

Capital Budgeting & NPV

Financial Management



Table of Contents

Introduction

- 1.1 Chapter Overview
- 1.2 Introduction

Capital Budgeting

- 2.1 Overview of Capital Investment Decisions
- 2.2 Classifying Projects
- 2.3 Tools Used in Practice
- 2.4 A Good Decision Criteria

Net Present Value

- 3.1 Setting up a Project for Evaluation
- 3.2 Net Present Value
- 3.3 The Math
- 3.4 Calculating NPV on a Calculator
- 3.5 Calculating NPV using Excel
- 3.6 Post Assessment of Net Present Value

Learning Tools

- 4.1 Summary

Chapter Overview

1. Introduction

A range of tools are used for making capital investment decisions, ranging from the simple (Payback) to the complex (MIRR). This chapter focuses on the tool most commonly employed by financial managers, NPV, and understanding why this is the dominant tool and how to apply it.

2. Key Learning Outcomes

By the end of this module, students will be able to:

1. Identify the range of tools available for capital investment decisions.
2. Understand why NPV is the preferred method for capital budgeting.
3. Calculate NPV given a series of cash flows.
4. Use NPV to evaluate a capital investment decision.

These objectives are designed to provide a comprehensive understanding of capital budgeting techniques, focusing on the practical application of NPV in real-world scenarios.

3. Required Materials

To fully engage with the module content, students will need:

- Note-taking supplies
- A financial calculator or Excel for calculations

The use of these tools will be essential for practicing NPV calculations and understanding the practical application of the concepts discussed.

Introduction

1. Time Value of Money Review

Time Value of Money forms the foundation of capital investment decisions, including NPV. The key idea is to compare "apples to apples" when evaluating cash flows that occur at different times. Cash flows today and in the future are inherently different:

- **Present cash flow:** It is certain and can be immediately invested to earn returns.
- **Future cash flow:** It is uncertain and cannot be invested now, making it less valuable.

Understanding this difference is crucial for making informed investment decisions. The time value of money concept forms the basis for several important financial analysis techniques:

1. **Discounted Cash Flow (DCF) Valuation:** This method is widely used in finance for valuing assets and investments.
2. **Capital Investment Decisions:** The focus of this chapter, where we apply time value principles to business investments.
3. **Valuing Securities:** In later chapters, the same principles are used to value stocks and bonds.

These applications demonstrate the versatility and importance of mastering time value of money concepts.

2. Valuation Framework

Net Present Value is a universal framework that can be applied to valuing any asset, as long as it can provide the following 3 pieces of information:

1. What are the cash flows
2. When does each cash flow occur
3. What is the risk associated with these cash flows

By addressing these questions, analysts can apply NPV to value a wide range of assets, from machinery to real estate, to financial securities.

3. Module Structure

The chapter is divided into four stages, ensuring a logical progression through the concepts behind NPV:

1. **Capital budgeting:** An overview of the process and its importance.
2. **Net Present Value (NPV):** An introduction to this crucial valuation method.
3. **Calculating NPV:** A step-by-step guide to performing NPV calculations.
4. **Post-assessment of NPV:** Evaluating the strengths and limitations of the NPV method.

Overview of Capital Investment Decisions

1. Importance of Capital Investment Decisions

Capital investment decisions are often the most complex and important decisions facing management. The outcomes of these decisions can significantly impact a company's future growth, profitability, and competitive position in the market.

One way to conceptualize a business is as a collection of departments, each specializing in its area and constantly seeking the next best investment opportunity. This perspective highlights the ongoing nature of capital investment decisions across an organization. Marketing departments compete with production departments, which compete with HR, and so on throughout the firm. Management's job is to determine which product will generate the highest return for the firm and prioritize investment in that first.

Capital investment decisions can take many forms, including:

- Expansion of existing product lines
- Entering new lines of business
- Launching advertising campaigns
- Investing in R&D
- Increasing working capital
- Implementing employee training programs
- Pursuing mergers and acquisitions
- Deciding whether to build, buy, or lease a factory

The diversity of these decisions underscores the need for robust evaluation methods that can be applied across various scenarios.

2. Capital Budgeting

Capital budgeting is the process of planning for the purchase of assets whose returns are expected to extend beyond one year. This long-term perspective distinguishes capital budgeting from short-term operational decisions.

