1. Introduction

As long as a company exists, it invests in assets. In fact, a company invests in assets to continue to exist, and moreover, to grow. By investing to grow, a company is at the same time investing to maximize the owners' wealth. Maximizing wealth of a company's owners requires that its managers continually evaluate investment opportunities and determine which ones provide a return commensurate with their risk. Let's look at Company A, B, and C, each having identical assets and investment opportunities, but that:

- Company A's management does not take advantage of its investment opportunities and simply pays all of its earnings to its owners;
- Company B's management only makes those investments necessary to replace any deteriorating plant and equipment, paying out any left-over earnings to its owners; and
- Company C's management invests in all those opportunities that provide a return better than what the owners could have earned had they had the same amount of invested funds to invest themselves.

In the case of Company A, the owners' investment in the company is not what it could be as long as the company has investment opportunities that are better than those available to owners. By not even making investments to replace deteriorating plant and equipment, Company A will eventually shrink until it has no more assets.

In the case of Company B, its management is not taking advantage of all profitable investments -- investments that provide a higher return than the return required by its owners. This means that there are foregone opportunities and owners' wealth is not maximized.

But in the case of Company C, management is making all profitable investments, maximizing owners' wealth. Company C will continue to grow as long as there are profitable investment opportunities and its management takes advantage of them. And Company C represents most large corporations: continually making investments and growing over time.
A. The investment problem

Capital investments

Companies continually invest funds in assets and these assets produce income and cash flows that the company may either reinvest in more assets or pay to its owners. These assets represent the company's capital. **Capital** is the company's total assets and is comprised of all tangible and intangible assets. These assets include physical assets (such as land, buildings, equipment, and machinery), as well as assets that represent property rights (such as accounts receivable, notes, stocks, and bonds). When we refer to **capital investment**, we are referring to the company's investment in its assets.\(^1\)

The company's capital investment decision may be comprised of a number of distinct decisions, each referred to as a project. A **capital project** is a set of asset investments that are contingent on one another and are considered together. Suppose a company is considering the production of a new product. It must make a decision of whether or not to produce this new product. This capital project requires acquiring land, building facilities, and purchasing production equipment. And this project may also require the company to increase its investment in its working capital -- inventory, cash, or accounts receivable. Working capital is the collection of assets needed for day-to-day operations that support a company's long-term investments.

The investment decisions of the company are decisions concerning a company's capital investment. When we refer to a particular decision that financial managers must make, we are referring to a decision pertaining to a capital project.

Investment decisions and owners' wealth maximization

Let's see what we must evaluate in our investment decisions to maximize the wealth of owners of the company we manage. We already know the value of the company today is the present value of all its future cash flows. But we need to understand better where these future cash flows come from. They come from:

1. assets that are already in place, which are the assets accumulated as a result of all past investment decisions, and
2. future investment opportunities.

Future cash flows are discounted at a rate that represents investors' assessments of the uncertainty that these cash flows will flow in the amounts and when expected. To evaluate the value of the company, we need to evaluate the risk of these future cash flows; that is, the project's business risk.

A project's business risk is reflected in the discount rate, which is the rate of return required to compensate the suppliers of capital (bondholders and owners) for the amount of risk they bear. From investors' perspective, the discount rate is the **required rate of return** (RRR). From the company's perspective, the discount rate is the **cost of capital** -- what it costs the company to raise a dollar of new capital.

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\(^1\) The term **capital** also has come to mean the funds used to finance the company's assets. In this sense, capital consists of notes, bonds, stock, and short-term financing. We use the term "capital structure" to refer to the mix of these different sources of capital used to finance a company's assets. The term **capital** in financial management, a company's resources and the funds committed to these resources, does not mean the same thing in other fields. In accounting, the term "capital" means the owners' equity, the difference between the amount of a company's assets and its liabilities. In economics, the term **capital** means the physical (real) of the company, and therefore excludes the assets that represent property rights. In law the term **capital** refers to the amount of owners' equity required by statute for the protection of creditors. This amounts to the **stated capital**, which often is the par value of the company's stock.
Suppose a company invests in a new project.

- If the project generates cash flows that just compensate the suppliers of capital for the risk they bear on this project (that is, it earns the cost of capital), the value of the company does not change.
- If the project generates cash flows greater than needed to compensate them for the risk they take on, it earns more than the cost of capital, increasing the value of the company.
- If the project generates cash flows less than needed, it earns less than the cost of capital, decreasing the value of the company.

How do we know whether the cash flows are more than or less than needed to compensate for the risk that they will indeed flow? If we discount all the cash flows at the cost of capital, we can assess how this project affects the present value of the company. If the expected change in the value of the company from an investment is:

- positive, the project returns more than the cost of capital;
- negative, the project returns less than the cost of capital;
- zero, the project returns the cost of capital.

**Capital budgeting** is the process of identifying and selecting investments in long-lived assets, where long-lived means assets expected to produce benefits over more than one year. In this reading, we first look at the capital budgeting process in general. After looking at the broad picture of how investment decisions are made, we look at how projects may be classified. This classification helps us identify the cash flows we need to consider in our decisions. We then look at the mechanics of estimating future cash flows using estimates of future revenues, expenses, and depreciation. We summarize our analysis of cash flows with examples analyzing two different investment projects.

### B. Capital budgeting

A company must continually evaluate possible investments. Investment decisions regarding long-lived assets are a part of the on-going capital budgeting process. Ideas about what projects to invest in are generated through facts gathered at lower management levels, where they are evaluated and screened. The suggested investments that pass this first level filter up through successive management levels toward top management or the board of directors, who make the decisions about which one will get how much capital.

Before a company begins thinking about capital budgeting, it must first determine its corporate strategy - its broad set of objectives for future investment. How does a company achieve its corporate strategy? By making investments in long-lived assets that will maximize owners' wealth. Selecting these projects is what capital budgeting is all about.

