CHAPTER 12

Analyzing Project Cash Flows

Chapter **Outline**

Principles P3 and P5 Applied

In this chapter, we calculate investment cash flows and discuss methods that can be used to develop cash flow forecasts. Calculating the appropriate cash flows in a valuation exercise is not always obvious, and we offer some guidelines that are designed to avoid some of the more common mistakes. In particular, we will stress P Principle 3: **Cash Flows Are the Source of Value**. In addition, we will be reminded that managers are often incentivized to do things that are not in the best interest of the firm's shareholders, which is P Principle 5: **Individuals Respond to Incentives**. Specifically, when managers forecast cash flows for a project in their department, they may be tempted to paint a rosy picture for the project in the hopes of winning the funding from headquarters.

Forecasting Sales of Hybrid Automobiles

In 2001, when Toyota introduced the first-generation model of its gas- and electric-powered hybrid car, the Prius, it seemed more like a science experiment than real competition for auto industry market share. Toyota's decision to introduce the Prius and enter the hybrid car market was particularly difficult to evaluate because the cash flows were so difficult to forecast. Revenues from the Prius would depend largely on how many buyers the newly designed hybrids drew away from traditionally powered cars—a number that would be strongly influenced by the future price of gasoline. Moreover, some of the hybrid sales would come from customers who would have otherwise bought another Toyota model. These are difficult issues for any firm to face; however, they are issues a financial manager must address to make an informed decision about the introduction of an innovative new product.

Regardless of Your Major…

"The Internet on Airline Flights—Making It Happen"

Cash flow forecasting frequently involves more employees than just the finance specialists in a firm. In practice, teams of technical, marketing, accounting, and other specialists often work together to develop cash flow forecasts for large investments. For example, major airlines are now beginning to provide internet access on their flights. The idea is that for a fee of, say, $10 per flight, a customer can buy wireless access to the internet while in flight. However, an airline must overcome a number of hurdles to offer this service. There are technical issues related to both the hardware that must be installed on the aircraft and the infrastructure required to support access to the internet—and all of this costs money. Then there is the question of how much revenue the airline is expected to receive from this service. Consequently, for the airline to analyze the decision to include in-flight internet access, it needs a team that includes technical individuals to address the cost of installing and maintaining the service, marketing personnel to estimate customer acceptance rates and revenues, and financial analysts to combine the various cost and revenue estimates into a project evaluation.

Your Turn: See Study Question 12–2.

12.1 Project Cash Flows

Figure 12.1 characterizes typical project cash flows for a capital investment into one of three categories of cash flow:

- The cash flows associated with the launching of the investment, which are commonly referred to collectively as the initial cash outlays;
- The operating period cash flows, which include the cash flows for all years up until the project's termination; and
- The terminal cash flows, which are a direct result of shutting down the project.

Although the initial cash outlay period is typically assumed to be immediate (i.e., Year 0), for some types of projects such as large construction projects, this period and its cash flows may extend over multiple years. During this period, the firm making the investment will acquire the plant and equipment needed to support the investment, pay to install the equipment and train personnel to operate it (if need be), and acquire the additional inventory needed to support the

Figure 12.1

The Anatomy of Project Cash Flows for the Typical Investment

Project Life Cycle	Initial Investment Period	Interim Operating Period	Terminal Period
Relevant cash flows	• Costs of purchasing plant and equipment • Costs of installing equipment and training employees • Investment in working-capital requirements (e.g., investments in accounts receivable and inventories less those in accounts payable)	• Incremental revenues • Incremental expenses • Incremental taxes • Increase in working-capital requirements • Incremental capital expenditures for plant and equipment	• Proceeds from the disposal of plant and equipment (net of taxes) • Cleanup or decommissioning costs • Recapture of working-capital investment

operation of the investment for the coming year. In addition to inventories, the firm may need to finance added accounts receivable if it sells some of its output on credit. Finally, at least some part of this added investment in current assets is financed by the firm's suppliers in the form of trade credit, so we deduct any increase in accounts payable from the added investments in receivables and inventory. During the interim operating period, we account for the cash flow consequences of incremental revenues and expenses as well as any need for additional plant and equipment or working capital. Finally, in the final or terminal year of the investment's life, the firm incurs both cash inflows (from the sale of plant and equipment and from working capital that is used up without replenishment) and cash outflows (related to decommissioning the investment). In some cases, the latter is very sizable. For example, shutting down a crude-oil refinery would include the costs of cleaning up any environmental hazards on the plant site.

Incremental Cash Flows Are What Matters

When a firm takes on a new investment, it does so anticipating that the investment will increase the firm's future cash flows. So when we are evaluating whether to undertake the investment, as we learned from P Principle 3: **Cash Flows Are the Source of Value**, we consider what we will refer to as the **incremental cash flow** associated with the investment—that is, the additional cash flow a firm receives from taking on a new project.

To understand this concept of incremental cash flows, suppose that you recently opened a small convenience store. The store is a big success, and you are offered the opportunity to rent space in a strip mall six blocks away to open a second convenience store. To evaluate this opportunity, you begin by calculating the costs of the initial investment and the cash flows from the investment in exactly the same way you did when you evaluated the initial site. However, before calculating the net present value (NPV) of this new opportunity, you start to think about how adding a second location will affect your sales in the initial location. To what extent will you generate business by simply stealing business from your initial location? Cash flows that are generated by stealing customers from your initial location are clearly worth less to you than cash flows generated by stealing customers from your competitors.

This example serves to emphasize that the proper way to look at the cash flows from the second convenience store involves calculating the incremental cash flows generated by the new store. That is, the cash flows for the second store should be calculated by comparing the total cash flows from the two stores to the total cash flows without the second store. More generally, we define incremental project cash flows as follows:

$$\begin{pmatrix}\text{Incremental Project}\\ \text{Cash Flows}\end{pmatrix} = \begin{pmatrix}\text{Firm Cash Flows}\\ \text{with the Project}\end{pmatrix} - \begin{pmatrix}\text{Firm Cash Flows}\\ \text{without the Project}\end{pmatrix} \qquad \textbf{(12–1)}$$

Thus, to find the incremental cash flow for a project, we take the difference between the firm's cash flows if the new investment is and is not undertaken. This may sound simple enough, but there are a number of circumstances in which estimating this incremental cash flow can be very challenging, requiring the analyst to carefully consider each potential source of cash flow.

Guidelines for Forecasting Incremental Cash Flows

In this section, we focus on some simple guidelines for proper identification of incremental cash flows for a project. As we will see, this is not always easy to do, so it is helpful to have a set of basic guidelines to help us avoid some common mistakes.

Sunk Costs Are Not Incremental Cash Flows

Sunk costs are those costs that have already been incurred or are going to be incurred, regardless of whether or not the investment is undertaken. An example would be the cost of a market research study or a pilot program. These costs are not incremental cash flows resulting from the acceptance of the investment because they will be incurred in any case. For example, in the convenience store example just discussed, suppose last year you spent $1,000 getting an appraisal of the prospective site for the second store. This expenditure is not relevant to the decision we have to make today because you have already spent that money. The cost of the appraisal is a sunk cost because the money has already been spent and cannot be recovered whether or not you build the second convenience store.

Overhead Costs Are Generally Not Incremental Cash Flows

Overhead expenses such as the cost of heat, light, and rent often occur whether we accept or reject a particular project. In these instances, overhead expenses are not a relevant consideration when evaluating project cash flows.

To illustrate, consider the decision as to whether the university bookstore should open a sub shop in an underutilized portion of the bookstore. The bookstore manager estimates that the sub shop will take up one-tenth of the bookstore's floor space. If the store's monthly heat and light bill is $10,000, should the manager allocate $1,000 of this cost to the sub shop proposal? Assuming the space will be heated and lighted whether or not it is converted into a sub shop, the answer is no.

Look for Synergistic Effects

Oftentimes the acceptance of a new project will have an effect on the cash flows of the firm's other projects or investments. These effects can be either positive or negative, and if these synergistic effects can be anticipated, their costs and benefits are relevant to the project analysis.

Don't Overlook Positive Synergies

In 2000, General Motors' (GM) Pontiac division introduced the Aztek, a boldly designed sport-utility vehicle aimed at young buyers. The idea was to sell Azteks, of course, but also to help lure younger customers back into Pontiac's showrooms. Thus, in evaluating the Aztek, if Pontiac's analysts focused only on the expected revenues from new Aztek sales, they would have missed the incremental cash flow from new customers who came in to see the Aztek but instead purchased another Pontiac automobile.

Another example of a synergistic effect is that of Harley-Davidson's introduction of the Buell Blast and the Lightning Low XB95—two smaller, lighter motorcycles targeted at younger riders and female riders not yet ready for heavier and more expensive Harley-Davidson bikes. The company had two goals in mind when it introduced the Buell Blast and Lightning Low bikes. First, it was trying to expand its customer base into a new market made up of Generation Xers. Second, it wanted to expand the market for existing products by introducing more people to motorcycling. That is, the Buell Blast and Lightning Low models were offered not only to produce their own sales but also to ultimately increase the sales of Harley's heavier cruiser and touring bikes.

Beware of Cash Flows Diverted from Existing Products

An important type of negative synergistic effect comes in the form of revenue cannibalization. This occurs when the offering of a new product draws sales away from an existing product. This is a very real concern, for example, when a firm such as Frito-Lay considers offering a new flavor of Dorito® chips. A supermarket allocates limited shelf space to Frito-Lay's snack products, so if a new flavor is offered, it must take space away from existing products. If the new flavor is expected to produce $10 million per year in cash flows, perhaps as much as $6 million of this cash flow may be at the expense of existing flavors of Doritos®. Consequently, we take the resulting $4 million dollars, our incremental cash flow, as the relevant cash flow in evaluating whether or not to introduce the new flavor.

Account for Opportunity Costs

In calculating the cash flows of an investment, it is important to account for what economists refer to as opportunity cost, the cost of passing up the next best choice when making a decision. To illustrate, consider the convenience store example we introduced earlier. Remember that we were considering whether to open a second location just a few blocks from our first, very successful store. Let's now assume that you have purchased the building in which the second store is to be located and it has space for two businesses. One of the spaces is occupied by a tanning salon, and you are considering opening a second convenience store in the unoccupied space. Because you already own the building and the space needed for the convenience store is currently unused, should you charge the second convenience store business for use of the open space? The answer is no if you have no other foreseeable use for the space. However, what if a local restaurant owner approaches you with a proposal to rent the space for $2,000 a month? If you open the second convenience store, you will then forego the $2,000 per month in rent, and this becomes a very relevant incremental expense because it represents an opportunity cost of putting in the convenience store.

Work in Working-Capital Requirements

New projects often involve an additional investment in working capital. The need for additional working capital arises out of the fact that cash inflows and outflows from the operations of an investment are often mismatched. That is, inventory is purchased and paid for before it is sold. This may take the form of new inventory to stock a sales outlet or additional accounts receivable resulting from additional credit sales. Some of the funds needed to finance the increase in inventory and accounts receivable may come from an increase in accounts payable that arises when the firm buys goods on credit. As a result, the actual amount of new investment required by the project is determined by the sum of the increase in accounts receivables and inventories less the increase in accounts payable. We will refer to this quantity as net operating working capital. You may recall that in Chapter 3 we defined net working capital as the difference in current assets and current liabilities. Net operating working capital is very similar, but it focuses on the firm's accounts receivable and inventories compared to accounts payable.

Ignore Interest Payments and Other Financing Costs

Although interest payments are incremental to the investments that are partly financed by borrowing, we do not include the interest payments in the computation of project cash flows. The reason, as we will discuss more fully in Chapter 14, is that the cost of capital for the project takes into account how the project is financed, including the after-tax cost of any debt that is used to finance the investment. Consequently, when we discount the incremental cash flows back to the present using the cost of capital, we are implicitly accounting for the cost of raising funds to finance the new project (including the after-tax interest expense). Including interest expense in both the computation of the project's cash flows and the discount rate would amount to counting interest twice.