A capital expenditure refers to the cash outlay used to purchase these long-term assets. These expenditures are expected to generate cash flows for years to come, making their evaluation crucial for a company's long-term success.

3. Capital Rationing

A key challenge in capital budgeting is the reality of limited funds for investments. This scarcity necessitates a systematic approach to evaluating and selecting projects with the goal of identifying the most profitable projects and allocating the limited capital efficiently.

The process typically involves:

1. Determining the profitability of each potential project
2. Ranking projects by their profitability
3. Investing in projects until either all available capital is exhausted or the expected returns no longer exceed the marginal costs

This approach ensures that a company maximizes the value created from its limited investment capital.

Classifying Projects

1. Project Classifications

Understanding how to classify projects is crucial for effective capital budgeting. Projects typically fall into three main categories:

1.1 Independent Projects

Independent projects are those whose acceptance or rejection has no effect on other projects. This classification is important because it allows decision-makers to evaluate each project on its own merits. Examples include:

- Amazon adding 100 new trucks to an existing fleet of thousands
- Adding one new server to a large server farm

In these cases, deciding to proceed with the project does not necessitate or preclude other investments.

1.2 Contingent Projects

Contingent projects are those whose acceptance depends on the selection of another project. This classification highlights the interconnected nature of some investments. Examples include:

- Amazon buying its first 100 trucks (which would require additional projects such as storage facilities and service plans).
- A company purchasing its first set of servers (which necessitates investments in supporting infrastructure).

Understanding these dependencies is crucial for comprehensive project planning and budgeting.

1.3 Mutually Exclusive Projects

Mutually exclusive projects are those where the acceptance of one project necessarily means rejecting the others. This classification is important when a company must choose among alternative ways to achieve the same goal. Examples include:

- Choosing between attending law school at Stanford or Yale.
- Deciding whether to build, buy, or lease a factory.

In these cases, the challenge is to select the option that provides the greatest value to the company.

2. Importance of Project Classification

Proper classification of projects is essential for several reasons:

- It helps streamline the decision-making process by clarifying the relationships between different investment opportunities.
- It allows for an appropriate comparison of projects, ensuring that mutually exclusive options are evaluated against each other.
- It helps identify and plan for contingencies, ensuring that all necessary investments are considered.
- It aids in selecting the most valuable option among mutually exclusive projects, thereby maximizing the return on invested capital.

By understanding these classifications, managers can make more informed and strategic investment decisions that align capital expenditures with the company's overall goals and resources.

Tools Used in Practice

1. Primary Capital Budgeting Tools

The field of capital budgeting has developed several tools to aid in the evaluation of investment opportunities. The primary tools, which are widely used in practice, include:

1. **Net Present Value (NPV):** NPV is considered the most important and reliable tool in capital budgeting. It calculates the present value of all future cash flows associated with a project, including the initial investment. The golden rule in capital budgeting is never to accept a project with a negative NPV, as it would destroy shareholder value.
2. **Payback Rule:** This simple tool measures how long it takes for a project to recoup its initial investment. While easy to understand, it has limitations, as it does not account for the time value of money or cash flows beyond the payback period.
3. **Discounted Payback Rule:** An improvement on the simple payback rule, this method incorporates the time value of money. However, it still does not consider cash flows beyond the payback period.
4. **Internal Rate of Return (IRR):** IRR is the second most important tool after NPV. It calculates the discount rate at which the NPV of a project is zero. IRR is widely used and often agrees with NPV in project rankings. However, in some complex scenarios, IRR can lead to conclusions that differ from those of NPV.

2. Secondary Capital Budgeting Tools

In addition to the primary tools, several secondary tools are also used in practice:

1. **Modified IRR (various methods):** These are variations of the standard IRR calculation designed to address certain limitations.
2. **Average Accounting Return:** This method uses accounting income rather than cash flows, providing a different perspective on project profitability.
3. **Profitability Index:** Also known as the benefit-cost ratio, this tool measures the ratio of the present value of future cash flows to the initial investment.