### C. Classifying investment projects

An investment generally provides benefits over a limited period of time, referred to as its economic life. The economic life or useful life of an asset is determined by factors including physical deterioration, obsolescence, and the degree of competition in the market for a product.

**Economic life**

The **economic life** or **useful life** of a project is an estimate of the length of time that the asset will provide benefits to the company. After its useful life, the revenues generated by the asset tend to decline rapidly and its expenses tend to increase.

Typically, an investment requires expenditure up-front -- immediately -- and provides benefits in the form of cash flows received in the future. If benefits are received only within the current period -- within one
year of making the investment -- we refer to the investment as a short-term investment. If these benefits are received beyond the current period, we refer to the investment as a long-term investment and refer to the expenditure as a capital expenditure.

Any project representing an investment may comprise one or more assets. For example, a new product may require investment in production equipment, a building, and transportation equipment -- all making up the bundle of assets comprising the project we are evaluating. Short-term investment decisions involve, primarily, investments in current assets: cash, marketable securities, accounts receivable, and inventory. The objective of investing in short-term assets is the same as long-term assets: maximizing owners' wealth. Nevertheless, we consider them separately for two practical reasons:

1. Decisions about long-term assets are based on projections of cash flows far into the future and require us to consider the time value of money.

2. Long-term assets do not figure into the daily operating needs of the company.

Decisions regarding short-term investments, or current assets, are concerned with day-to-day operations. And a company needs some level of current assets to act as a cushion in case of unusually poor operating periods, when cash flows from operations are less than expected.

Risk

Suppose you are faced with two investments, A and B, each promising a $100 cash inflow ten years from today. If A is riskier than B, what are they worth to you today? If you do not like risk, you would consider A less valuable than B because the chance of getting the $100 in ten years is less for A than for B. Therefore, valuing a project requires considering the risk associated with its future cash flows.

The project's risk of return can be classified according to the nature of the project represented by the investment:

- A replacement project is an investment that involves the replacement of existing equipment or facilities.

  Replacement projects include the maintenance of existing assets to continue the current level of operating activity. Projects that reduce costs, such as replacing older technology with newer technology or improving the efficiency of equipment or personnel, are also considered replacement projects.

  To evaluate replacement projects we need to compare the value of the company with the replacement asset to the value of the company without that same replacement asset. What we're really doing in this comparison is looking at opportunity costs: what cash flows would have been if the company had stayed with the old asset.

  There's little risk in the cash flows from replacement projects. The company is simply replacing equipment or buildings already operating and producing cash flows. And the company typically has experience in managing similar new equipment.

- An expansion project is an investment in a project that broadens existing product lines and existing markets.

  Expansion projects are intended to enlarge a company's established product or market. There is little risk associated with expansion projects. The reason: A company with a history of experience in a product or market can estimate future cash flows with more certainty when considering expansion than when introducing a new product outside its existing product line.

- A new product or market investment involves introducing a new product or entering into a new market.
Investment projects that involve introducing new products or entering into new markets are riskier than the replacement and expansion projects. That's because the company has little or no management experience in the new product or market. Hence, there is more uncertainty about the future cash flows from investments in new product or new market projects.

- A mandated project is a project required by government laws or agency rules.

A company is forced or coerced into its mandated projects. These are government mandated projects typically found in "heavy" industries, such as utilities, transportation, and chemicals, all industries requiring a large portion of their assets in production activities. Government agencies, such as the Occupational Health and Safety Agency (OSHA) or the Environmental Protection Agency (EPA), may impose requirements that companies install specific equipment or alter their activities (such as how they dispose of waste).

Dependence among projects

In addition to considering the future cash flows generated by project, a company must consider how it affects the assets already in place -- the results of previous project decisions -- as well as other projects that may be undertaken. Projects can be classified as follows according to the degree of dependence with other projects: independent projects, mutually exclusive projects, contingent projects, and complementary projects.

An independent project is one whose cash flows are not related to the cash flows of any other project. In other words, accepting or rejecting an independent project does not affect the acceptance or rejection of other projects. An independent project can be evaluated strictly on the effect it will have on the value of a company without having to consider how it affects the company's other investment opportunities, and vice versa.

Projects are mutually exclusive if the acceptance of one precludes the acceptance of other projects. There are some situations where it is technically impossible to take on more than one project. For example, suppose a manufacturer is considering whether to replace its production facilities with more modern equipment. The company may solicit bids among the different manufacturers of this equipment. The decision consists of comparing two choices:

1. Keeping its existing production facilities, or
2. Replacing the facilities with the modern equipment of one manufacturer.

Because the company cannot use more than one production facility, it must evaluate each bid and determine the most attractive one. The alternative production facilities are mutually exclusive projects: the company can accept only one bid. The alternatives of keeping existing facilities or replacing them are also mutually exclusive projects. The company cannot keep the existing facilities and replace them!

Contingent projects are dependent on the acceptance of another project. Suppose a greeting card company develops a new character, Joe Cool, and is considering starting a line of Joe Cool cards. If Joe catches on, the company will consider producing a line of Joe Cool office supplies -- but only if the Joe Cool character becomes popular. The office supply project is a contingent project. It is contingent on the company (1) taking on the Joe project and (2) Joe Cool 's success.

Another form of dependence is found in complementary projects. Projects are complementary projects if the investment in one enhances the cash flows of one or more other projects. Consider a manufacturer of personal computer equipment and software. If it develops new software that enhances the abilities of a computer mouse, the introduction of this new software may enhance its mouse sales as well.
2. Cash flow from investments

A. Incremental cash flows

A company invests only to make its owners "better off", meaning increasing the value of their ownership interest. A company will have cash flows in the future from its past investment decisions. When it invests in new assets, it expects the future cash flows to be greater than without this new investment. Otherwise it doesn't make sense to make this investment. The difference between the cash flows of the company with the investment project and the cash flows of the company without the investment project -- both over the same period of time -- is referred to as the project's incremental cash flows.