Before you move on to 12.2

Concept Check | 12.1

1. What makes an investment cash flow relevant to the evaluation of an investment proposal?
2. What are sunk costs?
3. What are some examples of synergistic effects that affect a project's cash flows?
4. When borrowing the money needed to make an investment, is the interest expense incurred relevant to the analysis of the project? Explain.

12.2 Forecasting Project Cash Flows

To analyze an investment and determine whether it adds value to the firm, following P Principle 3: **Cash Flows Are the Source of Value**, we use the project's free cash flow. Free cash flow is the total amount of cash available for distribution to the creditors who have loaned money to finance the project and to the owners who have invested in the equity of the project. In practice, this cash flow information is compiled from pro forma financial statements. **Pro forma financial statements** are forecasts of future financial statements. We can calculate free cash flow using Equation (12–2) as follows:

$$\text{Free Cash Flow} = \overbrace{\underbrace{\text{Net Operating Income (Profit)} - \text{Taxes}}_{\textbf{Net Operating Profit after Taxes or NOPAT}} + \text{Depreciation Expense}}^{\textbf{Operating Cash Flow}} - \text{Increase in Capital Expenditures } (CAPEX) - \text{Increase in Net Operating Working Capital } (NOWC) \quad \textbf{(12–2)}$$

Dealing with Depreciation Expense, Taxes, and Cash Flow

When accountants calculate a firm's taxable income, one of the expenses they subtract out is depreciation. In fact, depreciation has already been deducted from revenues before we calculate net operating income. However, depreciation is a non–cash flow expense. If you think about it, depreciation occurs because you bought a fixed asset (for example, you built a plant) in an earlier period, and

now, by depreciating the asset, you're effectively allocating the expense of acquiring the asset over time. However, depreciation is not a cash expense because the actual cash expense occurred when the asset was acquired. As a result, the firm's net operating income understates cash flows by the amount of the depreciation expense that is deducted for the period. Therefore, we'll want to compensate for this by adding depreciation back into net operating income when calculating cash flows.

In this chapter we assume that depreciation is calculated using a simplified version of the straight-line method. Specifically, we calculate annual depreciation for a piece of plant or equipment by taking its initial cost (including the cost of any equipment plus shipping costs and other costs incurred when installing the equipment) and dividing this total by the depreciable life of the equipment. If the equipment has an expected salvage value at the end of its useful life, this is deducted from the initial cost before determining the annual depreciation expense. For example, if a firm purchased a piece of equipment for $100,000 and paid an additional $20,000 in shipping and installation expenses, the initial outlay for the equipment and its depreciable cost would be $120,000. If the equipment is expected to last five years, at which time it will have a salvage value of $40,000, then the annual depreciation expense would be $16,000 ([$100,000 + 20,000 − 40,000] ÷ 5 years).

In the Appendix to this chapter, we discuss the modified accelerated cost recovery system (MACRS), which is used for most tangible depreciable property. This method is typically used by firms to compute their tax liability, but the straight-line method is used for financial reporting to the public.

Four-Step Procedure for Calculating Project Cash Flows

Our objective is to identify incremental cash flows for the project—that is, the changes to the firm's cash flows as a result of taking the project. To do this, we forecast cash flows for future periods and then estimate the value of the project using the investment criteria discussed in the

Checkpoint 12.1

Forecasting a Project's Operating Cash Flow

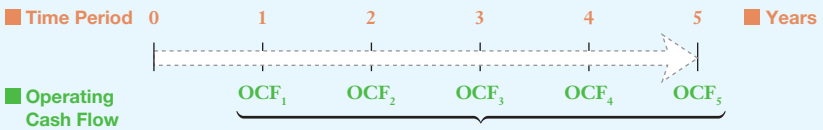
The Crockett Clothing Company, located in El Paso, Texas, owns and operates a clothing factory across the Mexican border in Juarez. The Juarez factory imports materials into Mexico for assembly and then exports the assembled products back to the United States without having to pay duties or tariffs. This type of factory is commonly referred to as a *maquiladora*.

Crockett is considering the purchase of an automated sewing machine that will cost $200,000 and is expected to operate for five years, after which time it is not expected to have any value. The investment is expected to generate $360,000 in additional revenues for the firm during each of the five years of the project's life. Due to the expanded sales, Crockett expects to have to expand its investment in accounts receivable by $60,000 and inventories by $36,000. These investments in working capital will be partially offset by an increase in the firm's accounts payable of $18,000, which makes the increase in net operating working capital equal to $78,000 in Year 0. Note that this investment will be returned at the end of Year 5 as inventories are sold, receivables are collected, and payables are repaid.

The project will also result in a cost of goods sold equal to 60 percent of revenues while incurring other annual cash operating expenses of $5,000 per year. In addition, the depreciation expense for the machine is $40,000 per year. This depreciation expense, which is one-fifth of the initial investment of $200,000, assumes that the salvage value is zero at the end of the machine's five-year life. Profits from the investment will be taxed at a 30 percent tax rate. Calculate the operating cash flow.

STEP 1: Picture the problem

Operating cash flows encompass only the revenues and operating expenses (after taxes) corresponding to the operation of the asset. Therefore, they begin only with the end of the first year of operations (Year 1). The operating cash flow then is determined by the revenues less operating expenses for Years 1 through 5.



The operating cash flow (OCF) for Years 1 through 5 equals the sum of additional revenues less operating expenses (cash expenses and depreciation) less taxes plus depreciation expense.

The following table summarizes what we know about the investment opportunity:

Equipment cost or CAPEX (today)	$(200,000)
Project life	5 years
Salvage value	0
Depreciation expense	$ 40,000 per year
Cash operating expenses	$ (5,000) per year
Revenues (Year 1)	$ 360,000 per year
Growth rate for revenues	0% per year
Cost of goods sold/revenues	60%
Investment in net operating working capital (Year 0)	$ (78,000)
Required rate of return	20%
Tax rate	30%

STEP 2: Decide on a solution strategy

Using Equation (12–3), we calculate operating cash flow as the sum of NOPAT and depreciation expense as follows:

$$\text{Operating Cash Flow} = \underbrace{\text{Net Operating Income (or Profit)} - \text{Taxes}}_{\text{NOPAT}} + \text{Depreciation Expense} \quad \textbf{(12–3)}$$

STEP 3: Solve

The project produces $360,000 in revenues annually, and the cost of goods sold equals 60 percent of revenues or $(216,000), leaving gross profits of $144,000. Subtracting cash operating expenses of $5,000 per year and depreciation expenses of $40,000 per year, we get a net operating income of $99,000. Subtracting taxes of $29,700 leaves a net operating profit of $69,300. Finally, adding back depreciation expenses gives us an operating cash flow of $109,300 per year for Years 1 through 5:

	Year 1	Year 2	Year 3	Year 4	Year 5
Project revenues **(growing at 0% per year)**	$360,000	$360,000	$360,000	$360,000	$360,000
− Cost of goods sold **(60% of revenues)**	(216,000)	(216,000)	(216,000)	(216,000)	(216,000)
= Gross profit	$144,000	$144,000	$144,000	$144,000	$144,000
− Cash operating expenses **(fixed at $5,000 per year)**	(5,000)	(5,000)	(5,000)	(5,000)	(5,000)
− Depreciation **($200,000/5 years)**	(40,000)	(40,000)	(40,000)	(40,000)	(40,000)
= Net operating income	$ 99,000	$ 99,000	$ 99,000	$ 99,000	$ 99,000
− Taxes **(30%)**	(29,700)	(29,700)	(29,700)	(29,700)	(29,700)
= Net operating profit after taxes (NOPAT)	$ 69,300	$ 69,300	$ 69,300	$ 69,300	$ 69,300
+ Depreciation	40,000	40,000	40,000	40,000	40,000
= Operating cash flow	$109,300	$109,300	$109,300	$109,300	$109,300

STEP 4: Analyze

The project contributes $99,000 to the firm's net operating income (before taxes), and if the project operates exactly as forecast here, this will be the observed impact of the project on the net operating income on the firm's income statement. Of course, in a world where the future is uncertain, this will not be the outcome. As such, we might want to analyze the consequences of lower revenues and higher costs. For example, if project revenues were to drop to $300,000, the operating cash flow would drop to only $92,500. We will have more to say about how analysts typically address project risk analysis in Chapter 13.

STEP 5: Check yourself

Crockett Clothing Company is reconsidering its sewing machine investment in light of a change in its expectations regarding project revenues. The firm's management wants to know the impact of a decrease in expected revenues from $360,000 to $240,000 per year. What would be the project's operating cash flow under the revised revenue estimate?

ANSWER: Operating cash flow = $75,700.

Your Turn: For more practice, do related **Study Problems** 12–8, 12–12, 12–14, and 12–22 at the end of this chapter.

>> END Checkpoint 12.1

previous chapter. As we introduce these calculations, keep in mind the guidelines introduced in the previous section dealing with sunk costs, synergistic effects, and opportunity costs. In order to estimate project cash flows for future periods, we use the following four-step procedure:

Step 1. Estimate the Project's Operating Cash Flows

Step 2. Calculate the Project's Working-Capital Requirements

Step 3. Calculate the Project's Capital Expenditure Requirements

Step 4. Calculate the Project's Free Cash Flow

In the pages that follow, we will discuss each of these steps in detail.

Step 1: Estimate the Project's Operating Cash Flows

Operating cash flow is simply the sum of the first three terms found in Equation (12–2). Specifically, operating cash flow for year t is defined in Equation (12–3):

$$\text{Operating Cash Flow}_t = \underbrace{\text{Net Operating Income (Profit)}_t - \text{Taxes}_t}_{\text{NOPAT}_t} + \text{Depreciation Expense}_t \qquad \textbf{(12–3)}$$

There are two observations we should make regarding the computation of operating cash flow:

1. **Our estimate of cash flows from operations begins with an estimate of net operating income.** However, when calculating net operating income, we subtract out depreciation expense because it is a tax-deductible expense. Thus, to estimate the cash flow the firm has earned from its operations, we first calculate the firm's tax liability based on net operating income and then add back depreciation expense.
2. **When we calculate the increase in taxes, we ignore interest expenses.** Even if the project is financed with debt, we do not subtract out the increased interest payments. Certainly, there is a cost to money, but we are accounting for this cost when we discount the free cash flows back to present. If we were to subtract out any increase in interest expenses and then discount those cash flows back to the present, we would be double counting the interest expense—once when we subtracted it out and once again when we discounted the cash flows back to the present. In addition, when we calculate the increased taxes from taking on the new project, we calculate those taxes from the change in net operating income so as not to allow any increase in interest expense to impact our tax calculations. The important point to remember here is that *no interest or other costs of financing* are deducted in determining the project's free cash flow.

The format we use in calculating a project's operating cash flow looks a lot like a typical income statement. The left-hand column below depicts the calculation of operating cash flow, whereas the right-hand column depicts the calculation of net income using a traditional income statement:

Note: Operating expenses include both cash expenses and depreciation expense.

Operating Cash Flow Calculation	Income Statement Calculation
Revenues	Revenues
Less: Cost of goods Sold	Less: Cost of goods sold
Equals: Gross profit	Equals: Gross profit
Less: Operating expenses (including depreciation)	Less: Operating expenses (including depreciation)
Equals: Net operating income (profit or earnings before interest and taxes, EBIT)[a]	Equals: Net operating income (profit)
Less: Taxes (based on net operating income or EBIT)	Less: Interest expense
Equals: Net operating profit after taxes (NOPAT)	Earnings before taxes (EBT)
Plus: Depreciation expense	Less: Taxes (based on EBT)
Operating cash flow	Net income

Differences

[a]Recall that NOI is the same as EBIT if there is no non-operating income or expense.

To compute operating cash flow in the left-hand column, we begin with revenues (just like we do for the income statement). Next, we subtract cost of goods sold and operating expenses to calculate net operating income (profit). To this point, the calculation of operating cash flow looks just like that in the income statement in the right-hand column. From this point forward, the calculation of operating cash flow deviates from the standard form of the income statement. Specifically, to calculate operating cash flow, we estimate taxes based on the firm's net operating profit. Deducting taxes from net operating profit gives us an estimate of net operating profit after taxes (NOPAT). Finally, because depreciation expense is a noncash operating expense and was subtracted before the tax calculation, we add it back to NOPAT to estimate operating cash flow.