3. The Need For Multiple Tools

While NPV is the dominant tool in capital budgeting, other methods offer valuable perspectives and communication advantages:

- They provide different sets of information, allowing for a more comprehensive analysis of investment opportunities.
- Some tools, such as the payback period, are easier to explain to non-financial stakeholders.
- Using multiple tools can help identify potential issues or inconsistencies in project evaluation.

4. Key Takeaway

The overarching principle in capital budgeting is the supremacy of NPV as a decision-making tool. However, financial managers should be familiar with and utilize various tools to gain a comprehensive understanding of investment opportunities and effectively communicate with various stakeholders. The ability to apply and interpret multiple evaluation methods is a valuable skill in financial management.

A Good Decision Criteria

1. Key Criteria for Evaluating Capital Investment Decisions

When assessing the tools used for making capital investment decisions, they should be able to answer the following three questions successfully:

1. **Does the tool adjust for the time value of money?** This is critical for long-term investments, such as a factory expected to last 60 years. Cash flows generated in the distant future are not equivalent to near-term cash flows.
2. **Does the tool account for varying degrees of risk across different projects?** For example, building a factory (which is a 60-year commitment) is much higher risk than leasing a factory for 5 years. The tool should be able to differentiate and account for these risk variations.
3. **Does the tool provide information on whether the project creates value for the firm?** This is arguably the most important criterion. Ideally, the tool should not only provide a yes/no decision but also quantify the value created. This allows for ranking multiple projects based on their value-creation potential.

These criteria are essential for comprehensive project evaluation and align with the goal of increasing shareholder wealth.

Setting up a Project for Evaluation

1. Robotics Company Machinery Purchase

To illustrate capital budgeting concepts, let us consider a hypothetical scenario:

- **Company:** A robotics firm producing lawyer-replacement robots
- **Investment:** A new piece of machinery that costs \$195,000
- **Expected cash flows resulting from the machinery:**
 - Year 1: \$57,000
 - Year 2: \$60,000
 - Year 3: \$70,000
 - Year 4: \$93,000
- **Project Lifespan:** 4 years (limited by anticipated technological advancements)
- **Required Return:** 12%

This example will be used throughout the module to demonstrate various capital budgeting concepts and calculations.

Net Present Value (NPV)

1. Calculating NPV

Net Present Value (NPV) is the primary tool for making capital investment decisions. It is calculated as the difference between the present value of the cash flows the machine will produce in the future, less the upfront cost of the machine today:

$$\text{NPV} = \text{Market Value} - \text{Price of the Machine}$$

$$\text{NPV} = \text{Present Value of the Future Cash Flows} - \text{Price of the Machine}$$

To calculate the NPV, follow these steps:

1. Estimate the expected future cash flows
2. Estimate the required return for projects at this risk level
3. Find the present value of cash flows and subtract the initial investment

2. NPV Decision Rule

Once the NPV has been calculated, financial managers apply the following decision rule:

- If the NPV is positive, the project returns a higher amount than is required to be acceptable. In other words, a positive NPV indicates that the project is expected to add value to the firm. The amount of NPV directly represents the anticipated increase in shareholder wealth.
- If the NPV is negative, the project should be rejected as it generates a lower return than the firm requires.

NPV is favored because it directly measures how well a project meets the goal of increasing shareholder wealth.

The Math

1. Example NPV Calculation

Using the example of acquiring the machinery to build replacement lawyer robots, the cash flows are:

- CF₀ (Today): -\$195,000 (Cost of machinery)
- CF₁ (Year 1): \$57,000
- CF₂ (Year 2): \$60,000
- CF₃ (Year 3): \$70,000
- CF₄ (Year 4): \$93,000

These cash flows need to be input into the NPV formula as follows:

$$NPV = CF_0 + \frac{CF_1}{(1+r)^1} + \frac{CF_2}{(1+r)^2} + \frac{CF_3}{(1+r)^3} + \frac{CF_4}{(1+r)^4}$$

Where r is the discount rate; 12% in this example.

$$NPV = -\$195,000 + \frac{\$57,000}{(1+0.12)^1} + \frac{\$60,000}{(1+0.12)^2} + \frac{\$70,000}{(1+0.12)^3} + \frac{\$93,000}{(1+0.12)^4}$$

$$NPV = -\$195,000 + \frac{\$57,000}{1.12} + \frac{\$60,000}{1.25} + \frac{\$70,000}{1.40} + \frac{\$93,000}{1.57}$$

$$NPV = -\$195,000.00 + \$50,892.86 + \$47,831.63 + \$49,824.62 + \$59,103.18$$

$$NPV = \$12,652.29$$

2. Interpretation

The NPV of this project is \$12,652.29. This is above \$0, and therefore, it indicates that the project exceeds the required rate of return for a financial manager to consider pursuing it. Furthermore, this project is projected to deliver \$12,652.29 above the required level of return. This figure can be compared to the NPV of other potential projects in order to determine which project should be undertaken by the firm.

