.

11A-2. (Depreciation) The Mason Falls Mfg. Company just acquired a depreciable asset this year, costing \$500,000. Furthermore, the asset falls into the 7-year property class using the MACRS.

- Using the MACRS, compute the annual depreciation.
- What assumption is being made about when the asset was bought within the year?