We have to look at how it will change the future cash flows of the company to evaluate an investment. How much the value of the company changes as a result of the investment? The change in a company's value as a result of a new investment is the difference between its benefits and its costs:

\[
\text{Project's change in the value of the company} = \text{Project's benefits} - \text{Project's costs}.
\]

A more useful way of evaluating the change in the value is the breakdown the project's cash flows into two components

1. The present value of the cash flows from the project's operating activities (revenues and operating expenses), referred to as the project's operating cash flows (OCF) ; and
2. The present value of the investment cash flows, which are the expenditures needed to acquire the project's assets and any cash flows from disposing the project's assets.

or,

\[
\text{Change in the value of the company} = \text{Present value of the change in operating cash flows provided by the project} + \text{Present value of investment cash flows}.
\]

The present value of a project's operating cash flows is typically positive (indicating predominantly cash inflows) and the present value of the investment cash flows is typically negative (indicating predominantly cash outflows).

3. Investment cash flows

When we consider the cash flows of an investment we must also consider all the cash flows associated with acquiring and disposing of assets in the investment. An investment may comprise:

- one asset or many assets;
- an asset purchased and another sold; and
- cash outlays that occur at the beginning of the project or spread over several years.

Let's first become familiar with cash flows related to acquiring assets; then we'll look at cash flows related to disposing assets.

A. Asset acquisition

In acquiring any asset, there are three cash flows to consider:

1. Cost of the asset,
2. Set-up expenditures, including shipping and installation; and
3. Any tax credit.
The tax credit may be an investment tax credit or a special credit -- such as a credit for a pollution control device -- depending on the tax law. Cash flow associated with acquiring an asset is:

\[
\text{Cash flow from acquiring assets} = \text{Cost} + \text{Set-up expenditures} - \text{Tax credit}.
\]

Suppose the company buys equipment that costs $100,000 and it costs $10,000 to install it. If the company is eligible for a 10% tax-credit on this equipment (that is, 10% of the total cost of buying and installing the equipment), the change in the company's cash flow from acquiring the asset is $99,000:

\[
\begin{align*}
\text{Cash flow from acquiring assets} &= 100,000 + 10,000 - 0.10(100,000+10,000) \\
&= 100,000 + 10,000 - 11,000 \\
&= 99,000.
\end{align*}
\]

The cash outflow is $99,000 when this asset is acquired: $110,000 out to buy and install the equipment and $11,000 in from the reduction in taxes. What about expenditures made in the past for assets or research that would be used in the project we're evaluating? Suppose the company spent $1,000,000 over the past three years developing a new type of toothpaste. Should the company consider this $1,000,000 spent on research and development when deciding whether to produce this new product we are considering? No! These expenses have already been made and do not affect how the new product changes the future cash flows of the company. We refer to this $1,000,000 as a sunk cost and do not consider it in the analysis of our new project. Whether or not the company goes ahead with this new product, this $1,000,000 has been spent. A sunk cost is any cost that has already been incurred that does not affect future cash flows of the company.

Let's consider another example. Suppose the company owns a building that is currently empty. Let's say the company suddenly has an opportunity to use it for the production of a new product. Is the cost of the building relevant to the new product decision? The cost of the building itself is a sunk cost because it was an expenditure made as part of some previous investment decision. The cost of the building does not affect the decision to go ahead with the new product.

Suppose the company was using the building in some way producing cash (say, renting it) and the new project is going to take over the entire building. The cash flows given up represent opportunity costs that must be included in the analysis of the new project. However, these forgone cash flows are not asset acquisition cash flows. Because they represent operating cash flows that could have occurred but will not because of the new project, they must be considered part of the project's future operating cash flows. Further, if we incur costs in renovating the building to manufacture the new product, the renovation costs are relevant and should be included in our asset acquisition cash flows.

B. Asset disposition

Many new investments require getting rid of old assets. At the end of the useful life of an asset, the company may be able to sell it or may have to pay someone to haul it away. If the company is making a decision that involves replacing an existing asset, the cash flow from disposing of the old asset must be figured in since it is a cash flow relevant to the acquisition of the new asset.

Disposition of new investment

If the company disposes of an asset, whether at the end of its useful life or when it is replaced, two types of cash flows must be considered:

1. what you receive or pay in disposing of the asset; and
2. any tax consequences resulting from the disposal.

\[
\text{Cash flow from disposing assets} = \text{Proceeds or payment from disposing assets} - \text{Taxes from disposing assets}
\]
The proceeds are what you expect to sell the asset for if you can get someone to buy it. If the company must pay for the disposal of the asset, this cost is a cash outflow.

Consider the investment in a gas station. The current owner may want to leave the business (retire, whatever), selling the station to another gas station proprietor. But if a buyer cannot be found because of lack of gas buyers in the area, the current owner may be required to remove the underground gasoline storage tanks to prevent environmental damage. Thus, a cost is incurred at the end of the asset's life.

The tax consequences are a bit more complicated. Taxes depend on:

1. the expected sales price, and
2. the book value of the asset for tax purposes at the time of disposition.

**Sales price more than book value but less than original cost**

If a company sells the asset for more than its book value but less than its original cost, the difference between the sales price and the book value is a gain, taxable at ordinary tax rates.

**Sales price more than original cost**

If a company sells the asset for more that its original cost, then the gain is broken into two parts:

1. Capital gain: the difference between the sales price and the original cost; and

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A common mistake in these calculations is to calculate the tax consequences of the sale, but forget to add the cash flow from the actual sale. This is an important cash flow that should not be left out.
4. Recapture of depreciation: the difference between the original cost and the book value.