NPV on Calculator

1. Using a Financial Calculator to Calculate NPV

While manual calculations are possible, using a financial calculator (like the TI BA2+) is more practical, especially for complex projects with numerous cash flows.

Steps to calculate NPV using a Texas Instruments BAII+:

1. Set decimal places:

- 2ND, FORMAT, 5, ENTER

2. Clear previous data:

- 2ND, CF, CLR WORK

3. Enter cash flows: CF,

- CF0: -195,000, Enter, ↓
- C01: 57,000, Enter, ↓
- F01: ↓
- C02: 60,000, Enter, ↓
- F02: ↓
- C03: 70,000, Enter, ↓
- F03: ↓
- C04: 93,000, Enter, ↓
- F04: ↓

4. Calculate NPV:

- NPV, 12 (for a 12% discount rate), Enter, ↓, CPT

The calculator should display an NPV of \$12,652.29, matching the previous manual calculation.

Calculating NPV Using Excel

While manual calculations of NPV are possible for simple projects, real-world scenarios often involve complex cash flow patterns over many years. In such cases, using spreadsheet software like Microsoft Excel becomes invaluable. This section will walk through the process of setting up an NPV calculation in Excel.

1. Setting Up the Spreadsheet

1. Create columns for:

- **Time (T):** This column will represent the years, starting from 0 (present) to the end of the project's life.
- **Cash Flows (C):** Here, you will enter the expected cash flows for each year.

2. Enter cash flows for each year (t=0 to t=4)

- Remember, the initial investment at t=0 is typically a negative number.

3. Enter the discount rate (e.g., 12%)

- This should be in a separate cell, as you will reference it in your NPV calculation.

2. Using Excel's NPV Function

1. Use the NPV function in Excel.

- The function is =NPV(rate, value1, [value2], ...)

2. Important note: Excel's NPV function is actually a Present Value function.

- This is a crucial point that often confuses users. The NPV function in Excel does not include the initial investment in its calculation.

3. Steps:

1. Enter the discount rate
2. Select cash flows from years 1 to 4 (exclude year 0)
3. You will need to add or subtract this cash flow outlay in period zero from the result of the NPV function.

3. Common Mistakes to Avoid

- Do not include the $t=0$ cash flow in the NPV function.
- This is perhaps the most common error in Excel NPV calculations. Remember, Excel's NPV function assumes all cash flows occur at the end of each period.
- Always add the initial investment separately.
- This ensures that you are truly calculating NPV and not just the present value of future cash flows.

4. Verifying the Result

- The final NPV should match manual calculations (e.g., \$12,652.29).
- If your Excel result does not match your manual calculation, double-check your inputs and formula structure.
- Remember, a small discrepancy might occur due to rounding, but significant differences indicate an error.

Post-Assessment of Net Present Value (NPV)

This post-assessment will help in understanding why NPV is considered the gold standard in capital investment decision-making. In evaluating the effectiveness of Net Present Value (NPV) as a capital budgeting tool, it is crucial to revisit the key criteria established earlier.

1. Revisiting Key Criteria for Capital Budgeting Tools

Recalling from a previous discussion, the key criteria for a capital budgeting tool are:

1. Does the tool adjust for the time value of money?
2. Does the tool account for varying degrees of risk across different projects?
3. Does the tool provide information on whether the project creates value for the firm?

Let us explore each of these below.

1.1 Time Value of Money:

Does NPV account for time value of money? Yes.

NPV discounts each cash flow back to the present, recognizing that a dollar today is worth more than a dollar in the future. The very name "Net Present Value" indicates this feature. By calculating the present value of all future cash flows and netting them against the initial investment, NPV inherently accounts for the time value of money. This is crucial for long-term investments, where the timing of cash flows can significantly impact the project's value.

