Basic Capital Budgeting Concepts

1. INTRODUCTION

Capital budgeting refers to the tools and methods a company uses in making long-term investment decisions. All companies have limited financial resources. By having a disciplined capital budgeting process, firms can make intelligent decisions regarding the use of these resources.

Capital budgeting methods are linked to a firm's cost of capital. A company creates economic worth for its shareholders when its discretionary expenditures earn returns greater than the firm’s cost of capital.

While we discuss the techniques in this article in the context of corporate projects, these techniques can also be used to analyze financial securities.

2. OVERVIEW OF THE CAPITAL BUDGETING PROCESS

2.1. Fundamentals of Capital Budgeting

A proper capital budgeting analysis should address several important conceptual issues:
• The analysis should be based on estimates of the project’s cash flows, not measures of accounting profit.

• The analysis must recognize the time value of money. Analysts must take care in estimating when cash flows occur. The analytical method of choice should compare the project’s cash costs and cash benefits in present value terms.

• If the firm is using any existing assets in the proposed project, the analysis must consider any opportunity costs, i.e., any foregone benefit the firm would have received in an alternative use of the asset.

• The analysis should consider only after-tax cash flows.

• The analysis should recognize financing costs in the discount rate rather than the project’s cash flows.

• The analysis should ignore any sunk costs, i.e., those costs which have already been incurred and cannot be changed regardless of the decision to undertake the project.

• The analysis must incorporate any effects which the investment may have on other parts of the firm or on the environment. These effects are known as externalities. One common externality is known as cannibalization, and it occurs when a project or expansion takes sales away from the firm’s existing operations.

• The analysis should address nonconventional cash flows. In a nonconventional cash flow pattern, the initial outflow is followed by cash flows which change from positive to negative.
• The analysis should determine if the project is independent or mutually exclusive.

An **independent project** has cash flows which are not impacted by other projects. A **mutually exclusive project**, however, competes with other projects. Thus, for two mutually exclusive projects the company can only accept one but not both.

2.2. Types of Capital Investment

Corporate capital investments may be broadly classified as follows: (1) replacement projects, (2) expansion projects, (3) new products or services, (4) regulatory or environmental projects, and (5) other. Some categories of capital investment require more elaborate analysis than others. For example, replacement (maintenance) projects often require simple calculations, while discretionary investments may require more sophisticated financial analysis.

2.3. Typical Capital Budgeting Chronology

Although the exact steps which a company may take in their capital budgeting process may change from project-to-project, the following is a typical chronology: (1) identify investment ideas, (2) gather necessary information and analyze individual proposals, (3) plan the capital budget, and (4) compare actual results to the budget plan.
3. COMMON METHODS FOR EVALUATING CORPORATE PROJECTS

3.1. Net Present Value (NPV)

The **net present value (NPV)** technique is the most theoretically sound and widely used capital budgeting technique. The NPV compares the present value of the project’s cash flows with the present value of the project’s costs. For a project with conventional cash flows, NPV can be calculated as:

$$ NPV = \sum_{t=1}^{n} \frac{CF_t}{(1 + r)^t} - \text{outlay} $$

Where \( CF_t \) is represents each period’s cash flow. The discount rate, \( r \), is the company’s weighted average cost of capital (WACC). The WACC is the weighted average of the company’s equity and debt costs, each weighted according to the proportion of the firm’s total capital. By discounting the project’s future cash benefits and subtracting the project’s outlay, the NPV shows the amount of economic value created by the project. In other words, a project with a positive NPV creates economic value for the firm while a project with a negative NPV destroys economic value. Thus, the firm should only accept projects with positive NPVs and reject those with negative NPVs.

For a project with nonconventional cash flows, the NPV is calculated as:
In practice, financial analysts use spreadsheet software in making these and other capital budgeting calculations.

3.2. Internal Rate of Return (IRR)

The internal rate of return (IRR), when used as \( r \) in the above calculations, leads to an NPV of zero. The IRR is found using spreadsheet software or a financial calculator, as trial-and-error iterations are impractical.

When using the IRR as an analytical method, the firm should pursue a project only when the IRR exceeds the project’s “hurdle rate”. As mentioned earlier, the analyst will generally use the firm’s cost of capital as the project’s hurdle rate.

The IRR is generally thought inferior to NPV. This is because the IRR has several flaws. For one, a project can have several IRRs. This is true for projects with nonconventional cash flows. Another shortcoming of IRR is that, unlike NPV, it is inappropriate for ranking projects
of different scale. The NPV, in contrast, shows the dollar amount of economic wealth which a project creates.

3.3. Modified Internal Rate of Return (MIRR)

The IRR assumes that the project's cash flows can be reinvested at the IRR. To help overcome this and other flaws, an analyst can use the modified internal rate of return (MIRR). To calculate the MIRR, the analyst would calculate the future value of all the projects subsequent positive cash flows using the firm's cost of capital. Likewise, the analyst would calculate the present value of the project's negative cash flows, also using the firm's cost of capital. The rate which equates the discounted future value of the projects cash inflows with the present value of the projects outflows is the MIRR. Unlike the IRR, which assumes reinvestment of the project's cash flows at the IRR, the MIRR assumes reinvestment at the firm's cost of capital.

