PROJECT CASH FLOWS AND RISK (CHAPTER 10)

- Cash Flow Estimation—when evaluating a capital budgeting project, we must estimate the after-tax cash flows the asset is expected to generate in the future. (Remember that the value of an asset is the present value of the future cash flows the asset is expected to generate.) Estimating future cash flows is not easy because the future cannot be predicted with perfect certainty. Some cash flows can be predicted more accurately than others. For example, the cash flows associated with a project that has existed for a long time—e.g., a utility power plant—might be *fairly* easy to predict, whereas the cash flows associated with a project that was introduced recently—e.g., a social media innovation—might be extremely difficult to predict. Accurate cash flow forecasts are important because incorrect forecasts could cause the firm to either accept projects that actually are unacceptable or reject projects that actually are acceptable.

- Relevant Cash Flows—the incremental cash flows that must be evaluated in capital budgeting decisions.

  - Cash flow versus accounting income—we are concerned with cash flows rather than income because cash flows pay the bills and cash flows can be invested to earn positive returns; income cannot. Always use cash flows after taxes—that is, after-tax cash flows—because cash must be used to pay taxes. The computation of accounting income often includes noncash items, such as depreciation. Thus, in simple terms, we can use the following relationship to estimate operating cash flows:

Net cash flow	=	Net income	+	Depreciation
	=	Return *on* capital	+	Return *of* capital

  - Incremental cash flows—when conducting a capital budgeting analysis, we are concerned with the marginal, or incremental, cash flows associated with the asset, which are the cash flows that are affected, or change, if the asset is purchased. When examining incremental cash flows keep in mind the following:
    - Sunk costs—if a cash outflow associated with the project has already occurred and will not be affected by the decision to purchase the asset, it is considered a sunk cost. For example, a firm might pay $250,000 for a feasibility study to determine whether a proposed product should be introduced. The $250,000 must be paid even if the firm decides it should not pursue the idea further after reviewing the completed feasibility study. Thus, the cost of the feasibility study is a sunk cost. This cost should not be included in the capital budgeting analysis because it is not an *incremental* future cash flow associated with the decision to manufacture the product; i.e., the $250,000cost will not be changed, regardless of whether the firm manufactures the new product or it decides not to manufacture it. We should only evaluate the cash flows that change in the future as a result of the capital budgeting decision.
    - Opportunity costs—the return that can be earned by investing funds in assets similar to those the firm already owns—that is, the next best return the firm can earn if the funds are not invested in the proposed capital budgeting project. For example, if a company owns an

empty warehouse with a market value of $3.5 million that it is considering converting into office space for the firm, the $3.5 million is considered an opportunity cost associated with the decision to turn the warehouse into an office building, because the firm can sell the building to another firm for $3.5 million.