1.2 Risk Adjustment:

Does NPV account for the risk of cash flows? Yes.

The discount rate used in NPV calculations (for example, 12% in the previous examples) reflects two important factors:

1. The time value of money.
2. The riskiness of the expected cash flows.

By using a higher discount rate for riskier projects, NPV automatically adjusts for the uncertainty of future cash flows. This risk adjustment is vital because it allows companies to compare projects with different risk profiles on an equal footing.

1.3 Value Creation:

Does NPV provide information on value creation? Yes.

A positive NPV indicates that a project is expected to create value for the company. More specifically, the NPV amount represents the exact amount of wealth expected to be added to shareholders if the project is undertaken. This direct link to shareholder value makes NPV an extremely useful tool for aligning investment decisions with the goal of maximizing shareholder wealth.

2. Conclusion on NPV

NPV meets all three key criteria robustly, confirming its status as the best method for capital budgeting decisions. Its ability to account for time value of money, adjust for risk, and directly indicate value creation makes it a comprehensive tool for financial decision-making. As other capital budgeting tools are discussed, NPV will be used as the benchmark for comparison, always remembering its strengths and the reasons for its primacy in financial analysis.

Summary

1. Capital Budgeting Definition

- Capital budgeting is the process of planning for asset purchases with returns expected beyond one year.
- This long-term perspective distinguishes capital budgeting from short-term operational decisions.
- Capital expenditures are the cash outlays used to purchase these long-term assets.
- These decisions are crucial, as they often involve large sums of money and can significantly impact a company's future.

2. Economic Framework

- Companies identify valuable projects that have the potential to increase shareholder wealth.
- They expand operations by taking on projects until the marginal revenue equals the marginal cost.
- Projects are accepted as long as their expected return exceeds the marginal cost of capital.
- This framework ensures that companies maximize value creation within their resource constraints.

3. Project Classifications

Understanding different types of projects is crucial for effective capital budgeting:

1. **Independent projects:** These projects have no effect on other projects. Decisions about them can be made in isolation.
2. **Contingent projects:** The acceptance of these projects depends on the acceptance of other projects. They often come in clusters or sequences.
3. **Mutually exclusive projects:** Accepting one of these projects precludes the acceptance of others. This requires careful comparison to select the best option.

4. Capital Budgeting Tools

While this chapter is focused primarily on NPV, it is important to be aware of other tools:

1. **Primary Capital Budgeting Tools:** NPV, Payback Method, Discounted Payback Method, IRR (Internal Rate of Return).
2. **Secondary Capital Budgeting Tools:** Modified IRR, Average Accounting Return, Profitability index.

NPV is the most important and commonly used method due to its comprehensive nature and direct link to shareholder value.

5. NPV Calculation Process

The NPV calculation process for a financial manager involves three key steps:

1. **Project the expected future cash flows:** This requires careful analysis and often involves input from various departments within the firm.
2. **Estimate the required return for the project's risk level:** The discount rate should reflect both the time value of money and the project's risk.
3. **Calculate the present value of cash flows and subtract the initial investment:** This step brings all cash flows to a common point in time for fair comparison.

6. NPV Decision Rule

The NPV decision rule is straightforward but powerful:

- If the NPV is positive, the project is acceptable as it returns more than the required level of return.
- A positive NPV indicates that the project is expected to increase shareholder wealth.
- The magnitude of the NPV indicates the expected value creation in present value dollars.

7. Advantages of NPV

NPV's superiority as a capital budgeting tool stems from three main advantages:

1. It accounts for the time value of money, recognizing that cash flows at different times have different values.
2. It adjusts for risk through the discount rate, allowing for a fair comparison of projects with different risk profiles.

3. It provides a clear indication of value creation, directly showing the expected impact on shareholder wealth.

8. Conclusion

Net Present Value stands out as the primary decision criterion for capital budgeting due to its comprehensive nature and direct link to shareholder value. However, it is important to remember that other methods can provide additional useful information and may be preferred in certain situations or by certain stakeholders.

Understanding NPV and its application is crucial for making informed capital investment decisions. As financial managers, the ability to correctly calculate and interpret NPV can significantly impact a company's long-term success and value creation.