The capital gain is the benefit from the appreciation in the value of the asset and may be taxed at special rates, depending on the tax law at the time of sale. The recapture of depreciation represents the amount by which the company has over-depreciated the asset during its life. This means that more depreciation has been deducted from income (reducing taxes) than necessary to reflect the usage of the asset. The recapture portion is taxed at the ordinary tax rates, since this excess depreciation taken all these years has reduced taxable income.

Sales price less than book value

If a company sells an asset for less than its book value, the result is a capital loss. In this case, the asset's value has decreased by more than the amount taken for depreciation for tax purposes. A capital loss is given special tax treatment:

- If there are capital gains in the same tax year as the capital loss, they are combined, so that the capital loss reduces the taxes paid on capital gains, and
- If there are no capital gains to offset against the capital loss, the capital loss is used to reduce ordinary taxable income.

The benefit from a loss on the sale of an asset is the amount by which taxes are reduced. The reduction in taxable income is referred to as a tax-shield, since the loss shields some income from taxation. If the company has a loss of $1,000 on the sale of an asset and has a tax rate of 40%, this means that its taxable income is $1,000 less and its taxes are $400 less than they would have been without the sale of the asset.

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2 MACRS depreciation rates are the rates prescribed by the U.S. Internal Revenue Code for depreciation for tax purposes. These rates are provided in the Appendix to this reading.
**Example 1: Gains and losses from selling an asset**

Suppose you are evaluating an asset that costs $10,000 that you expect to sell in five years. Suppose further that the book value of the asset for tax purposes will be $3,000 after five years and that the company's tax rate is 40%. What are the expected cash flows from disposing this asset?

**Case 1: Sell the asset for $8,000**

If you expect the company to sell the asset for $8,000 in five years, $10,000 - 3,000 = $7,000 of the asset's cost will be depreciated, yet the asset lost only $10,000 - 8,000 = $2,000 in value. Therefore, the company has over-depreciated the asset by $5,000. Since this over-depreciation represents deductions to be taken on the company's tax returns over the five years that don't reflect the actual depreciation in value (the asset doesn't lose $7,000 in value, only $2,000), this $5,000 is taxed at ordinary tax rates. If the company's tax rate is 40%, the tax = 40% x $5,000 = $2,000.

The cash flow from disposition is the sum of the direct cash flow (someone pays us for the asset or the company pays someone to dispose of it) and the tax consequences. In this example, the cash flow is the $8,000 we expect someone to pay the company for the asset, less the $2,000 in taxes we expect the company to pay, or $6,000 cash inflow.

**Case 2: Sell the asset for $12,000**

Suppose instead that you expect the company to sell this asset in five years for $12,000. Again, the asset is over-depreciated by $7,000. In fact, the asset is not expected to depreciate, but rather appreciate over the five years. The $7,000 in depreciation is recaptured after five years and taxed at ordinary rates: 40% of $7,000, or $2,800. The $2,000 capital gain is the appreciation in the value of the asset and may be taxed at special rates. If the tax rate on capital gain income is 30%, you expect the company to pay 30% of $2,000, or $600 in taxes on this gain. Selling the asset in five years for $12,000 therefore results in an expected cash inflow of $12,000 - 2,800 - 600 = $8,600.

**Cash 3: Sell the asset for $1,000**

Suppose you expect the company to sell the asset in five years for $1,000. If the company can reduce its ordinary taxable income by the amount of the capital loss, $3,000 - 1,000 = $2,000, our tax bill be 40% of $2,000, or $800 because of this loss. We refer to this reduction in the taxes as a tax-shield, since the loss "shields" $2,000 of income from taxes. Combining the $800 tax reduction with the cash flow from selling the asset, the $1,000, gives the company a cash inflow of $1,800.

**Disposition of existing asset(s)**

Let's also not forget about disposing of any existing assets. Suppose the company bought equipment ten years ago and at that time expected to be able to sell fifteen years later for $10,000. If the company decides today to replace this equipment, it must consider what it is giving up by not disposing of an asset as planned.

- If the company does not replace the equipment today, it would continue to depreciate it for five more years and then sell it for $10,000.
- If the company replaces the equipment today, it would not have five more years' depreciation on the replaced equipment and it would not have $10,000 in five years (but perhaps some other amount today).

This $10,000 in five years, less any taxes, is a forgone cash flow that we must figure into the investment cash flows. Also, the depreciation the company would have had on the replaced asset must be considered in analyzing the replacement asset's operating cash flows. So, any time that you are making a decision pertaining to replacing an asset, don't forget about the forgone.
Example 2: Initial cash flow

**Problem**
Suppose a company spends $1 million on research and development of a new drug. The cost to buy the necessary equipment to produce and distribute the drug is $2.5 million. Working capital is expected to increase by $250,000 when the company embarks on the new product. What is the initial cash flow for this project?

**Solution**

Initial cash flow:

<table>
<thead>
<tr>
<th>Cash flow</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost of equipment</td>
<td>-$2,500,000</td>
</tr>
<tr>
<td>Increase in working capital</td>
<td>-$250,000</td>
</tr>
<tr>
<td>Initial cash flow</td>
<td>-$2,750,000</td>
</tr>
</tbody>
</table>

Example 3: Cash flow from disposition

**Problem**
Equipment is bought for $500,000. It is depreciated as a three-year asset using MACRS. At the end of two years, the equipment is sold for $100,000. What is the cash flow effect of this sale? Assume a 35% tax rate. MACRS rates for a 3-year asset are 33.33%, 44.45%, 14.81%, and 7.41%, respectively.