Step 2: Calculate the Project's Working-Capital Requirements

When a firm invests in a new project, it often experiences an increase in sales that requires it to extend credit, which means that the firm's accounts receivable balance will grow. In addition, new projects often lead to a need to increase the firm's investment in inventories. Both the increase in accounts receivable and the increase in inventories mean that the firm must invest more cash in the business. This is a cash outflow. However, if the firm is able to finance some or all of its inventories using trade credit, this offsets the effects of the increased investment in receivables and inventories. The difference in the increased accounts receivable and inventories and the increased accounts payable (trade credit) indicates just how much cash the firm must come up with to cover the project's additional working-capital requirements.

To calculate the increase in net operating working capital, we examine the levels of accounts receivable, inventory, and accounts payable with and without the project. For the Crockett Clothing Company, let's assume that the purchase of an automated sewing machine described in Checkpoint 12.1 would cause the following changes:

	Without the Project (A)	With the Project (B)	Difference (B – A)
Accounts receivable	$600,000	$660,000	$60,000
Inventory	390,000	426,000	36,000
Accounts payable	180,000	198,000	18,000

We can now use Equation (12–4) to calculate Crockett's additional investment in working capital as follows:

$$\begin{aligned}\text{Investment in Net Operating Working Capital} &= \left(\text{Increase in Accounts Receivable}\right) + \left(\text{Increase in Inventories}\right) - \left(\text{Increase in Accounts Payable}\right) \qquad \textbf{(12–4)}\\ &= \$60{,}000 + 36{,}000 - 18{,}000 = \$78{,}000\end{aligned}$$

So to meet the needs of the firm for working capital in Year 1, Crockett must invest $78,000. Although this investment will be made throughout the year, to be conservative we assume that the full $78,000 is invested immediately in Year 0. In this particular example, sales do not grow or decline over the five-year life of the investment, so there are no additional investments in working capital in Years 1 through 5. However, at the end of Year 5, Crockett will collect outstanding receivables, sell down its remaining inventory, and pay off the outstanding balance of its accounts payable, thereby realizing a $78,000 cash inflow at the end of Year 5 from its initial investment of $78,000 in net operating working capital made in Year 0. In summary, Crockett expects to have a cash *outflow* of $78,000 for working capital in Year 0 and receive a cash *inflow* of $78,000 in Year 5 when the project is shut down.

Step 3: Calculate the Project's Capital Expenditure Requirements

Capital expenditures, or *CAPEX*, is the term we use to refer to the cash the firm spends to purchase fixed assets. As we discussed earlier, for accounting purposes, the cost of a

firm's purchases of long-term assets is not recognized immediately but is allocated or expensed over the life of the asset by depreciating the investment. Specifically, the difference between the purchase price and the expected salvage value of the investment is allocated over the life of the investment as a depreciation expense on the firm's accounting income statements.

We incorporate depreciation into our computation of project cash flow by deducting it from taxable income and then adding it back after taxes have been computed. In this way, the effect of depreciation is simply to reduce the tax liability created by the investment. When the project life is over, the book value of the investment is expected to equal the salvage value. Because the book value and salvage value are equal, there is no taxable gain or loss on the sale, and we simply add the salvage value to the final year's free cash flow along with the recovery of any net operating working capital.

Step 4: Calculate the Project's Free Cash Flow

Using Equation (12–2), we calculate Crockett Clothing Company's free cash flows for the five-year life of its investment opportunity in the new automated sewing machine. These cash flows are as follows:

	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5
Project revenues **(growing at 0% per year)**		$ 360,000	$ 360,000	$ 360,000	$ 360,000	$ 360,000
− Cost of goods sold **(60% of revenues)**		(216,000)	(216,000)	(216,000)	(216,000)	(216,000)
= Gross profit		$ 144,000	$ 144,000	$ 144,000	$ 144,000	$ 144,000
− Cash operating expenses **(fixed at $5,000 per year)**		(5,000)	(5,000)	(5,000)	(5,000)	(5,000)
− Depreciation **($200,000/5 years)**		(40,000)	(40,000)	(40,000)	(40,000)	(40,000)
= Net operating income		$ 99,000	$ 99,000	$ 99,000	$ 99,000	$ 99,000
− Taxes **(30%)**		(29,700)	(29,700)	(29,700)	(29,700)	(29,700)
= Net operating profit after taxes (NOPAT)		$ 69,300	$ 69,300	$ 69,300	$ 69,300	$ 69,300
+ Depreciation		40,000	40,000	40,000	40,000	40,000
= Operating cash flow		$ 109,300	$ 109,300	$ 109,300	$ 109,300	$ 109,300
Less: Increase in CAPEX	$(200,000)	—	—	—	—	—
Less: Increase in net operating working capital	(78,000)	—	—	—	—	78,000
Free cash flow	**(278,000)**	**$ 109,300**	**$ 109,300**	**$ 109,300**	**$ 109,300**	**$ 187,300**

Note that in Year 0 the free cash flow is simply the sum of the capital expenditure of $200,000 and the investment in net operating working capital of $78,000. The operating cash flows for Years 1 through 5 are $109,300, and in Year 5, we add back the $78,000 investment in net operating working capital, which produces a total free cash flow in this year of $187,300. Finally, note that because the equipment is not expected to have a salvage value, none is added back in Year 5.

Computing Project NPV

We can now apply the tools we studied in Chapter 11 to evaluate the investment opportunity. If Crockett applies a 20 percent discount rate or required rate of return to evaluate the sewing machine investment, we can calculate the NPV of the investment using Equation (11–1) as follows:

$$NPV = CF_0 + \frac{CF_1}{(1+k)^1} + \frac{CF_2}{(1+k)^2} + \frac{CF_3}{(1+k)^3} + \frac{CF_4}{(1+k)^4} + \frac{CF_5}{(1+k)^5} \quad \textbf{(11–1)}$$

CF_0 is the –$278,000 initial cash outlay, k is the required rate of return (20 percent) used to discount the project's future cash flows, and CF_1 through CF_5 are the investment's free cash flows for Years 1 through 5. Substituting for each of these terms in the NPV equation above, we get the following:

$$NPV = -\$278{,}000 + \frac{\$109{,}300}{(1 + .20)^1} + \frac{\$109{,}300}{(1 + .20)^2} + \frac{\$109{,}300}{(1 + .20)^3} + \frac{\$109{,}300}{(1 + .20)^4} + \frac{\$187{,}300}{(1 + .20)^5}$$
$$= \$80{,}220$$

Based on our estimates of the investment's cash flows, it appears that Crockett should go ahead and purchase the new automated machine because it offers an expected NPV of $80,220.

Tools of Financial Analysis—Free Cash Flow

Name of Tool	Formula	What It Tells You
Free cash flow	$\text{Free Cash Flow} = \begin{matrix}\text{Net Operating} \\ \text{Income } (\textit{Profit})\end{matrix} - \text{Taxes} + \begin{matrix}\text{Depreciation} \\ \text{Expense}\end{matrix} - \begin{matrix}\text{Capital} \\ \text{Expenditures} \\ (\textit{CAPEX})\end{matrix} - \begin{matrix}\text{Change in Net} \\ \text{Operating Working} \\ \text{Capital } (\textit{NOWC})\end{matrix}$ *Net operating income* is the profit after deducting the cost of goods sold and all operating expenses (including depreciation expense). Net operating income or net operating profit is also equal to earnings before interest and taxes (EBIT) for capital investment projects that do not have other (non-operating) sources of income or expense. For firms that have both operating and non-operating income and expenses, EBIT differs from net operating income by the amount of these non-operating sources of income and expenses. *Net operating profit after taxes (NOPAT)* is equal to the firm's net operating profit times 1 minus the corporate tax rate or simply net operating profit minus income taxes calculated using operating profit as taxable income. Note that we do not deduct interest expense before computing the corporate income taxes owed because the tax deductibility of interest is accounted for in the computation of the discount rate or the weighted average cost of capital, which is discussed in detail in Chapter 14. *Depreciation expense* is the allocation of the cost of fixed assets to the period when the assets are used. *Capital expenditures (CAPEX)* are periodic expenditures of money for new capital equipment that generally occur at the time the investment is undertaken (i.e., in Year 0). However, many investments require periodic expenditures over the life of the investment to repair or replace worn-out capital equipment. Finally, if the equipment has a salvage value, this becomes a cash inflow in the final year of the project's life. *Change in net operating working capital (NOWC)* represents a change in the balance of accounts receivable and inventories less accounts payable. Any change in this quantity represents either the need to invest more cash or an opportunity to extract cash from the project.	• Free cash flow is the cash the firm has left over from its operations for the year that it can use to retire debt early and give to its stockholders through the payment of cash dividends or the repurchase of some of the firm's outstanding shares of stock. • Free cash flow is a key measure of firm performance during a particular period of time that is used by the firm's managers to value new investments and by the firm's creditors (lenders) to determine whether to lend the firm money.

Before you move on to 12.3

Concept Check | 12.2

1. What does the term *free cash flow* mean?
2. What are the four steps used to forecast a project's future cash flows?
3. What is net operating working capital, and how does it affect a project's cash flows?
4. What is CAPEX, and how does it affect a project's cash flows?

12.3 Inflation and Capital Budgeting

Because investments are expected to provide cash flows over many years, we cannot overlook the issue of inflation. Fortunately, we can adjust project revenues and expenses for the anticipated effects of inflation. Cash flows that account for future inflation are generally referred to as **nominal cash flows**. Sometimes analysts calculate what we refer to as **real cash flows**, which are the cash flows that would occur in the absence of inflation.

When nominal cash flows are used, they should be discounted at the nominal interest rate, which you can recall from Chapter 9 as the rate that we observe in the financial markets. In most cases, firms do use nominal rates of return for the discount rates that are used to evaluate projects, so it is appropriate to also calculate nominal cash flows. However, when a firm calculates the real cash flows that are generated by a project, these cash flows should be discounted at the **real rate of interest**, which is the **nominal rate of interest** adjusted for inflation.

Typically, firms calculate project values by discounting nominal cash flows at nominal rates of interest. Let's see how nominal cash flows are estimated.

Estimating Nominal Cash Flows

Although not stated explicitly, the cash flows that we have looked at up to now have been nominal cash flows. To illustrate how we can directly incorporate the effects of inflation into our cash flow forecasts, consider the situation faced by the Plantation Chemical Company. The firm purchases high-density polyethylene (HDPE) pellets manufactured by oil refineries and uses them to manufacture the plastic containers for milk, fruit juice, and soft drinks. The firm is considering the expansion of one of its milk bottle plants, which will allow it to produce 5 million additional plastic bottles a year. The bottles currently sell for $0.20 each and cost $0.10 each to produce. The price of the bottles is expected to rise at a rate of 3 percent a year, and the cost of HDPE is expected to increase by 8 percent per year due to restrictions on world crude-oil production. We can forecast the gross profit for the proposed investment for each of the next three years as follows:[1]

.2060 = .20(1.03)

	1	2	3
Units sold	5,000,000	5,000,000	5,000,000
Price per unit (inflation rate = 3%)	$0.2060	$0.2122	$0.2185
Cost per unit (inflation rate = 8%)	$0.1080	$0.1166	$0.1260
Revenues	$1,030,000.00	$1,060,900.00	$1,092,727.00
Cost of goods sold	(540,000.00)	(583,200.00)	(629,856.00)
Gross profit	$ 490,000.00	$ 477,700.00	$ 462,871.00

.2185 = .2122(1.03)

.1260 = .1166(1.08)

.1080 = .10(1.08)

Note that gross profit actually declines over time, as the cost of raw materials is inflating more rapidly than the price of the end product.

Before you move on to 12.4

Concept Check | 12.3

1. What is the distinction between nominal and real interest rates?
2. If you forecast nominal cash flows, should you use the nominal or the real discount rate? Why?

[1] Although the numbers listed for price and cost per unit have been rounded to four decimal places in this table, the calculations for revenues and cost of goods sold have been made without rounding.