- Externalities—the effect purchasing a project will have on the firm's existing business. Any effect a project is expected to have on another part of the firm's operations must be identified in a capital budgeting analysis to determine whether it provides new cash flows or it represents a shift in existing cash flows. For example, many firms that have traditionally sold their products in stores are now selling merchandise on the Internet. If a company decides to examine viability of selling on the Internet, the capital budgeting analysis must take into consideration the fact that some of the cash flows generated by Internet sales will be derived from customers who previously purchased at the stores. These "transfer" cash flows should not be included as part of the incremental cash flows for the purposes of evaluating this project because this portion of sales is not new, or incremental to the firm.
- Shipping and installation costs—these costs often are not included in the quoted purchase price of an asset, but they are "effectively" part of the purchase price because the firm cannot use the asset until it is received, installed, and made operational. Also, the depreciable basis of an asset—that is, the amount that can be depreciated over the life of the asset—includes its purchase price plus whatever it costs to make the asset operational, which includes shipping and installation.
- Depreciation—depreciation is a noncash expense. Remember from accounting that depreciation is used to match the reduction in value (cost) associated with using a long-term (fixed) asset to generate revenues during its lifetime. The cash flow associated with depreciation occurred when the fixed asset was originally purchased. Even though depreciation is a noncash expense (i.e., it is not a cash flow), it affects cash flows because depreciation is a tax-deductible expense. Thus, if a firm's depreciation expense will change if an asset is purchased, taxes, which are paid with cash, will also change. As a result, depreciation must be considered in capital budgeting analysis to determine its effect on taxes. For example, suppose a firm is evaluating whether to purchase a new machine that will be depreciated at a rate of $5,000 per year. If the firm purchases the new machine, its tax-deductible expenses will increase by $5,000 due to the increase in depreciation. This increase in tax-deductible expenses will decrease the firm's taxable income by $5,000, which, in turn, will decrease the amount of taxes it pays. If the firm's marginal tax rate is 40 percent, taxes will be reduced by $2,000 = $5,000(0.40), which represents a cash inflow to the firm.
- Inflation—inflation expectations should be built into the forecasts of the future cash flows associated with a project; otherwise, the analysis could produce incorrect results. However, remember from the discussion in the Cost of Money notes that the rate of return investors require in the financial markets includes a factor that reflects investors' inflation expectations in the future. That is, $r = r_{RF}$ + (Risk premium), where $r_{RF} = r^* + IP$; r^* is the real risk-free rate of return and IP is the inflation premium that is based on investors' inflation expectations. As a result, the firm's required rate of return, r, should not be adjust for inflation, because inflation expectations are already contained in r, which is determined by investors (participants in the financial markets).

- Identifying Incremental Cash Flows—incremental cash flows generally fit into one of three categories:

  - Initial investment outlay—includes cash flows that occur only at the beginning of the project's life. Cash flows in this category include the purchase price of the asset, shipping and installation costs, the cash flows associated with disposal of an old asset if that asset is being replaced (this could be the cash received from selling the asset), taxes, changes in net working capital, and any other "up-front" cash flows associated with a capital budgeting project. The item "changes in net working capital" refers to the fact that in many cases inventory or other working capital accounts are affected when a new machine is purchased and added to the firm or when an old machine is replaced by a new, more technologically advanced machine. In some cases inventory will increase, which means there will be an additional cash outflow associated with purchasing the additional inventory; in other cases inventory will decrease, which means there will be a cash inflow associated with purchasing the asset because inventory can be sold until the new, lower level of inventory is attained.

  - Incremental operating cash flows—changes in cash flows that are sustained throughout the life of the asset—that is, the cash flow effects that are ongoing. Cash flows in this category include permanent changes in cash sales, salaries, costs of raw materials, and other cash operating revenues and expenses that change because the asset is purchased. One item that must be included in incremental cash flows is the effect of taxes—if revenues and expenses change, then there is a good chance the tax liability of the firm changes also. In most cases, incremental operating cash flows can be computed using the following equation:

$$\begin{aligned}\text{Incremental operating cash flow in Period t, } CF_t &= \Delta\text{Cash revenues}_t - \Delta\text{Cash expenses}_t - \Delta\text{Taxes}_t \\ &= \Delta NOI_t \times (1-T) + \Delta Depr_t \\ &= (\Delta NOI_t + \Delta Depr_t) \times (1-T) + T(\Delta Depr_t)\end{aligned}$$

    where Δ represents a change, thus ΔNOI_t is the change in net operating income, or EBIT, in Period t that is associated with the project. The other variables are defined as follows: T is the firm's marginal tax rate and Depr is depreciation.

  - Terminal cash flow—cash flows that occur only at the end of the life of the asset. Cash flows in this category include the salvage value of the asset, which could be positive if the asset is sold for cash or negative if the firm has to pay to have the asset removed, any taxes associated with salvage, changes in net working capital, and any other cash flows that occur at the end of the life of the asset only. The cash flow effect of the item "changes in net working capital" that is included here is opposite the effect of the change in net working capital that is included in the initial investment outlay. The rationale for this adjustment is that the firm will return to the same operating position it was in before the asset was purchased so that inventories and other working capital accounts return to their "normal" levels. As a result, if an increase in inventory is required when the asset is purchased, the inventory should decrease to its "normal" level when the firm disposes of the asset, which would represent a cash inflow at the end of the

asset's life.