**Solution**

Book value (BV) at the time of sale:

\[ BV = 500,000 \left( 0.0741 + 0.1481 \right) = 111,100 \]

or

\[ BV = 500,000 \left( 1 - 0.3333 - 0.4445 \right) = 111,100 \]

Loss = $100,000 - 111,100 = $11,100

Tax benefit = (0.35)(11,100) = $3,885

CF = $100,000 + 3,885 = $103,885

4. Operating cash flows

In the simplest form of investment, there will be a cash outflow when the asset is acquired and there may be either a cash inflow or an outflow at the end of its economic life. In most cases these are not the only cash flows -- the investment may result in changes in revenues, expenditures, taxes, and working capital. These are operating cash flows since they result directly from the operating activities -- the day-to-day activities of the company.

What we are after here are estimates of operating cash flows. We cannot know for certain what these cash flows will be in the future, but we must attempt to estimate them. What is the basis for these estimates? We base them on marketing research, engineering analyses, operations research, analysis of our competitors -- and our managerial experience.

A. Change in revenues

Suppose we are a food processor considering a new investment in a line of frozen dinner products. If we introduce a new ready-to-eat dinner product that is not frozen, our marketing research will indicate how much we should expect to sell. But where do these new product sales come from? Some may come from consumers who do not already buy frozen dinner products. But some of the not-frozen dinner product sales may come from consumers who choose to buy the not-frozen dinners product instead of frozen dinners. It would be nice if these consumers are giving up buying our competitors' frozen dinners. Yet some of them may be giving up buying our frozen dinners. So, when we introduce a new product, we are really interested in how it changes the revenues of the entire company (that is, the incremental revenues), rather than the sales of the new product alone.

We also need to consider any foregone revenues -- opportunity costs -- related to our investment. Suppose our company owns a building currently being rented to another company. If we are considering terminating that rental agreement so we can use the building for a new project, we need to consider the foregone rent -- what we would have earned from the building. Therefore, the revenues from the new project are really only the additional revenues -- the revenues from the new project minus the revenue we could have earned from renting the building.

Bottom line: When a company undertakes a new project, the financial managers want to know how it changes the company's total revenues, not merely the new product's revenues.
B. Change in expenses

When a company takes on a new project, all the costs associated with it will change the company's expenses. If the investment involves changing the sales of an existing product, we need an estimate the change in unit sales. Once we have an estimate in how sales may change, we can develop an estimate of the additional costs of producing the additional number of units by consulting with production management. And, we will want an estimate of how the product's inventory may change when production and sales of the product change.

If the investment involves changes in the costs of production, we compare the costs without this investment with the costs with this investment. For example, if the investment is the replacement of an assembly line machine with a more efficient machine, we need to estimate the change in the company's overall production costs such as electricity, labor, materials, and management costs.

A new investment may change not only production costs but also operating costs, such as rental payments and administration costs. Changes in operating costs as a result of a new investment must be considered as part of the changes in the company's expenses. Increasing cash expenses are cash outflows, and decreasing cash expense are cash inflows.

C. Change in taxes

Taxes figure into the operating cash flows in two ways. First, if revenues and expenses change, taxable income and, therefore, taxes change. That means we need to estimate the change in taxable income resulting from the changes in revenues and expenses resulting from a new project to determine the effect of taxes on the company. Second, the deduction for depreciation reduces taxes. Depreciation itself is not a cash flow. But depreciation reduces the taxes that must be paid, shielding income from taxation. The tax-shield from depreciation is like a cash inflow.

Suppose a company is considering a new product that is expected to generate additional sales of $200,000 and increase expenses by $150,000. If the company's tax rate is 40%, considering only the change in sales and expenses, taxes go up by $50,000 x 40% or $20,000. This means that the company is expected to pay $20,000 more in taxes because of the increase in revenues and expenses.

Let's change this around and consider that the product will generate $200,000 in revenues and $250,000 in expenses. Considering only the change in revenues and expenses, if the tax rate is 40%, taxes go down by $50,000 x 40%, or $20,000. This means that we reduce our taxes by $20,000, which is like having a cash inflow of $20,000 from taxes. Now, consider depreciation. When a company buys an asset that produces income, the tax laws allow it to depreciate the asset, reducing taxable income by a specified percentage of the asset's cost each year. By reducing taxable income, the company is reducing its taxes. The reduction in taxes is like a cash inflow since it reduces the company's cash outflow to the government.

Suppose a company has taxable income of $50,000 before depreciation and a flat tax rate of 40%. If the company is allowed to deduct depreciation of $10,000, how has this changed the taxes it pays?

<table>
<thead>
<tr>
<th>Without depreciation</th>
<th>With depreciation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taxable income</td>
<td>$50,000</td>
</tr>
<tr>
<td>Tax rate</td>
<td>0.40</td>
</tr>
<tr>
<td>Taxes</td>
<td>$20,000</td>
</tr>
</tbody>
</table>

Depreciation reduces the company's tax-related cash outflow by $20,000 - 16,000 = $4,000 or, equivalently, by $10,000 x 40% = $4,000. A reduction is an outflow (taxes in this case) is an inflow. We refer to the effect depreciation has on taxes as the depreciation tax-shield.
Let's look at another depreciation example, this time considering the effects of replacing an asset on the depreciation tax-shield cash flow. Suppose you are replacing a machine that you bought five years ago for $75,000. You were depreciating this old machine using straight-line depreciation over ten years, or $7,500 depreciation per year. If you replace it with a new machine that costs $50,000 and is depreciated over five years, or $10,000 each year, how does the change in depreciation affect the cash flows if the company's tax rate is 30%? We can calculate the effect two ways:

1. We can compare the depreciation and related tax-shield from the old and the new machines. The depreciation tax-shield on the old machine is 30% of $7,500, or $2,250. The depreciation tax-shield on the new machine is 30% of $10,000, or $3,000. Therefore, the change in the cash flow from depreciation is $3,000 - 2,250 = $750.