12.4 Replacement Project Cash Flows

To this point, we have been evaluating project cash flows for an **expansion project** that increases the scope of the firm's operations but does not replace any existing assets or operations. In this section, we consider a **replacement investment**, an acquisition of a new productive asset that replaces an older, less productive asset. A distinctive feature of many replacement investments is that the principal source of investment cash flows is cost savings, not new revenues, because the firm already operates an existing asset to generate revenues.

The objective of our analysis of investment cash flows is the same for a replacement project as it was for the expansion projects considered earlier. Specifically, project or investment free cash flow is still defined by Equation (12–3). However, with a replacement project, we must explicitly compare what the firm's cash flows would be without making a change to what they would be with the replacement assets. To perform this analysis, it is helpful to categorize investment cash flows as an initial outlay of CF_0 and future cash flows as CF_1, CF_2, CF_3, and so forth.

Category 1: Initial Outlay, CF_0

For an expansion project, the initial cash outlay typically includes the immediate cash outflow (CAPEX) necessary to purchase fixed assets and put them in operating order plus the cost of any increased investment in net operating working capital (NOWC) required by the project. However, when the investment proposal involves the replacement of an existing asset, the computation of the initial cash outlay is a bit more complicated because disposing of the existing asset can involve immediate expenses. If the old asset is sold for more than the book value of the asset, this gives rise to a taxable gain on the sale. On the other hand, if the old asset is sold for less than its book value, then a tax-deductible loss occurs.

When an existing asset is sold, there are three possible tax scenarios:

- **The old asset is sold for a price above the depreciated value.** Here the difference between the selling price of the old machine and its depreciated book value is a taxable gain, taxed at the marginal corporate tax rate and subtracted from the CAPEX. For example, assume that the old machine was originally purchased for $350,000, has a depreciated book value of $100,000 today, and could be sold for $150,000 and that the firm's marginal corporate tax rate is 30 percent. The taxes due from the gain would then be ($150,000 − $100,000) × (.30), or $15,000.
- **The old asset is sold for its depreciated value.** In this case, no taxes result, as there is neither a gain nor a loss from the asset's sale.
- **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-deductible loss and may be used to offset capital gains. Thus, it results in tax savings, and we add it to the CAPEX. For example, if the depreciated book value of the asset is $100,000 and it is sold for $70,000, we have a $30,000 loss. Assuming the firm's marginal corporate tax rate is 30 percent, the cash inflow from tax savings is ($100,000 − $70,000) × (.30), or $9,000.

Category 2: Annual Cash Flows

Annual cash flows for a replacement decision differ from those for a simple asset acquisition because we must now consider the differential operating cash flow of the new versus the old (replaced) asset.

Changes in Depreciation and Taxes

Once again, we are interested only in any change in taxes that the change in depreciation might bring about—after all, depreciation is not a cash flow expense, but because it is tax-deductible, it impacts taxes, which *are* a cash flow item. We want to look at the incremental change in taxes—that is, what the taxes would be if the asset was replaced versus what they would be if the asset was not replaced.

For a replacement project, the firm's depreciation expense increases by the amount of depreciation on the new asset but decreases by the amount of the depreciation on the replaced asset. Because our concern is with incremental changes, we take the new depreciation less the lost depreciation, and that difference is our incremental change in depreciation. That is what we use in our cash flow calculations to determine the change in taxes.

Changes in Working Capital

Many replacement projects require an increased investment in working capital. For example, if the new asset has greater capacity than the one it replaces and generates more sales, these new sales, if they are credit sales, will result 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, which also requires additional financing. On the other hand, some of this increased investment in inventory is financed by an increase in accounts payable, which offsets the outlay for new investment in inventories.

Changes in Capital Spending

The replacement asset will require an outlay at the time of its acquisition but may also require additional capital over its life. We must be careful, however, to net out any additional capital spending requirements of the older, replaced asset when computing a project's free cash flows. Finally, at the end of the project's life, there will be a cash inflow equal to the after-tax salvage value of the new asset if it is expected to have one. Once again, we need to be careful to net out any salvage value that the older asset might have to get the net cash effect of salvage value.

Replacement Example

Checkpoint 12.2 describes an asset replacement problem faced by the Leggett Scrap Metal, Inc. The company operates a large scrap metal yard that buys junk automobiles, strips them of their valuable parts, and then crushes them in a large press. Leggett is considering the replacement of its largest press with a newer and more efficient model.

Checkpoint 12.2

Calculating Free Cash Flows for a Replacement Investment

Leggett Scrap Metal, Inc., operates an auto salvage business in Salem, Oregon. The firm is considering the replacement of one of the presses it uses to crush scrapped automobiles. The following information summarizes the new versus old machine costs:

	New Machine	Old Machine
Annual cost of defects	$ 20,000	$ 70,000
Net operating income	$580,000	$580,000
Book value of equipment	$350,000	$100,000
Salvage value (today)	NA	$150,000
Salvage value (Year 5)	$ 50,000	—
Shipping cost	$ 20,000	NA
Installation cost	$ 30,000	NA
Remaining project life (years)	5	5
Net operating working capital	$ 60,000	$ 60,000
Salaries	$100,000	$200,000
Fringe benefits	$ 10,000	$ 20,000
Maintenance	$ 60,000	$ 20,000

Leggett faces a 30 percent marginal tax rate and uses a 15 percent discount rate to evaluate equipment purchases for its automobile scrap operation.

The appeal of the new press is that it is more automated (its operation requires two fewer employees). The old machine requires four employees with salaries totaling $200,000 and fringe benefits costing $20,000. The new machine cuts this total in half. In addition, the new machine is able to separate out the glass and rubber components of the crushed automobiles, which reduces the annual cost of defects from $70,000 for the old machine to $20,000 for the new machine. However, the added automation feature comes at the cost of higher annual maintenance fees of $60,000 compared to only $20,000 for the old press.

Should Leggett replace the old machine with the new one?

STEP 1: Picture the problem

The automated scrap press machine requires an initial investment to purchase the equipment, which is partially offset by the after-tax proceeds realized from the sale of the old press. In addition, the new press provides net cash savings to Leggett in Years 1 through 5 based on the predicted difference in the costs of operating the two machines. Finally, in Year 5 the new press can be sold for an amount equal to its book value of $50,000. The relevant cash flow for analyzing the replacement decision equals the difference in cash flows between the new and old machines, illustrated as follows:

where the cash flows to be used in analyzing the replacement decision equal the difference in the cash flows of the new and old assets:

$$\begin{pmatrix}\text{Replacement}\\ \text{Cash Flows, } \Delta CF_{\text{Year } t}\end{pmatrix} = \begin{pmatrix}\text{Cash Flow for}\\ \text{the New Asset,}\\ CF(\text{New})_{\text{Year } t}\end{pmatrix} - \begin{pmatrix}\text{Cash Flow for}\\ \text{the Old Asset,}\\ CF(\text{Old})_{\text{Year } t}\end{pmatrix} \quad \textbf{(12–5)}$$

STEP 2: Decide on a solution strategy

The cash flows necessary to make the replacement decision are still calculated using Equation (12–3), which requires that we identify operating cash flows after taxes, capital expenditure (CAPEX) requirements, and required investments in net operating working capital:

$$\begin{pmatrix}\text{Free Cash}\\ \text{Flow}\end{pmatrix} = \begin{pmatrix}\text{Net Operating}\\ \text{Profit After}\\ \text{Taxes } (NOPAT)\end{pmatrix} + \begin{pmatrix}\text{Depreciation}\\ \text{Expense}\end{pmatrix} - \begin{pmatrix}\text{Increase in Capital}\\ \text{Expenditures}\\ (CAPEX)\end{pmatrix} - \begin{pmatrix}\text{Increase in Net}\\ \text{Operating Working}\\ \text{Capital } (NOWC)\end{pmatrix} \quad \textbf{(12–3)}$$

However, for a replacement decision we focus on the difference in costs and benefits between the new and the old machines. For this type of problem, it is helpful to focus on the initial cash outflow (CF_0) and then the annual cash flows, including any terminal cash flow resulting from the difference in the salvage values of the two machines in Year 5—in this case, $50,000 for the new machine compared to $0 for the older machine.

(12.2 CONTINUED >> ON NEXT PAGE)

STEP 3: Solve

The initial cash outlay for Year 0 reflects the difference between the cost of acquiring the new machine (including shipping and installation costs) and the after-tax proceeds Leggett realizes from the sale of the old press:

Analysis of the Initial Outlay		Year 0
New Machine		
Purchase price	$(350,000)	
Shipping cost	(20,000)	
Installation cost	(30,000)	
Total installed cost of purchasing the new press		$(400,000)
Old Machine		
Sale price	$ 150,000	
Less: Tax on gain = [($150,000 - 100,000) × .30]	(15,000)	
After-tax proceeds from the sale of the old press		$ 135,000
Operating working capital		0
Initial cash flow		$(265,000)

The new press costs $400,000 to purchase and install. This cost is partially offset by the after-tax proceeds from the sale of the old press, which equal $135,000, so the initial cash outlay is $265,000 ($400,000−$135,000).

Next, we estimate the annual cash flows for Years 1 through 5, assuming that the new press is purchased and the old one is sold.

Analysis of the Annual Cash Flows	Years 1–4	Year 5
Cash inflows		
Increase in operating income	$ 0	
Reduced salaries	$100,000	
Reduced defects	50,000	
Reduced fringe benefits	10,000	
	$ 160,000	$160,000
Cash outflows		
Increased maintenance	$ (40,000)	
Increased depreciation	(50,000)	
	(90,000)	$ (90,000)
Net operating income	$ 70,000	$ 70,000
Less: Taxes	(21,000)	(21,000)
Net operating profit after taxes (NOPAT)	$ 49,000	$ 49,000
Plus: Depreciation	50,000	50,000
Operating cash flow	$ 99,000	$ 99,000
Less: Increase in net operating working capital	0	0
Less: Increase in CAPEX	0	50,000
Free cash flows	$ 99,000	$149,000

Note: Capital expenditures (CAPEX) are generally outflows and hence are subtracted out. However, when a project has a salvage value at the end of its useful life, the CAPEX takes on a positive value and is added to the free cash flows in the project's final year.

The new press will reduce costs (by $160,000 per year) compared to the old press; however, the new press requires an additional $40,000 in maintenance expenses and has $50,000 more in depreciation expenses. For Years 1 through 4, this results in an increased after-tax free cash flow of $99,000 per year. In Year 5, the new press is salvaged for an estimated $50,000 (recall that this is also the book value of the machine, so there is no gain on the sale and, consequently, there is no tax to be paid).

STEP 4: Analyze

Free cash flows for replacement projects require us to explicitly consider the changes that occur when one asset is used to replace an existing asset. The replacement decision in this example resulted only in cost savings because it did not add to the firm's capacity to generate revenues. However, this will not always be the case. The new or replacement asset might have greater capacity, in which case additional revenues might be generated in addition to cost savings. Note, too, that if new revenues are produced, there will likely be an increase in the firm's investment in net operating working capital.

STEP 5: Check yourself

Forecast the project cash flows for the replacement press for Leggett. The new press generates additional revenues that result in an increase in net operating income per year to $600,000 compared to $580,000 for the old machine. This increase in revenues also means that the firm will have to increase its net operating working capital by $20,000. The information for the replacement opportunity is summarized as follows:

	New Machine	Old Machine
Annual cost of defects	$ 20,000	$ 70,000
Net operating income	$600,000	$580,000
Book value of equipment	$350,000	$100,000
Salvage value (today)	NA	$150,000
Salvage value (Year 5)	$ 50,000	—
Shipping cost	$ 20,000	NA
Installation cost	$ 30,000	NA
Remaining project life (years)	5	5
Net operating working capital	$ 80,000	$ 60,000
Salaries	$100,000	$200,000
Fringe benefits	$ 10,000	$ 20,000
Maintenance	$ 60,000	$ 20,000

Estimate the initial cash outlay required to replace the old machine with the new one, and estimate the annual cash flows for Years 1 through 5.

ANSWER: Initial cash outflow = −$285,000; cash flows for Years 1–4 = $113,000; and cash flow for Year 5 = $183,000.