- Capital Budgeting Project Evaluation—the techniques described in the section of the notes titled Capital Budgeting Techniques are used to evaluate the following types of capital budgeting projects:

  - Expansion projects—evaluation of expansion projects is relatively simple because identifying the incremental cash flows associated with such projects generally is straightforward. The initial investment outlay includes the asset's purchase price, shipping and installation costs, and any changes in net working capital; the incremental operating cash flows include increases in cash sales and the cash expenses associated with incremental sales and the impact of such changes on taxes; and the terminal cash flow includes the salvage value of the asset after taxes and the reversal of the changes in net working capital that occurred when the asset was purchased. Once the cash flows are identified, we can apply either NPV or IRR to determine whether the asset should be purchased.

  - Replacement analysis—evaluation of replacement projects is slightly more involved compared to expansion projects because an existing asset is being replaced. When identifying the cash flows for replacement projects, keep in mind that the cash flows associated with the existing (replaced) asset will no longer exist if the new asset is purchased. Therefore, we must not only determine the cash flows that the new asset will generate, but we must also determine the effect of eliminating the cash flows generated by the replaced asset. For example, if a new asset that will produce cash sales equal to $100,000 per year is purchased to replace an existing asset that is generating cash sales equal to $75,000, then the incremental, or marginal, cash flow associated with sales is $25,000. Likewise, if the asset that is replaced can be sold for $350,000, then the purchase price of the new asset effectively is $350,000 less than its invoice price. In other words, for replacement decisions, we must determine the overall net effect of purchasing a new asset to replace an existing asset—the cash flows associated with the old asset will be replaced with the cash flows associated with the new asset. Two items that you must remember to include when determining the incremental cash flows are depreciation—not because it is a cash flow, but because it affects cash flows through taxes—and taxes, both of which generally change when an older asset is replaced with a newer asset.

- Incorporating Risk in Capital Budgeting Analysis—when evaluating a capital budgeting project, we must examine the risk associated with the project and how the existing assets of the firm will be affected if the project is purchased. The reason we must evaluate the risk of a project is to determine whether the appropriate required rate of return is used to compute the project's NPV (or to compare to its IRR). If a firm is considering a project that is much riskier than its existing assets, then it makes sense that the firm should expect to earn a higher return on the riskier project than on its existing assets.

  There are three risks that we generally identify when evaluating a project: (1) *stand-alone risk*, which is the risk of the asset when it is held in isolation—that is, when it stands alone; (2) *corporate, or within-firm, risk*, which is measured by the impact an asset is expected to have on the operations of the firm—that is, how an asset will affect the firm's total (overall) risk if it is purchased and added to existing assets; and (3) *beta, or market, risk*, which is the portion of an

asset's risk that cannot be eliminated through diversification—that is, how an asset will affect the firm's market risk, or beta, if it is purchased and added to existing assets. For a more detailed discussion of how each of these types of risks is measured, see the notes for the "Risk and Return" section.

- Stand-Alone Risk—generally this is the risk that we compute when evaluating capital budgeting projects because it is easier to determine than the other two types of risk and it is usually very highly correlated to the other types of risk. To examine stand-alone risk, we must determine how uncertain a project's cash flows are. To do this, we often apply the following techniques:

  - Sensitivity analysis—determine by how much the final result of a computation, such as NPV, changes when the values (inputs) needed to complete the computation are changed. For example, if we examine the NPV of a project at various levels of sales and find that the result changes very little, then sales would be considered a fairly insensitive variable in the computation. Generally, if the final results are very sensitive to the value of a variable (the variable is said to be sensitive), greater care should be taken to ensure an accurate forecast of the variable is attained so that the final results are more accurate. Sensitivity analysis is easy to perform using a spreadsheet because you can input numerous values for the variable being evaluated and observe the effect on the bottom-line result.