2. We can calculate the change in depreciation and calculate the tax-shield related to the change in depreciation. The change in depreciation is $10,000 - 7,500 = $2,500. The change in the depreciation tax-shield is 30% of $2,500, or $750.

A Note on Depreciation

Depreciation itself is not a cash flow. But in determining cash flows, we are concerned with the effect depreciation has on our taxes -- and we all know that taxes are a cash outflow. Since depreciation reduces taxable income, depreciation reduces the tax outflow, which amounts to a cash inflow.

For tax purposes, companies are permitted to use accelerated depreciation (specifically the rates specified under the Modified Accelerated Cost Recovery System (MACRS)) or straight-line. An accelerated method is preferred in most situations since it results in larger deductions sooner in the asset's life than using straight-line depreciation. Therefore, accelerated depreciation, if available, is preferable to straight-line due to the time value of money.

Under the present tax code, assets are depreciated to a zero book value. Salvage value -- what we expect the asset to be worth at the end of its life -- is not considered in calculating depreciation. So is salvage value totally irrelevant to the analysis? No. Salvage value is our best guess today of what the asset will be worth at the end of its useful life some time in the future. Salvage value is our estimate of how much we can get when we dispose of the asset. Just remember you can't use it to figure depreciation for tax purposes.

### D. Change in working capital

Working capital consists of short-term assets, also referred to as current assets, which support the day-to-day operating activity of the business. Net working capital is the difference between current assets and current liabilities. Net working capital is what would be left over if the company had to pay off its current obligations using its current assets. The adjustment we make for changes in net working capital is attributable to two sources:

1. a change in current asset accounts for transactions or precautionary needs; and
2. the use of the accrual method of accounting.

An investment may increase the company's level of operations, resulting in an increase in the net working capital needed (also considered transactions needs). If the investment is to produce a new product, the company may have to invest more in inventory (raw materials, work-in-process, and finished goods). If to increase sales means extending more credit, then the company's accounts receivable will increase. If the investment requires maintaining a higher cash balance to handle the increased level of transactions, the company will need more cash. If the investment makes the company's production facilities more efficient, it may be able to reduce the level of inventory.

Because of an increase in the level of transactions, the company may want to keep more cash and inventory on hand for precautionary purposes. That is because as the level of operations increase, the effect of any fluctuations in demand for goods and services may increase, requiring the company to keep...
additional cash and inventory "just in case". The company may increase working capital as a precaution because if there is greater variability of cash and inventory, a greater safety cushion will be needed. On the other hand, if a project enables the company to be more efficient or lowers costs, it may lower its investment in cash, marketable securities, or inventory, releasing funds for investment elsewhere in the company.

We also use the change in working capital to adjust accounting income (revenues less expenses) to a cash basis because cash flow is ultimately what we are valuing, not accounting numbers. But since we generally have only the accounting numbers to work from, we use this information, making adjustments to arrive at cash.

To see how this works, let's look at the cash flow from sales. Not every dollar of sales is collected in the year of sale. Customers may pay some time after the sale. Using information from the accounts receivable department about how payments are collected, we can determine the change in the cash flows from revenues. Suppose we expect sales in the first year to increase by $20,000 per month and it typically takes customers thirty days to pay. The change in cash flows from sales in the first year is $20,000 x 11 = $220,000 -- not $20,000 x 12 = $240,000. The way we adjust for this difference between what is sold and what is collected in cash is to keep track of the change in working capital, which is the change in accounts receivable in this case. An increase in working capital is used to adjust revenues downward to calculate cash flow:

\[
\begin{align*}
\text{Change in revenues} & \quad \$240,000 \\
\text{Less: Increase in accounts receivable} & \quad 20,000 \\
\text{Change in cash inflow from sales} & \quad 220,000
\end{align*}
\]

On the other side of the balance sheet, if the company is increasing its purchases of raw materials and incurring more production costs, such as labor, the company may increase its level of short-term liabilities, such as accounts payable and salary and wages payable.

Suppose expenses for materials and supplies are forecasted at $10,000 per month for the first year and it takes the company thirty days to pay. Expenses for the first year are $10,000 x 12 = $120,000, yet cash outflow for these expenses is only $10,000 x 11 = $110,000 since the company does not pay the last month's expenses until the following year. Accounts payable increases by $10,000, representing one month's of expenses. The increase in net working capital (increase in accounts payable \(\Rightarrow\) increases current liabilities \(\Rightarrow\) increases net working capital) reduces the cost of goods sold to give us the cash outflow from expenses:

\[
\begin{align*}
\text{Cost of goods sold} & \quad \$120,000 \\
\text{Less: increase in accounts payable} & \quad 10,000 \\
\text{Change in cash flow from expenses} & \quad 110,000
\end{align*}
\]

A new project may result in either:

- an increase in net working capital;
- a decrease in net working capital; or
- no change in net working capital.

Further, working capital may change at the beginning of the project and at any point during the life of the project. For example, as a new product is introduced, sales may be terrific in the first few years, requiring an increase in cash, accounts receivable, and inventory to support these increased sales. But all of this requires an increase in working capital -- a cash outflow.
But later sales may fall off as competitors enter the market. As sales and production fall off, the need for the increased cash, accounts receivable and inventory falls off also. As cash, accounts receivable, and inventory are reduced, there is a cash inflow in the form of the reduction in the funds that become available for other uses within the company.

A change in net working capital can be thought of specifically as part of the initial investment -- the amount necessary to get the project going. Or it can be considered generally as part of operating activity -- the day-to-day business of the company. So where do we classify the cash flow associated with net working capital? With the asset acquisition and disposition represented in the new project or with the operating cash flows?