Your Turn: For more practice, do related **Study Problem** 12–30 at the end of this chapter.

>> END Checkpoint 12.2

Cash flows for the replacement decision are forecast in Checkpoint 12.2 and indicate that Leggett will have to invest an additional $265,000 to purchase the new press. This figure takes into account the $150,000 the firm will receive from the sale of the old model. In addition, Leggett expects to generate additional free cash flows in Years 1 through 5 equal to $99,000 from the savings in personnel costs and reduced defects. Finally, in Year 5, the sale of the replacement press is expected to generate an additional $50,000 in after-tax cash flows for a total free cash flow of $149,000 ($99,000 + 50,000).

We are now prepared to estimate the NPV of the replacement proposal as follows:

$$NPV = -\$265{,}000 + \frac{\$99{,}000}{(1 + .15)^1} + \frac{\$99{,}000}{(1 + .15)^2} + \frac{\$99{,}000}{(1 + .15)^3} + \frac{\$99{,}000}{(1 + .15)^4} + \frac{\$149{,}000}{(1 + .15)^5}$$

$$= \$91{,}722$$

Thus, we estimate that the NPV of the replacement opportunity is $91,722, which suggests that the added cost savings from the new press more than offset the cost of making the replacement.

Finance in a **Flat World**

Entering New Markets

When measuring free cash flow, it is important to think globally. We should consider threats from foreign competition as well as opportunities to sell internationally. To illustrate the threat from foreign competition, we need only look at how the U.S. auto industry has evolved over the past 40 years. When foreign carmakers first started making inroads into the U.S. market during the 1970s, no one would have thought that firms like Toyota, Honda, and Nissan could challenge the likes of Ford and GM. On the other hand, the opportunities that come from selling in foreign markets can be huge. For example, more than half of the revenues from Hollywood movies now come from abroad.

There are also other intangible benefits from investing in countries such as Germany and Japan, where cutting-edge technology is making its way into the marketplace. Such investments provide a chance to observe the introduction of overseas innovations on a first-hand basis. This allows firms such as IBM, GE, and 3Com to react more quickly to any technological advances and product innovations that might come out of countries such as Germany or Japan.

Finally, if a product is well received at home, international markets can be viewed as an opportunity to expand. For example, McDonald's was much more of a hit at home than anyone ever expected 40 years ago. Once it conquered the United States, it moved abroad—but it hasn't always been a smooth move. McDonald's faces cultural challenges whenever it opens in a new country. However, what McDonald's learns in the first store that it opens in a new country can be used to modify the firm's plans for opening subsequent stores in that country. McDonald's also learns what works in different countries and maintains the flexibility to adapt to different tastes. As a result, you'll find McLaks, a sandwich made of grilled salmon and dill sauce in Norway, Koroke Burgers (mashed potato, cabbage, and katsu sauce, all in a sandwich) and green-tea-flavored milkshakes in Japan, and McHuevos (regular hamburgers topped with a poached egg) in Uruguay. In effect, taking a product that has been successful in the United States to a new country requires flexibility, and the success of the venture is much less predictable.

Your Turn: See Study Question 12–14.

Before you begin end-of-chapter material

Concept Check | 12.4

1. What is a replacement investment?
2. What is the relevant depreciation expense when you are analyzing a replacement decision?

Applying the Principles of Finance to Chapter 12

P Principle 3: **Cash Flows Are the Source of Value** The process of deciding whether or not to accept an investment proposal begins with an estimation of the amount and timing of the relevant future free cash flows. These cash flows are discounted back to the present at the project's required rate of return to determine the present value of the investment proposal.

P Principle 5: **Individuals Respond to Incentives** When managers forecast cash flows for a project in their own department, they may be tempted to paint a rosy picture for the project in the hopes of winning the funding from headquarters.

Chapter Summaries

12.1 Identify incremental cash flows that are relevant to project valuation. (pgs. 406–409)

SUMMARY: The cash flows that are relevant to the valuation of an investment project are those that are *incremental* to the firm. Although this seems straightforward, identifying incremental cash flows can be very challenging; therefore, we offered the following guidelines and words of caution:

- **Sunk costs are not incremental cash flows.** Sunk costs are one particular category of expenditures that frequently give rise to difficulty when evaluating an investment opportunity; they are expenditures that have already been made and cannot be undone if the project is not undertaken. By definition, such costs are not incremental to the decision to undertake a new investment.
- **Overhead costs are generally not incremental cash flows.** Overhead costs include such things as the utilities required to heat and cool a business. If the utility bills of the firm will not change if the new investment is undertaken, then the allocated costs of utilities should not be included in the analysis of the investment proposal.
- **Beware of cash flows diverted from existing products.** Oftentimes a new product will get some portion of its revenues from reduced demand for another product produced by the same firm. For example, you might purchase lime-flavored Dorito® chips rather than nacho cheese Doritos®. When this happens, the analyst must be careful not to count the cannibalized sales taken away from an existing product as incremental sales.
- **Account for opportunity costs.** Sometimes there are important cash flow consequences of undertaking an investment that do not actually happen but that are foregone as a result of the investment. For example, if you rent out a part of your floor space, you obviously cannot use it in your business. Similarly, if you decide to use the space yourself, you forego the rent that would otherwise be received. The latter is an opportunity cost of using the space.
- **Work in working-capital requirements.** If an investment requires that the firm increase its investment in working capital (e.g., accounts receivable and inventories net of any corresponding increase in funding provided in the form of accounts payable), this investment is no different than capital expenditures and results in a cash outflow.
- **Ignore interest payments and other financing costs.** Interest expense associated with the debt used to finance an investment is not included as part of incremental cash flows. Rather, it is considered as part of the firm's cost of capital.

Concept Check | 12.1

1. What makes an investment cash flow relevant to the evaluation of an investment proposal?
2. What are sunk costs?
3. What are some examples of synergistic effects that affect a project's cash flows?
4. When borrowing the money needed to make an investment, is the interest expense incurred relevant to the analysis of the project? Explain.

KEY TERMS

Incremental cash flow, page 407 The change in a firm's cash flows that is a direct consequence of its having undertaken a particular project.

Sunk costs, page 407 Costs that have already been incurred.

KEY EQUATION

$$\begin{pmatrix}\text{Incremental Project}\\ \text{Cash Flows}\end{pmatrix} = \begin{pmatrix}\text{Firm Cash Flows}\\ \text{with the Project}\end{pmatrix} - \begin{pmatrix}\text{Firm Cash Flows}\\ \text{without the Project}\end{pmatrix} \quad \textbf{(12–1)}$$

12.2 Calculate and forecast project cash flows for expansion-type investments.

(pgs. 409–415)

SUMMARY: An expansion project expands or increases the scope of the firm's operations, including the addition of both revenues and costs, but does not replace any existing assets or operations. Project cash flows equal to the sum of operating cash flows less capital expenditures and any change needed in the firm's investment in working capital:

$$\text{Free Cash Flow} = \overbrace{\underbrace{\text{Net Operating Income (Profit)} - \text{Taxes}}_{\text{Net Operating Profit after Taxes or NOPAT}} + \text{Depreciation Expense}}^{\text{Operating Cash Flow}} - \text{Increase in Capital Expenditures } (CAPEX) - \text{Increase in Net Operating Working Capital } (NOWC) \quad \textbf{(12–2)}$$

Estimating a project's free cash flow involves a four-step process:

Step 1. Measure the effect of the proposed investment on the firm's operating cash flows—that is, its cash flows from operations. This includes the estimated incremental revenues and operating expenses resulting from the project's acceptance.

Step 2. Calculate the project's requirements for working capital and the resulting cash flows. Here we consider the incremental investment that the project may require in accounts receivable and inventories less any increase in accounts payable or trade credit.

Step 3. Calculate the project's cash requirements for capital expenditures. Capital expenditures include expenditures for property, plant, and equipment that are expected to last for longer than one year. The biggest capital expenditure for most investments occurs when the investment is made. However, additional capital expenditures may have to be made periodically over the life of the project as older equipment wears out or new capacity needs to be added to meet the needs of growth over time.

Step 4. Combine the project's operating cash flow with any investments made in net operating working capital and capital expenditures to calculate the project's free cash flow. In the initial year, the free cash flow will generally include only the required investment outlays for capital equipment and working capital. In subsequent years, both operating revenues and expenses determine the project's cash flows, and in the final year of the project, additional cash inflows from salvage value and the return of working capital may be present.

Concept Check | 12.2

1. What does the term *free cash flow* mean?
2. What are the four steps used to forecast a project's future cash flows?
3. What is net operating working capital, and how does it affect a project's cash flows?
4. What is CAPEX, and how does it affect a project's cash flows?

KEY TERM

Pro forma financial statements, page 409 A forecast of financial statements for a future period.

KEY EQUATIONS

$$\text{Free Cash Flow} = \overbrace{\underbrace{\text{Net Operating Income (Profit)} - \text{Taxes}}_{\text{Net Operating Profit after Taxes or NOPAT}} + \text{Depreciation Expense}}^{\text{Operating Cash Flow}} - \text{Increase in Capital Expenditures } (CAPEX) - \text{Increase in Net Operating Working Capital } (NOWC) \quad \textbf{(12–2)}$$

$$\text{Operating Cash Flow}_t = \underbrace{\text{Net Operating Income (Profit)}_t - \text{Taxes}_t}_{\text{NOPAT}} + \text{Depreciation Expense}_t \quad \textbf{(12–3)}$$

$$\text{Investment in Net Operating Working Capital} = \left(\text{Increase in Accounts Receivable}\right) + \left(\text{Increase in Inventories}\right) - \left(\text{Increase in Accounts Payable}\right) \quad \textbf{(12–4)}$$

12.3 Evaluate the effect of inflation on project cash flows. (pg. 416)

SUMMARY: Inflation can have a very significant effect on project cash flows and, consequently, the value of an investment opportunity. The consequences of inflation can be felt in both revenues and costs, and the effect is often quite different. Inflation may cause project cash flows to increase

(revenues rise faster than costs) or to fall (costs rise faster than revenues). The important thing is that the analysts carefully consider the potential effects of inflationary expectations and incorporate them into the cash flow forecast. These inflation-adjusted cash flows are referred to as nominal cash flows (as contrasted with real cash flows, which do not incorporate the effects of inflation). Because we forecast nominal cash flows, we should use nominal rates of interest as the basis for determining the discount rate for the project.

Concept Check | 12.3

1. What is the distinction between nominal and real interest rates?
2. If you forecast nominal cash flows, should you use the nominal or the real discount rate? Why?

KEY TERMS

Nominal cash flows, page 416 Cash flows that account for the effects of inflation.

Nominal rate of interest, page 416 The rate of interest that is observed in financial markets and that incorporates consideration for inflation.

Real cash flows, page 416 Cash flows that would occur in the absence of any inflation.

Real rate of interest, page 416 The rate of interest that would occur in the absence of any inflation.

12.4 Calculate the incremental cash flows for replacement-type investments.

(pgs. 417–422)

SUMMARY: A replacement project is one in which an existing asset is taken out of service and another is added in its place. Thus, a distinctive feature of many replacement investments is that the principal source of investment cash flows is cost savings, not new revenues. Because the firm already operates an existing asset to generate revenues, the primary benefit of acquiring the new asset comes from the cost savings it offers.

The cash flows for a replacement project are calculated using Equation (12–1) just like those for an expansion project. The only difference is that with a replacement project, we are continually asking how cash flows generated by the new asset differ from those generated by the older asset. For this reason, computing project cash flows for replacement asset investments is a bit more complicated. However, the principles are exactly the same.

Concept Check | 12.4

1. What is a replacement investment?
2. What is the relevant depreciation expense when you are analyzing a replacement decision?

KEY TERMS

Expansion project, page 417 An investment proposal that increases the scope of the firm's operations, including the addition of both revenues and costs, but does not replace any existing assets or operations.

Replacement investment, page 417 An investment proposal that is a substitute for an existing investment.