  - Scenario analysis—compute outcomes using various circumstances, or scenarios. Often firms will compute the NPVs of a project using the normal, or most likely, situation, a conservative, or worst-case, situation, and an optimistic, or best-case, situation. After determining the NPVs, a probability is assigned to each scenario, and the expected NPV and standard deviation of the NPV are computed. For example, consider the following:

Scenario	Probability, Pr_i	NPV	NPV x Pr_i
Best case	0.30	$75,100	22,530
Most likely case	0.50	34,500	17,250
Worst case	0.20	(7,200)	(1,440)
			E(NPV) = $38,340

$$\sigma = \sqrt{0.3(75,100-38,740)^2 + 0.5(34,500-38,740)^2 + 0.2(-7,200-38,740)^2} = \$28,767$$

$$\text{Coefficient of variation} = \text{CV} = \frac{\$28,767}{\$38,340} = 0.75$$

In this case, if the company's assets have an average CV = 1.0, this project probably would be desirable. However, if the firm's average CV = 1.0 and it is evaluating a project with a CV = 2.0, the new project should be identified as a riskier-than-average asset, and the firm should evaluate the project with a rate that is higher than its average required rate of return. Remember that a lower CV is better than a higher CV when we are measuring risk relative to return.

- Monte Carlo simulation—we try to simulate the real world by identifying all the possible outcomes for all the situations, or variables that are associated with a capital budgeting project. For example, one variable that generally must be forecast is the change in sales that will occur if a project is implemented. When using simulation, you must predict every sales level that is feasible under various circumstances—for example, sales if projections are met during good economic times, sales if projections are not met during good economic times, sales if projections are met during normal economic times, and so forth. After identifying all the possible sales outcomes, you must determine the possibility (probability) that such outcomes will occur. This process is completed for each variable included in the final outcome, or computation (e.g., NPV), and then all the information is input into a computer program that computes a final outcome value based on the various values and the probabilities that were provided. The computation is completed numerous times such that the final product is a distribution of possible values for the final outcome. For example, if the project's NPV is computed, then the computer program generates various NPV values under different circumstances as defined by the different projections that are used. This helps us determine the most likely outcome for NPV, the range within which NPV is likely to fall, and the riskiness of the project.

- Corporate (within-Firm) Risk—determine how a capital budgeting project is related to the existing assets of the firm. If the firm wants to diversify its risk, it will try to invest in projects that are negatively related (or have little relationship) to its existing assets. If a firm can reduce its overall risk, then it generally becomes more stable and its required rate of return decreases.

- Beta (Market) Risk—at least theoretically, any asset has a beta, β, or some way to measure its systematic risk (see the notes for "Risk and Rates of Return" for a detailed discussion).

  - If we can determine the beta coefficient of an asset, then we can use the capital asset pricing model, CAPM, to compute its required rate of return as follows:

    $$r_{proj} = r_{RF} + (r_M - r_{RF})\beta_{proj}$$

    According to the CAPM, the greater a project's systematic risk as measured by β, the greater the return the firm should require to invest in the project. For example, if a firm uses the CAPM and determines $r_{proj} = 16\%$, then the IRR for the project must be greater than 16 percent for it to be acceptable.

    The concept of beta can also be used to determine the impact of adding a project to existing assets. Remember that the beta of a portfolio is the weighted average of the betas of the individual investments. The beta for a firm can be thought of as the weighted average of the betas of the individual assets it possesses. For example, if the firm's beta equals 1.5, then the weighted average of the betas of all the assets in the firm is 1.5. Suppose this firm adds a new project. If the new project has a beta equal to 3.0 and it will comprise 20 percent of the firm's operations once it is added, then the beta of the firm after the project is added, β_{new}, will be:

    $$\beta_{new} = (0.20 \times \beta_{project}) + (0.80 \times \beta_{old}) = (0.20 \times 3.0) + (0.80 \times 1.5) = 1.8$$

Clearly, adding a riskier project to existing assets increases the overall riskiness of the firm; i.e, $\beta_{new} = 1.8 > \beta_{old} = 1.5$.