**Bottom line:** If a project requires a change in the company's net working capital accounts that persists for the duration of the project -- say, an increase in inventory levels starting at the time of the investment -- we tend to classify the change as part of the acquisition costs at the beginning of the project and as part of disposition proceeds at the end of project. If, on the other hand, the change in net working capital is due to the fact that accrual accounting does not coincide with cash flows, we tend to classify the change is part of the operating cash flows.

### Classifying working capital changes

In many applications, we can arbitrarily classify the change in working capital as either investment cash flows or operating cash flows. And the classification doesn't really matter since it's the bottom line, the net cash flows, that matter. How we classify the change in working capital doesn't affect a project's attractiveness.

However, we will take care in the examples in this text to classify the change in working capital according to whether it is related to operating or investment cash flows so you can see how to make the appropriate adjustments.

5. **Putting it all together**

Here's what we need to put together to calculate the change in the company's operating cash flows related to a new investment we are considering:

- Changes in revenues and expenses;
- Cash flow from changes in taxes from changes in revenues and expenses;
- Cash flow from changes in cash flows from depreciation tax-shields; and
- Changes in net working capital.

There are many ways of compiling the component cash flow changes to arrive at the change in operating cash flow. We will start by first calculating taxable income, making adjustments for changes in taxes, non-cash expenses, and net working capital to arrive at operating cash flow.

Suppose you are evaluating a project that is expected to increase sales by $200,000 and expenses by $150,000. Accounts receivable are expected to increase by $20,000 and accounts payable are expected to increase by $5,000, but no changes in cash or inventory are expected. Further, suppose the project's assets will have a $10,000 depreciation expense for tax purposes. If the tax rate is 40%, what is the operating cash flow from this project?
Change in sales $200,000
Less change in expenses 150,000
Less change in depreciation 10,000
Change in taxable income $ 40,000
Less taxes 16,000
Change in income after taxes $ 24,000
Add depreciation 10,000
Less increase in working capital 15,000
Change in operating cash flow $ 19,000

So that we can mathematically represent how to calculate the change in operating cash flows for a project, let's use the symbol "Δ" to indicate "change in":

ΔOCF = change in operating cash flow;  
ΔR = change in revenues;  
ΔE = change in expenses;  
ΔD = change in depreciation;  
t = tax rate; and  
ΔNWC = change in working capital

The change in the operating cash flow is:

ΔOCF = (ΔR - ΔE - ΔD) (1 - t) + ΔD - ΔNWC

We can also write this as:

ΔOCF = (ΔR - ΔE) (1 - t) + ΔDt - ΔNWC

Applying these equations to the previous example,

ΔOCF = (ΔR - ΔE - ΔD) (1 - t) + ΔD - ΔNWC
ΔOCF = ($200,000 - 150,000 - 10,000)(1 - 0.40) + $10,000 - $15,000
ΔOCF = $19,000

or, using the rearrangement of the equation,

ΔOCF = (ΔR - ΔE) (1 - t) + ΔDt - ΔNWC
ΔOCF = ($200,000 - 150,000)(1 - 0.40) + $10,000 (0.40) - $15,000
ΔOCF = $19,000.

Let's look at one more example for the calculation of operating cash flows. Suppose you are evaluating modern equipment which you expect will reduce expenses by $100,000 during the first year. And, since the new equipment is more efficient, you can reduce the level of inventory by $20,000 during the first year. The old machine cost $200,000 and was depreciated using straight-line over ten years, with five years remaining. The new machine cost $300,000 and will be depreciated using straight-line over ten years. If the company's tax rate is 30%, what is the expected operating cash flow in the first year? Let's identify the components:

ΔR = $0  
The new machine does not affect revenues
ΔE = -$100,000  
The new machine reduces expenses that will reduce taxes and increase cash flows
ΔD = +$10,000  
The new machine increases the depreciation expense from $20,000 to $30,000
ΔNWC = -$20,000  
The company can reduce its investment in inventory releasing funds to be invested elsewhere
t = 30%
The operating cash flow from the first year is therefore:

\[
\Delta \text{OCF} = (\Delta R - \Delta E - \Delta D) (1 - t) + \Delta D - \Delta \text{NWC}
\]

\[
\Delta \text{OCF} = (+$100,000 - 10,000) (1 - 0.30) + $10,000 - -$20,000
\]

\[
\Delta \text{OCF} = $63,000 + $10,000 + $20,000
\]

\[
\Delta \text{OCF} = $93,000.
\]

Example 4: Change in expenses

**Problem**

If a project is expected to increase costs by $50,000 per year and the tax rate of the company is 40%, what is the net cash flow from the change in costs?

**Solution**

\[-$50,000 + 20,000 = -$30,000\]

Example 5: Change in depreciation

**Problem**

Suppose the Inter.Com Company is evaluating its depreciation methods on a new piece of equipment that costs $100,000. And suppose the equipment can be depreciated using straight-line over five years or treating it as a 3-year MACRS asset. What is the difference in the cash flows associated with depreciation under these two methods in the second year if its marginal tax rate is 40%?

**Solution**

Difference in depreciation = $20,000 – 44,450 = $24,450

Tax shield of difference = (0.40) $24,450 = $9,780

A. Net cash flows

By now we should know that an investment's cash flows consist of: (1) cash flows related to acquiring and disposing the assets represented in the investment, and (2) how it affects cash flows related to operations. To evaluate of any investment project, we must consider both to determine whether or not the company is better off with or without it.

The sum of the cash flows from asset acquisition and disposition and from operations is referred to as net cash flows (NCF). And this sum is calculated for each period. In each period, we add the cash flow from asset acquisition and disposition and the cash flow from operations. For a given period,

\[\text{Net cash flow} = \text{Investment cash flow} + \text{Change in operating cash flow (i.e., } \Delta \text{OCF)}\]

The analysis of the cash flows of investment projects can become quite complex. But by working through any problem systematically, line-by-line, you will be able to sort out the information and focus on those items that determine cash flows.
Example 6: Determining net cash flows

Problem

The Acme.Com Company is evaluating replacing its production equipment that produces anvils. The current equipment was purchased ten years ago at a cost of $1.5 million.