Study Questions

12–1. As you saw in the introduction, the Toyota Prius took some of its sales away from other Toyota products. Toyota has also licensed its hybrid technology to Ford Motor Company, which allowed Ford to introduce a Ford Fusion hybrid in 2010 that traveled 39 miles per gallon (mpg), almost doubling the city efficiency of the non-hybrid Fusion. Obviously, this new Ford product will compete directly with Toyota's hybrids. Why do you think Toyota licensed its technology to Ford?

12–2. In *Regardless of Your Major: The Internet on Airline Flights—Making It Happen* on page 406, we described an investment proposal involving the sale of internet services on airlines. How would you approach the problem of calculating the cash flows for such a venture? What costs would you include in the initial cash outlay, the annual operating cash flows, capital expenditures, and working capital?

12–3. A business is currently considering the project cash flows for the acquisition of a new subsidiary. The business is operated from a head-office in London. The CEO wants to include a flow for absorption of some head-office costs, but the CFO says this is not correct. Whom do you agree with? Explain why.

12–4. A food manufacturing business is looking to commission six new production lines that will double the output capacity of the business. Why should the project cash flows include an incremental cash flow for working capital?

12–5. When a firm finances a new investment, it often borrows part of the money, so the interest and principal payments this creates are incremental to the project's acceptance. Why are these expenditures not included in the project's cash flow computation?

12–6. Discuss how free cash flow differs from a firm's operating cash flow.

12–7. If depreciation is not a cash flow item, why does it affect the level of cash flows from a project?

12–8. Describe net operating working capital, and explain how changes in this quantity affect an investment proposal's cash flows.

12–9. What are sunk costs, and how should they be considered when evaluating an investment's cash flows?

12–10. Consider how an IT business can help its clients to construct the cash flow benefits of the implementation of its accounting software. The main advantage will be that the software will save time. Consider this from two different perspectives: (a) a business with only marginal growth, and (b) a business with exponential growth.

12–11. What are opportunity costs, and how should they affect an investment's cash flows? Give an example.

12–12. A multinational company is looking to open a new operating division. Revenue and cost cash flows have been identified, and the only remaining decision is whether to base the division in a higher wage and lower inflation country or a lower wage and higher inflation country. Consider the questions that would need to be addressed to derive the optimal result for the worldwide business.

12–13. When McDonald's moved into India, it faced a particularly difficult task. The major religion in India is the Hindu religion, and Hindus don't eat beef—in fact, most of the 1 billion people living in India are vegetarians. Still, McDonald's ventured into India and has been enormously successful. Why do you think the restaurant has been so successful, and what kinds of products do you think it sells in India?

12–14. In *Finance in a Flat World: Entering New Markets* on page 422, we described the importance of thinking globally when making investments. Pick a new product that you have just learned about that is being sold domestically, and describe how the product might benefit from international markets.

12–15. A food manufacturing company has found that products that do not meet the quality standards of supermarkets and are currently going to waste can be reprocessed at a minimum cost and turned into animal feed. Suggest the cash flows that should be considered in assessing the viability of such a project.

12–16. Throughout the examples in this chapter, we have assumed that the initial investment in working capital is later recaptured when the project ends. Is this a realistic assumption? Do firms always recover 100 percent of their investment in accounts receivable and inventories?

Study Problems

MyLab Finance
Go to **www.myfinancelab.com** to complete these exercises online and get instant feedback.

Forecasting Project Cash Flows

12–1. **(Identifying incremental revenues from new products)** Morten Food Products, Inc., is a regional manufacturer of salty food snacks. The firm competes directly with the national brands including Frito-Lay—but only in the southeastern part of the United States. Next year Morten expects total revenues of $300 million from its various chip products. Moreover, a new line of baked chips is expected to produce revenue of $60 million. However, the firm's analysts estimate that about 60 percent of this revenue will come from existing customers who switch their purchases from one of the firm's existing products to the new, healthier baked chips.

a. What level of incremental sales should the company analyst attribute to the new line of baked chips?

b. Assume that some of Morten's existing customers are actively looking for a healthier snack alternative and will move to another company's baked chip offering if Morten does not introduce the new product. How would the loss of chip revenue due to the defection of Morten customers to other brands affect your analysis of incremental sales? Discuss (no computations required).

12–2. **(Determining relevant cash flows)** Landcruisers Plus (LP) has operated an online retail store selling off-road truck parts. As the name implies, the firm specializes in parts for the venerable Toyota FJ40, which is known throughout the world for its durability and off-road prowess. The fact that Toyota stopped building and exporting the FJ40 to the U.S. market in 1982 meant that FJ40 owners depended more and more on remanufactured parts to keep their beloved off-road vehicles running. More and more FJ40 owners are replacing the original inline six-cylinder engines with a modern American-built engine. The engine replacement requires mating the new engine with the Toyota drive train. LP's owners had been offering engine adaptor kits for some time but have recently decided to begin building their own units. To make the adaptor kits, the firm would need to invest in a variety of machine tools costing a total of $700,000.

LP's management estimates that the company will be able to borrow $400,000 from its bank and pay 8 percent interest. The remaining funds would have to be supplied by LP's owners. The firm estimates that it will be able to sell 1,000 units a year for $1,300 each. The units would cost $1,000 each in cash expenses to produce (this does not include depreciation expense of $70,000 per year or interest expense of $32,000). After all expenses, the firm expects earnings before interest and taxes of $198,000. The firm pays taxes equal to 30 percent, which results in net income of $138,600 per year over the 10-year expected life of the equipment.

a. What is the annual free cash flow LP should expect to receive from the investment in Year 1, assuming that it does not require any other investments in either capital equipment or working capital and that the equipment is depreciated over a 10-year life to a zero salvage and book value? How should the financing cost associated with the $400,000 loan be incorporated into the analysis of cash flow?

b. If the firm's required rate of return for its investments is 10 percent and the investment has a 10-year expected life, what is the anticipated NPV of the investment?

12–3. **(Identifying incremental earnings from advertising synergies)** Fastfoot shoes currently sells £1 million worth of products to a major sports warehouse retailer delivering an operating profit of 35 percent for Fastfoot. The retailer has offered a promotional deal to Fastfoot that would see projected (but not guaranteed) additional sales of £300,000 for Fastfoot. To achieve this, the retailer wants to reduce Fastfoot's margin. Fastfoot has calculated that their operating profit on their entire sales to the retailer will fall to 30 percent. Fastfoot pays corporation tax at 22 percent. Is the deal worth doing from a cash flow perspective? What are the two main risks faced by Fastfoot?

12–4. **(Identifying incremental earnings from lowering product prices)** Apple's (AAPL) iPad jump-started the touchscreen computer market, driving it to levels few analysts had ever dreamed possible. Moreover, the popularity of the iPad pushed Apple's competitors to offer similar touchscreen computers. Hewlett Packard (HPE) offered its Slate product, and others soon followed suit. One such manufacturer was Soko Industries. The Soko product, the sPad, had a number of appealing features and initially sold for $600. However, the relative obscurity of the company did not help product sales. In fact, disappointing sales led Soko Industries' management to consider taking a 25 percent price break on the computer, which cost $400 to manufacture and sell.

a. If Soko goes through with the price adjustment and it leads to total sales of 400,000 sPads, what are the incremental revenues attributable to the new pricing strategy?

b. Now suppose that for each new sPad it sells, the firm also sells an average of $100 worth of applications on which the firm has 75 percent operating profit margins (i.e., the firm earns $75 in additional operating profits for each $100 in application sales). What is the incremental impact on firm operating profits of the new lower-price strategy under these conditions?

12–5. **(Identifying incremental costs for products involving pilot studies)** Look back at your answer to Study Problem 12–3. Before accepting the deal with the retailer, Fastfoot

has found that the additional manufacturing requirement will add an unexpected one-off machine upgrade cost of £75,000 (this will be an in-year cost); the capital allowances available will reduce net tax to 21 percent. What impact will this have on the cash projection? What operating margin will be required for the deal to be worth accepting?

12–6. **(Determining relevant cash flows)** A business in a small town in southern England believes that it has an opportunity to increase its sales revenue from mobile phones by either 5 percent, 10 percent, or 15 percent through an innovative marketing campaign. The marketing cost will reduce the operating margin of 10 percent by £25,000. If current sales are £3 million, what level of sales needs to be achieved to deliver additional NOPAT assuming a tax rate of 20 percent? What other risks ought to be considered?

12–7. **(Determining relevant cash flows)** Fruity Stones is considering introducing a variation of its current breakfast cereal, Jolt 'n Stones. This new cereal will be similar to the old with the exception that it will contain more sugar in the form of small pebbles. The new cereal will be called Stones 'n Stuff. It is estimated that the sales for the new cereal will be $100 million; however, 40 percent of those sales will be from current Fruity Stones customers who will switch to Stones 'n Stuff. These customers will be lost, regardless of whether the new product is offered, because this is the amount of sales the firm expects to lose to a competitor product that is going to be introduced at about the same time. What is the relevant sales level to consider when deciding whether or not to introduce Stones 'n Stuff?

12–8. **(Calculating changes in net operating working capital)** **(Related to Checkpoint 12.1 on page 410)** Tetious Dimensions is introducing a new product that it expects will increase its net operating income by $475,000. The company has a 30 percent marginal tax rate. This project will also produce $200,000 of depreciation per year. In addition, it will cause the following changes:

	Without the Project	With the Project
Accounts receivable	$ 105,000	$ 130,000
Inventory	200,000	280,000
Accounts payable	90,000	130,000

What is the project's free cash flow for Year 1?

12–9. **(Calculating changes in net operating working capital)** Duncan Motors is introducing a new product that it expects will increase its net operating income by $300,000. The company has a 34 percent marginal tax rate. This project will also produce $50,000 of depreciation per year. In addition, it will cause the following changes:

	Without the Project	With the Project
Accounts receivable	$33,000	$23,000
Inventory	25,000	40,000
Accounts payable	50,000	86,000

What is the project's free cash flow for Year 1?

12–10. **(Calculating changes in net operating working capital)** Faraway Fabricators, Inc., is considering the expansion of its welding and stamping division and estimates that this will require the firm's accounts receivable to increase by 12 percent of the added sales. Moreover, Faraway estimates that inventories will be 15 percent of the added cost of goods sold, while accounts payable will be 10 percent of that added cost. The firm's CFO estimates that its sales and cost of goods sold over the five-year estimated life of the investment are as follows:

Year	0	1	2	3	4	5
Sales	$150,000	$162,000	$174,960	$188,957	$204,073	$220,399
Cost of goods sold	90,000	97,200	104,976	113,374	122,444	132,240

a. What are the (operating) working-capital requirements of the project for Years 1 through 5? (Hint: You can assume that the expenditure for operating net working capital for Year 1 is made in Year 0 and so forth.)
b. How much additional money must Faraway invest annually because of its working-capital requirements?

12–11. (Calculating changes in net operating working capital) Visible Fences is introducing a new product and has an expected change in net operating income of $900,000. The company has a 34 percent marginal tax rate. This project will also produce $300,000 of depreciation per year. In addition, this project will cause the following changes:

	Without the Project	With the Project
Accounts receivable	$55,000	$ 63,000
Inventory	55,000	70,000
Accounts payable	90,000	106,000

What is the project's free cash flow for Year 1?

12–12. (Calculating operating cash flows) Timeapp has a new app available for mobile phones. It is expected to generate additional revenue of £3 million (being derived from 300,000 sales at £10) with direct expenses of £2.9 million. The current tax cost is 22 percent, and the project is expected to include a £75,000 share of the payment of head office costs. What additional cash flow would be generated? You have been asked to consider the sensitivity of a 30 percent sales volume difference in either direction.

12–13. (Calculating operating cash flows) Revisit Study Problem 12–12. The directors believe that 300,000 units is a sensible and realistic goal; however, they are concerned that the head office have increased their overhead cover expectation to 100,000. It has also just been announced that corporation tax is due to rise to 24 percent. Consider the impact of these two changes and the improvement required in operating margin to generate the same level of projected profitability for 300,000 units.