- Measuring beta risk for a project—it is difficult to determine the beta for a project. One method we use to determine a project's beta is to identify a firm that sells only one product, which is identical to the project we are evaluating, and then use the beta of that single-product firm as the beta of the project. When a single-product company is used to identify characteristics of a similar capital budgeting project, it is termed the *pure play method*.

- How Project Risk Is Considered in Capital Budgeting Decisions—in reality, risk generally is incorporated into capital budgeting decisions somewhat arbitrarily. The firm generally uses its "normal," or average, required rate of return to evaluate projects that have average risk, a few percentage points are added to the average required rate of return to evaluate projects that have above-average risk, and a few percentage points are subtracted from the average required rate of return to evaluate projects that have below-average risk. For example, consider the following independent capital budgeting projects:

Project	IRR	Risk Compared to Existing Assets
A	18%	High
B	11	Low
C	10	Average

If the firm's average required rate of return is 12 percent, and it adjusts this rate by 3 percent for projects identified as high-risk and by 2 percent for projects identified as low-risk, which projects should be purchased? The following table shows the risk-adjusted required rates of return for the three projects as well as which project(s) should be purchased:

Project	IRR	Risk Compared to Existing Assets	Risk-Adjusted Rate	Purchase?
A	14%	High	15% = 12% + 3%	No
B	11	Low	10% = 12% – 2%	Yes
C	10	Average	12% = 12% (no adj.)	No

As you can see, it is important that a project's risk be considered in capital budgeting analysis, because incorrect decisions might be made if risk is not considered. As our example shows, if the firm uses its average required rate of return, 12 percent, to evaluate all projects, only Project A would be purchased. However, when the average required rate of return is adjusted for the riskiness of the project, then only Project B is considered acceptable.

If the firm's average rate of return is used to evaluate all capital budgeting projects, regardless of their risk, then projects with little (great) risk might be rejected (accepted) when they should be accepted (rejected). Our example illustrates this point—using r =12% to evaluate all projects, Project A, which is highlighted in green, is considered acceptable, whereas Project B, which is highlighted in blue, is considered unacceptable; as the bottom table indicates, both of these

conclusions are incorrect.

- Capital Rationing—in most cases firms do not have access to unlimited amounts of funds or financial managers do not want to access additional funds, which might mean that some acceptable capital budgeting projects are not purchased. If the amount of funds that is invested in capital budgeting projects is constrained, then *capital rationing* exists. In such situations, the firm should invest in the combination of projects that provides the highest combined NPV—that is, that increases the firm's value the most.

- Multinational Capital Budgeting—for the most part, the capital budgeting projects of multinational firms should be evaluated the same as for domestic firms. However, the multinational firm must be aware that many countries have restrictions on how much cash can be sent back to the parent company from its foreign subsidiaries (repatriation of cash). Restrictions on the *repatriation of cash (earnings)* can often be very severe, thus the cash flows that are relevant to the parent company are those that can be repatriated, not those that must stay in the foreign country. Also, capital budgeting projects associated with foreign operations generally are considered riskier than those associated with domestic operations because (1) movements in exchange rates—that is, exchange rate risk—affect the translation of foreign currency into domestic currency, and (2) there is a risk that foreign governments will takeover or severely restrict operations of foreign subsidiaries—that is, political risk exists. Such risks must be considered when evaluating capital budgeting projects of foreign subsidiaries.

- Capital Budgeting Summary Questions—You should answer these questions as a summary for the chapter and to help you study for the exam.
  - What are the relevant cash flows associated with a capital budgeting project?
  - What are the three categories of cash flows that are relevant for making capital budgeting decisions? What should be included as part of the initial investment outlay, terminal cash flow, and so forth? How does the identification of these cash flows differ if the project is a replacement asset rather than an expansion asset?
  - What is depreciation and how does it affect a project's relevant cash flows?
  - Why should the risk associated with a project be considered when making a capital budgeting decision? What incorrect decisions could be made if risk is not considered in capital budgeting analysis?
  - What techniques are used to incorporate risk into capital budgeting decisions?