Acme depreciated its current equipment using MACRS, considering the equipment to be a 5-year MACRS asset. If they sell the current equipment, they estimate that they can get $100,000 for it.

The new equipment would cost $2.5 million and would be depreciated as a 5-year MACRS asset. The new equipment would not affect sales, but would result in a costs savings of $400,000 each year of the asset's 10-year useful life.

At the end of its 10-year life, Acme estimates that it can sell the equipment for $30,000. Also, because the new equipment would be more efficient, Acme would have less work-in-process anvils, reducing inventory needs initially by $20,000. Acme's marginal tax rate is 40%. Assume that the equipment purchase (and sale of the old equipment) occurs at the end of the year 2000 and that the first year of operating this equipment is 2001 and the last year of operating the equipment is 2010.

Solution

Pieces of information to use:
- Book value of current equipment = $0
- Sale of current equipment = $100,000
- Tax on sale of current equipment = $40,000
- Initial outlay for new = - $2,500,000
- \( \Delta E \) = $400,000
- \( \Delta WC \) = -$20,000 (initially)
- \( \Delta WC \) = $20,000 (at end of project)

Depreciation:

Year 1: 0.2000 (2,500,000) = $500,000
Year 2: 0.3200 (2,500,000) = $800,000
Year 3: 0.1920 (2,500,000) = $480,000
Year 4: 0.1152 (2,500,000) = $288,000
Year 5: 0.1152 (2,500,000) = $288,000
Year 6: 0.0576 (2,500,000) = $144,000

Worksheet:

<table>
<thead>
<tr>
<th></th>
<th>2000</th>
<th>2001</th>
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<td>$560,000</td>
<td>$432,000</td>
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</tr>
</tbody>
</table>
### B. Simplifications

To actually analyze a project's cash flows, we need to make several simplifications:

- **We assume that cash flows into or out of the company at certain points in time, typically at the end of the year, although we realize a project's cash flows into and out of the company at irregular intervals.**

- **We assume that the assets are purchased and put to work immediately.**

- **By combining inflows and outflows in each period, we are assuming that all inflows and outflows in a given period have the same risk.**

Because there are so many flows to consider, we focus on flows within a period (say a year), assuming they all occur at the end of the period. We assume this to reduce the number of things we have to keep track of. Whether or not this assumption matters depends: (1) the difference between the actual time of cash flow and when we assume it flows at the end of the period (that is, a flow on January 2 is 364 days from December 31, but a flow on December 30 is only one day from December 31), and (2) the opportunity cost of funds. Also, assuming that cash flows occur at specific points in time simplifies the financial mathematics we use in valuing these cash flows.

Keeping track of the different cash flows of an investment project can be taxing. Developing a checklist of things to consider can help you wade through the analysis of a project's cash flows.

### Try it! Determining cash flows

The president of the Cha-Cha Company (CCC) has asked you to evaluate the proposed acquisition of a dance floor, converting its floor space from “mingling” to “dancing”. The new floor costs $1,000,000 and it is classified in the 7-year MACRS class. The purchase of the dance floor would not require any change in working capital. The dance floor would increase the company's attendance, increasing before-tax revenues by $400,000 per year, but would also increase operating costs by $100,000 per year because it increases maintenance costs. The floor is expected to be used for ten years. At the end of the ten years, CCC is likely to convert it back to “mingling” at a cost of $200,000. The firm's marginal tax rate is 30%. What are the net cash flows for each year of the project's life?
6. Summary

Determining whether an investment’s benefits outweigh its costs requires that the financial manager first estimate the future cash flows associated with the investment. For a capital project, this often entails estimating future periods’ revenues and costs. In addition, the manager must incorporate taxes into these cash flows because this is a significant part of these future cash flows.

The task of estimating the cash flows appears, at first, to be quite daunting. But this is an exercise that all companies must go through for every capital project. The amount of material that must be sorted through to determine the relevant information for this estimation is often substantial and it is the responsibility of the financial managers of the company to sort through this material, determine the relevant information, and organize it in such a way to enable the estimation of the cash flows in every period of the project’s life. One of the key tools that financial managers use is a spreadsheet program, such as Microsoft Excel®.

The goal is to estimate the net cash flow associated with each year of a project’s life. Once these are determined, we apply financial theory and mathematics to assess whether the project’s benefits outweigh its costs.

7. Solutions to Try it!

Gains and losses

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<th>Year</th>
<th>Book value at end of year</th>
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<td>20X1</td>
<td>$666,700</td>
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<td>20X2</td>
<td>$222,200</td>
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<td>20X3</td>
<td>$74,100</td>
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<td>20X4</td>
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Calculate the gain or loss if the asset described above is sold:

1. At the end of 20X2 for $250,000
   
   Gain = $250,000 - 222,200 = $27,800
   
   This gain is taxed at ordinary rates because $250,000 is less than $1 million.

2. At the end of 20X3 for $50,000
   
   Loss = $50,000 - 74,100 = -$24,100
   
   This is a capital loss.

3. At the end of 20X1 for $1,100,000
   
   Gain = $1,100,000 - 666,700 = $433,300
   
   Because the sales price exceeds the original cost, the gain is taxed in two parts:
   
   Taxed at capital gains rates $100,000
   
   Taxed at ordinary rates $333,300
   
   Total gain $433,300
Determining cash flows

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<td>$262,470</td>
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<td>$236,790</td>
<td>$236,790</td>
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8. Appendix: MACRS depreciation rates

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<th>7-year</th>
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For more detail on MACRS, check out the information provided by the Internal Revenue Service.