12–14. (Calculating project cash flows and NPV) (Related to Checkpoint 12.1 on page 410) As part of its planning for the coming Christmas season, Criswell Motorsports is considering whether to expand its product line that currently consists of skateboards to include gas-powered skateboards. The company feels it can sell 2,000 of these per year for 10 years (after which time this project is expected to shut down, with solar-powered skateboards taking over). Each gas-powered skateboard would have variable costs of $40 and sell for $200; annual fixed costs associated with production would be $160,000. In addition, there would be a $450,000 initial expenditure associated with the purchase of new production equipment. It is assumed that the simplified straight-line method would be used to depreciate this initial expenditure down to zero over 10 years. The project would also require a one-time initial investment of $50,000 in net working capital associated with inventory, and this working-capital investment would be recovered when the project is shut down. Finally, the firm's marginal tax rate is 34 percent.

a. What is the initial cash outlay associated with this project?
b. What are the annual net cash flows associated with this project for Years 1 through 9?
c. 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 termination of the project)?
d. What is the project's NPV, given a 10 percent required rate of return?

12–15. (Calculating project cash flows and NPV) You are considering adding new elliptical trainers to your firm's product line of fitness equipment, and you feel you can sell 5,000 of these per year for five years (after which time this project is expected to shut down when it is learned that being fit is unhealthy). Each elliptical trainer would have variable costs of $500 and sell for $1,000; 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 the simplified straight-line method would be used to depreciate this initial expenditure down to zero over five years. This project would also require a one-time initial investment of $1,000,000 in net working capital associated with inventory, and

this working-capital investment would be recovered when the project is shut down. Finally, the firm's marginal tax rate is 34 percent.

a. What is the initial cash outlay associated with this project?
b. What are the annual net cash flows associated with this project for Years 1 through 4?
c. 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 termination of the project)?
d. What is the project's NPV, given a 10 percent required rate of return?

12–16. (Calculating project cash flows and NPV) Bestkits are considering launching a new model kit version of a previously best-selling remote control car. Market research undertaken this year at a cost of £60,000 has indicated that the product should be commercially viable for four years, with likely sales figures in Year 1 of 125,000 units selling at £5 each; it is anticipated that units will increase by 2 percent per year and the price by 3 percent per year. The product will require some immediate alteration to the production line costing £400,000 and additional annual maintenance from Year 1 of £15,000 per annum. In Year 3 there will be a technical inspection cost of £50,000. The production of these units will require variable costs of production of £475,000, increasing at 3 percent per year. The business has a cost of funds of 6 percent.

a. Calculate the project cashflows.
b. Calculate the project payback.
c. Calculate the project NPV.

12–17. (Calculating project cash flows and NPV) Review your answer to the previous Study Problem (12–16). You now find out that the business has an expected payback period of three years and that it plans to fund this project with bank debt at a cost of 10 percent. You have been asked to give an opinion, with reasons, as to whether the project should still go ahead.

a. What percentage increase in unit sales would be required cumulatively across the four years to generate an NPV in excess of £100,000?
b. What difference would it make if the £60,000 research cost were viewed as sunk funds?

12–18. (Calculating project cash flows and NPV) Weir's Trucking, Inc., is considering the purchase of a new production machine for $100,000. The purchase of this new machine would result in an increase in earnings before interest and taxes of $25,000 per year. To operate this machine properly, workers would have to go through a brief training session that would cost $5,000 after taxes. In addition, it would cost $5,000 after taxes to install this machine correctly. Also, because this machine is extremely efficient, its purchase would necessitate an increase in inventory of $25,000. This machine has an expected life of 10 years, after which it would have no salvage value. Finally, to purchase the new machine, it appears that the firm would have to borrow $80,000 at 10 percent interest from its local bank, resulting in additional interest payments of $8,000 per year. Assume the use of the simplified straight-line method to depreciate this machine down to zero, a 34 percent marginal tax rate, and a required rate of return of 12 percent.

a. What is the initial cash outlay associated with this project?
b. What are the annual net 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 free cash flow in Year 10 plus any additional cash flows associated with termination of the project)?
d. Should this machine be purchased?

12–19. (Calculating project cash flows and NPV) The Chung Chemical Corporation is considering the purchase of a chemical analysis machine. Although the machine being considered would 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 after taxes to correctly install this machine. In addition, to properly operate this machine, inventory would have to be increased by $5,000. This machine has an expected life of 10 years, after which it will have no salvage value. Also, assume the use of the simplified straight-line method to depreciate this machine down to zero, a 34 percent marginal tax rate, and a required rate of return of 15 percent.

a. What is the cash initial outlay associated with this project?
b. What are the annual net 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 free cash flow in Year 10 plus any additional cash flows associated with termination of the project)?
d. Should this machine be purchased?

12–20. (Calculating project cash flows and NPV) Raymobile Motors is considering the purchase of a new production machine for $500,000. The purchase of this machine would 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. In addition, it would cost $5,000 after taxes to install this machine correctly. Also, because this 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 would have no salvage value. Assume the use of the simplified straight-line method to depreciate this machine down to zero, a 34 percent marginal tax rate, and a required rate of return of 15 percent.

a. What is the initial cash outlay associated with this project?
b. What are the annual net 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 free cash flow in Year 10 plus any additional cash flows associated with termination of the project)?
d. Should this machine be purchased?

12–21. (Calculating project cash flows and NPV) Garcia's Truckin', Inc., is considering the purchase of a new production machine for $200,000. The purchase of this machine would result in an increase in earnings before interest and taxes of $50,000 per year. To operate this machine properly, workers would have to go through a brief training session that would cost $5,000 after taxes. In addition, it would cost $5,000 after taxes to install this machine correctly. 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 would 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 the use of the simplified straight-line method to depreciate this machine down to zero, a 34 percent tax rate, and a required rate of return of 10 percent.

a. What is the initial cash outlay associated with this project?
b. What are the annual net 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 free cash flow in Year 10 plus any additional cash flows associated with termination of the project)?
d. Should this machine be purchased?

12–22. (Calculating project cash flows, NPV, profitability index, and internal rate of return in a comprehensive problem) (Related to Checkpoint 12.1 on page 410) Traid Winds Corporation, a firm in the 34 percent marginal tax bracket with a 15 percent required rate of return or discount rate, is considering a new project that involves the introduction of a new product. This project is expected to last five years, and then, because this is somewhat of a fad project, it will be terminated. Given the following information, determine the net cash flows associated with the project and the project's NPV, profitability index, and internal rate of return. Apply the appropriate decision criteria.

Cost of new plant and equipment:	$26,800,000
Shipping and installation costs:	$ 200,000

Unit sales:

Year	Units Sold
1	65,000
2	125,000
3	120,000
4	80,000
5	70,000

Sales price per unit: $300/unit in Years 1–4, $250/unit in Year 5

Variable cost per unit: $200/unit

Annual fixed costs: $950,000

Working-capital requirements: There will be an initial working-capital requirement of $200,000 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 and then decrease in Years 3 through 5. Finally, all working capital will be liquidated at the termination of the project at the end of Year 5.

The depreciation method: Use the simplified straight-line method over five years. It is assumed that the plant and equipment will have no salvage value after five years.

12–23. (Calculating cash flows in a comprehensive problem) The Carson Distribution Corporation, a firm in the 34 percent marginal tax bracket with a 15 percent required rate of return or discount rate, is considering a new project that involves the introduction of a new product. This project is expected to last five years, and then, because this is somewhat of a fad product, it will be terminated. Given the following information, determine the net cash flows associated with the project and the project's NPV, profitability index, and internal rate of return. Apply the appropriate decision criteria.

Cost of new plant and equipment: $9,900,000

Shipping and installation costs: $ 100,000

Unit sales:

Year	Units Sold
1	70,000
2	100,000
3	140,000
4	70,000
5	60,000

Sales price per unit: $280/unit in Years 1–4, $180/unit in Year 5

Variable cost per unit: $140/unit

Annual fixed costs: $300,000

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 equal 10 percent of the dollar value of sales for that year. Thus, the investment in working capital will increase during Years 1 through 3 and 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: Use the simplified straight-line method over five years. It is assumed that the plant and equipment will have no salvage value after five years.

12–24. (Calculating cash flows in a comprehensive problem) The Shome Corporation is considering a new project that involves the introduction of a new product. The firm in in the 34 percent marginal tax bracket and has a 15 percent required rate of return or discount rate for new investments. This project is expected to last five years, and then, because this is somewhat of a fad project, it will be terminated. Given the following information, determine the net cash flows associated with the project and the project's NPV, profitability index, and 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:

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 1–4, $200/unit in Year 5

Variable cost per unit: $130/unit

Annual fixed costs: $300,000

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 and 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: Use the simplified straight-line method over five years. It is assumed that the plant and equipment will have no salvage value after five years.

12–25. (Calculating cash flows in a comprehensive problem) Mark McNibble is CFO for McNabb Fabrications, Inc. Mark is considering a new project that involves the introduction of a new product. McNabb is in the 34 percent marginal tax bracket has a 15 percent required rate of return or discount rate for new investments. The new project is expected to last five years, and then, because this is somewhat of a fad product, it will be terminated. Given the following information, determine the net cash flows associated with the project and the project's NPV, profitability index, and internal rate of return. Apply the appropriate decision criteria.

Cost of new plant and equipment: $198,000,000

Shipping and installation costs: $2,000,000

Unit sales:

Year	Units Sold
1	1,000,000
2	1,800,000
3	1,800,000
4	1,200,000
5	700,000

Sales price per unit: $800/unit in Years 1–4, $600/unit in Year 5

Variable cost per unit: $400/unit

Annual fixed costs: $10,000,000

Working-capital requirements: There will be an initial working-capital requirement of $2,000,000 just to get production started. For each year, the total investment in net working capital will equal 10 percent of the dollar value of sales for that year. Thus, the investment in working capital will increase during Years 1 through 3 and 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: Use the simplified straight-line method over five years. It is assumed that the plant and equipment will have no salvage value after five years.

Inflation and Capital Budgeting

12–26. (Calculating inflation and project cash flows) You are submitting a proposal to a prospective new client for the provision of haulage for the next five years. It has been

agreed that fuel costs for the duration of the project can be calculated using the predicted price of fuel in five years. The current cost of fuel is £1.12 per liter. What price will you use for the contract if inflation is projected to be

a. 3 percent?
b. 5 percent?
c. 8 percent?

12–27. **(Calculating inflation and project cash flows)** You are deciding whether to buy a new car this year or in two years' time. The price today is £25,000; the equivalent price five years ago was £20,000. If inflation remains constant, what will be the expected price in two years' time?

12–28. **(Calculating inflation and project cash flows)** Carlyle Chemicals is evaluating a new chemical compound used in the manufacture of a wide range of consumer products. The firm is concerned that inflation in the cost of raw materials will have an adverse effect on the project cash flows. Specifically, the firm expects that the cost per unit (which is currently $0.80) will rise at a 10 percent rate over the next three years. The per-unit selling price is currently $1.00, and this price is expected to rise at a meager 2 percent rate over the next three years. If Carlyle expects to sell 5, 7, and 9 million units for the next three years, respectively, what is your estimate of the firm's gross profits? Based on this estimate, what recommendation would you offer to the firm's management with regard to this product?

12–29. **(Calculating inflation and project cash flows)** After you reported your findings to Carlyle Chemicals' management (see Study Problem 12–28), the CFO suggested that the company could purchase raw materials in advance for future delivery. This would involve paying for the raw materials today and taking delivery as the materials are needed. Through the advance purchase plan, the cost of raw materials would be $0.90 per unit. How does this new plan affect gross profit estimates? How should the advance payment for the raw materials enter into your analysis of project cash flows?