As an example of the MIRR, consider a three-year project with an initial outlay of -$1,000, a year 1 inflow of $500, year 2 outflow of -$100, and a year 3 inflow of $800. The firm's cost of capital is 8%. The future value of the project's inflows and present value of the project's outflows are as follows:
The rate (MIRR) which equates the future value of $1,429.86 and the present value of - $1,085.73 is 9.61%.

3.4. Profitability Index (PI)

The profitability index (PI) divides the present value of a project's future cash flows by the project's initial investment. The profitability index shows the amount of present value created for each dollar of cost. The relationship between the PI and the NPV is shown below:

\[ PI = \frac{PV \text{ of future cash flows}}{Initial \text{ Investment}} = 1 + \frac{NPV}{Initial \text{ Investment}} \]

It is important to note that the PI will be greater than 1 for a positive NPV project and less than 1 for a negative NPV project.
3.5. Payback

A project’s **payback** is the time required for the cumulative cash flows to equal the project’s investment. The payback method is popular among small businesses, but it is seldom extensively used by large corporations. When using the payback method in capital budgeting analysis, the company would accept a project when the payback period is shorter than some predetermined cutoff date. The payback method has several major flaws. First, a project’s payback gives no consideration to the time value of money. In other words, the payback calculation gives equal weight to the project’s cash flows regardless of when they occur. The second major flaw is the payback rule ignores all cash flows after the cutoff date. This fact leads to erroneous conclusions about the project’s profitability when cash flows after the cutoff period are negative.

3.6. Discounted Payback

The **discounted payback** method is the number of years for the cumulative discounted project cash flows to equal the original investment. The discounted payback method still ignores any cash flows after the discounted payback period.
4. ADDITIONAL CONSIDERATIONS

4.1. Depreciation

**Depreciation** is the periodic and systematic expensing of the project’s capitalized costs. Companies often use different methods for calculating depreciation expense for tax purposes than for financial reporting purposes. Generally, companies will use the straight-line method for financial reporting and the accelerated method for tax purposes.

The capital budgeting analysis must recognize the cash tax benefit of depreciation, and incorporate this benefit into their cash flow forecast. Although depreciation expense is a non-cash expense, the tax savings derived from depreciation deductibility is considered a cash flow to the firm. Capital budgeting analysis is conducted using only after-tax cash flows, so the analyst has two choices for handling depreciation in the cash flow forecast:

- Subtract depreciation as a line-item expense, and then calculate after-tax operating income. The analyst would then calculate after-tax cash flow by adding back the depreciation expense:
  
  \[
  \text{After-tax operating income} = (\text{sales} - \text{cash expenses} - \text{depreciation}) \times (1 - \text{tax rate})
  \]
  
  \[
  \text{After-tax cash flow} = \text{after-tax operating income} + \text{depreciation}
  \]

- Calculate after-tax operating income by first ignoring depreciation. Then add the depreciation tax savings:
After-tax cash flow = \((sales - cash expenses) \times (1 - tax rate)\) + (depreciation \times tax rate)

4.2. Inflation

A sound capital budgeting model incorporates the effects of expected price increases. It is important for an analyst to stay consistent with his or her analysis when handling projected inflation. For example, if the analyst uses nominal prices in the sales forecasts, he or she must also use nominal values for costs. The discount rate used in the analysis should also reflect nominal capital costs.

One important impact of inflation is that it decreases the value of the depreciation tax savings. This is partly because depreciation is based on historical costs, not on the actual replacement value of the project (which would have increased with inflation).

4.3. Scenario Analysis

The capital budgeting methods presented in this article produce outputs based upon a single set of inputs. All cash flow based valuation models are highly sensitive to the inputs used in the models. Particularly, any change in either the cash flow forecast or the discount rate will greatly change the model’s output.
The cash flow forecast poses a significant challenge for the analyst, as cash flows depend on sales and cost assumptions. And both sales and costs are highly sensitive to many variables. Analysts usually deal with this uncertainty by creating different scenarios, with each scenario representing a unique set of inputs (assumptions). Analysts usually create models under three scenarios. First, the analyst creates a “base case” scenario, which incorporates the assumptions which the analyst believes is most probable. Then, the analyst will create a pessimistic and an optimistic scenario.

One advanced form of scenario analysis is known as Monte Carlo simulation. This method relies on sophisticated computer software to create thousands (or more) of combinations of random variables. Each input is assigned a probability distribution, and the software randomly combines inputs based on these distributions. Each “trial” will lead to a unique output metric (NPV, IRR, MIRR, etc.) from these random combinations. The software repeats the trials many times. Using the NPV, for example, the simulation will create a large range of NPV values. The analyst will generally use the average of the NPV values as the project’s expected return. To measure the project’s risk, the analyst would generally use some measure of dispersion, such as the standard deviation, of the NPV values.

Monte Carlo simulation can be a useful capital budgeting tool. Given the complexity of the method, however, it is generally only used by larger organizations.
Sources:


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i We discuss the WACC in depth in a subsequent article

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