Replacement Project Cash Flows

12–30. **(Calculating replacement project cash flows)** **(Related to Checkpoint 12.2 on page 418)** Madrano's Wholesale Fruit Company, located in McAllen, Texas, is considering the purchase of a new fleet of trucks to be used in the delivery of fruits and vegetables grown in the Rio Grande Valley of Texas. If the company goes through with the purchase, it will spend $400,000 on eight rigs. The new trucks will be kept for five years, during which time they will be depreciated toward a $40,000 salvage value using straight-line depreciation. The rigs are expected to have a market value in five years equal to their salvage value. The new trucks will be used to replace the company's older fleet of eight trucks, which are fully depreciated but can be sold for an estimated $20,000 (because the older trucks have a current book value of zero, the selling price is fully taxable at the firm's 30 percent tax rate). The existing truck fleet is expected to be usable for five more years, after which time the rigs will have no salvage value. The existing fleet of trucks uses $200,000 per year in diesel fuel, whereas the new, more efficient fleet will use only $150,000. In addition, the new fleet will be covered under warranty, so the maintenance costs per year are expected to be only $12,000 compared to $35,000 for the existing fleet.

a. What are the differential operating cash flow savings per year during Years 1 through 5 for the new fleet?
b. What is the initial cash outlay required to replace the existing fleet with the newer trucks?
c. Sketch a timeline for the replacement project cash flows for Years 0 through 5.
d. If Madrano requires a 15 percent discount rate for new investments, should the fleet be replaced?

12–31. **(Calculating replacement project cash flows)** The Minot Kit Aircraft Company of Minot, North Dakota, uses a plasma cutter to fabricate metal aircraft parts for its plane kits. The company currently is using a used cutter it purchased four years ago. The cutter has a remaining $80,000 book value that is being depreciated $20,000 per

year over the next four years. If the old cutter were to be sold today, the company estimates that it would bring in an amount equal to the book value of the equipment. The company is considering the purchase of a new, automated plasma cutter that would cost $400,000 to install and that would be depreciated over the next four years toward a $40,000 salvage value using straight-line depreciation. The primary advantage of the new cutter is that it is fully automated and can be run by one operator rather than the three employees currently required. The labor savings would be $100,000 per year. The firm faces a marginal tax rate of 30 percent.

a. What are the differential operating cash flow savings per year during Years 1 through 4 for the new plasma cutter?
b. What is the initial cash outlay required to replace the existing plasma cutter with the newer model?
c. Sketch a timeline for the replacement project cash flows for Years 0 through 4.
d. If the company requires a 15 percent discount rate for new investments, should the plasma cutter be replaced?

12–32. (Calculating replacement project cash flows) The Louisiana Land and Cattle Company (LL&CC) is one of the largest cattle buyers in the country. It has buyers at all the major cattle auctions throughout the U.S. Southeast who buy on the company's behalf and then have the cattle shipped to Sulpher Springs, Louisiana, where they are sorted by weight and type before shipping off to feedlots in the Midwest. The company has been considering the replacement of its tractor-trailer rigs with a newer, more fuel-efficient fleet for some time, and a local Peterbilt dealer has approached the company with a proposal. The proposal calls for the purchase of 10 new rigs at a cost of $100,000 each. Each rig will be depreciated toward a salvage value of $40,000 over a period of five years. If LL&CC purchases the rigs, it will sell its existing fleet of 10 rigs to the Peterbilt dealer for the current book value of $25,000 per unit. The existing fleet will be fully depreciated in one more year but is expected to be serviceable for five more years, at which time each rig will be worth only $5,000 per unit as scrap. The new fleet of trucks is much more fuel-efficient and will require only $200,000 for fuel costs compared to $300,000 for the existing fleet. In addition, the new fleet of trucks will require minimal maintenance over the next five years, equal to an estimated $150,000 compared to the almost $400,000 that is currently being spent to keep the older fleet running.

a. What are the differential operating cash flow savings per year during Years 1 through 5 for the new fleet? The firm pays taxes at a 30 percent marginal tax rate.
b. What is the initial cash outlay required to replace the existing fleet with new rigs?
c. Sketch a timeline for the replacement project cash flows for Years 0 through 5.
d. If LL&CC requires a 15 percent discount rate for new investments, should the fleet be replaced?

Mini-Cases

Danforth & Donnalley Laundry Products Company

Determining Relevant Cash Flows

At 3:00 P.M. on April 14, 2016, James Danforth, president of Danforth & Donnalley (D&D) Laundry Products Company, called to order a meeting of the financial directors. The purpose of the meeting was to make a capital-budgeting decision with respect to the introduction and production of a new product, a liquid detergent called Blast.

D&D was formed in 1993 with the merger of Danforth Chemical Company (producer of Lift-Off detergent, the leading laundry detergent on the West Coast) and Donnalley Home Products Company (maker of Wave detergent, a major laundry product in the Midwest). As a result of the merger, D&D was producing and marketing two major product lines. Although these products were in direct competition, they were not without product differentiation: Lift-Off was a low-suds, concentrated powder, and Wave was a more traditional powder detergent. Each line brought with it considerable

brand loyalty, and by 2016, sales from the two detergent lines had increased tenfold from 1993 levels, with both products now being sold nationally.

In the face of increased competition and technological innovation, D&D had spent large amounts of time and money over the past four years researching and developing a new, highly concentrated liquid laundry detergent. D&D's new detergent, which it called Blast, had many obvious advantages over the conventional powdered products. The company felt that Blast offered the consumer benefits in three major areas. Blast was so highly concentrated that only 2 ounces were needed to do an average load of laundry as compared with 8 to 12 ounces of powdered detergent. Moreover, being a liquid, it was possible to pour Blast directly on stains and hard-to-wash spots, eliminating the need for a presoak and giving it cleaning abilities that powders could not possibly match. And, finally, it would be packaged in a lightweight, unbreakable plastic bottle with a sure-grip handle, making it much easier to use and more convenient to store than the bulky boxes of powdered detergents with which it would compete.

The meeting participants included James Danforth, president of D&D; Jim Donnalley, a director on the board; Guy Rainey, vice president in charge of new products; Urban McDonald, controller; and Steve Gasper, a newcomer to the D&D financial staff who was invited by McDonald to sit in on the meeting. Danforth called the meeting to order, gave a brief statement of its purpose, and immediately gave the floor to Rainey.

Rainey opened with a presentation of the cost and cash flow analysis for the new product. To keep things clear, he passed out copies of the projected cash flows to those present (see Exhibits 1 and 2). In support of this information, he provided some insights as to how these calculations were determined. Rainey proposed that the initial cost for Blast include $500,000 for the test marketing, which was conducted in the Detroit area and completed in June of the previous year, and $2 million for new specialized equipment and packaging facilities. The estimated life for the facilities was 15 years, after which they would have no salvage value. This 15-year estimated life assumption coincides with company policy set by Donnalley not to consider cash flows occurring more than 15 years into the future, as estimates that far ahead "tend to become little more than blind guesses."

Exhibit 1

D&D Laundry Products Company Forecast of Annual Cash Flows from the Blast Product (including cash flows resulting from sales diverted from the existing product lines)

Year	Cash flows	Year	Cash flows
1	$280,000	9	$350,000
2	280,000	10	350,000
3	280,000	11	250,000
4	280,000	12	250,000
5	280,000	13	250,000
6	350,000	14	250,000
7	350,000	15	250,000
8	350,000		

Exhibit 2

D&D Laundry Products Company Forecast of Annual Cash Flows from the Blast Product (excluding cash flows resulting from sales diverted from the existing product lines)

Year	Cash flows	Year	Cash flows
1	$250,000	9	$315,000
2	250,000	10	315,000
3	250,000	11	225,000
4	250,000	12	225,000
5	250,000	13	225,000
6	315,000	14	225,000
7	315,000	15	225,000
8	315,000		

Rainey cautioned against taking the annual cash flows (as shown in Exhibit 1) at face value because portions of these cash flows actually would be a result of sales that had been diverted from Lift-Off and Wave. For this reason, Rainey also produced the estimated annual cash flows that were adjusted to include only those cash flows incremental to the company as a whole (as shown in Exhibit 2).

At this point, discussion opened between Donnalley and McDonald, and it was concluded that the opportunity cost on funds was 10 percent. Gasper then questioned the fact that no costs were included in the proposed cash budget for plant facilities that would be needed to produce the new product.

Rainey replied that at the present time Lift-Off's production facilities were being used at only 55 percent of capacity and, because these facilities were suitable for use in the production of Blast, no new plant facilities would need to be acquired for the production of the new product line. It was estimated that full production of Blast would only require 10 percent of the plant capacity.

McDonald then asked if there had been any consideration of increased working-capital needs to operate the investment project. Rainey answered that there had and that this project would require $200,000 of additional working capital; however, as this money would never leave the firm and would always be in liquid form, it was not considered an outflow and hence not included in the calculations.

Donnalley argued that this project should be charged something for its use of current excess plant facilities. His reasoning was that if another firm had space like this and was willing to rent it out, it could charge somewhere in the neighborhood of $2 million. However, he went on to acknowledge that D&D had a strict policy that prohibits renting or leasing any of its production facilities to any party from outside the firm. If the firm didn't charge for facilities, he concluded, it might end up accepting projects that under normal circumstances would be rejected.

From here the discussion continued, centering on the question of what to do about the lost contribution from other projects, the test marketing costs, and the working capital.

Questions

1. If you were put in the place of Steve Gasper, would you argue for the cost from market testing to be included in a cash outflow?
2. What would your opinion be as to how to deal with the question of working capital?
3. Would you suggest that the product be charged for the use of excess production facilities and building space?
4. Would you suggest that the cash flows resulting from erosion of sales from current laundry detergent products be included as a cash inflow? If there was a chance that competitors would introduce a similar product if D&D did not introduce Blast, would this affect your answer?
5. If debt was used to finance this project, should the interest payments associated with this new debt be considered cash flows?
6. What are the NPV, internal rate of return, and profitability of this project, both including cash flows resulting from sales diverted from the existing product lines (Exhibit 1) and excluding cash flows resulting from sales diverted from the existing product lines (Exhibit 2)? Under the assumption that there is a good chance that competitors would introduce a similar product if D&D doesn't, would you accept or reject this project?

Caledonia Products

Calculating Free Cash Flow and Project Valuation

It's been two 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 tax bracket with a 15 percent discount rate. This project is expected to last five years, and then, because this is somewhat of a fad project, it will 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:

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 1–4, $260/unit in Year 5

Variable cost per unit: $180/unit

Annual fixed costs: $200,000 per year

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 and 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: Straight-line over five years. It is assumed the plant and equipment have no salvage value after five years.

Questions

1. Why should Caledonia focus on the project's free cash flows, as opposed to the accounting profits it would earn when analyzing whether to undertake the project?
2. What are the incremental cash flows for the project in Years 1 through 5, and how do these cash flows differ from accounting profits or earnings?
3. What is the project's initial cash outlay?
4. Sketch out a cash flow diagram for this project.
5. What is the project's NPV?
6. What is its internal rate of return?
7. Should the project be accepted? Why or why not?

Appendix: The Modified Accelerated Cost 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, since 1987 the **modified accelerated cost recovery system (MACRS)** has been used. 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 also for the final taxable year. As a result, a three-year property class asset has a depreciation calculation that spans four years, with only a half-year of depreciation in the first and fourth years. In effect, it is assumed that the asset is in service for six months during both the first and the last years.

Table 12A.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

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 in which 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 12A.1.

To demonstrate the use of the MACRS, assume that a piece of equipment costs $12,000 and has been assigned to a five-year class. Using the percentages in Table 12A.1 for a five-year class asset, the depreciation deductions can be calculated as shown in Table 12A.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 of This Mean?

Depreciation, although 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 this chapter, 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 noncash item) in the earlier years and less depreciation expense in the later years. As a result, you have less taxable profit in the early years and more taxable profit in the later years. This reduces taxes in the earlier years, when the present values are greatest, while increasing taxes in the later years, when present values are smaller. In effect, the MACRS allows you to postpone paying taxes. Regardless of whether you use straight-line or accelerated (MACRS) depreciation, the total depreciation is the same; it is just the timing of when the deprecation is expensed that changes.

Most corporations prepare two sets of books, one for calculating taxes for the Internal Revenue Service, 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.

Table 12A.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
	100.0%	$12,000

Study Problems

12A–1. **(Computing depreciation)** Compute the annual depreciation for an asset that costs $250,000 and is in the five-year property class. Use the MACRS in your calculation.

12A–2. **(Computing depreciation)** The Mason Falls Manufacturing Company just acquired a depreciable asset this year, costing $500,000. Furthermore, the asset falls into the seven-year property class using the MACRS.

a. Using the MACRS, compute the annual depreciation.

b. What assumption is being made about when you bought the asset within the year?