

Comparison of Net Present Value Model and Internal Rate of Return Model in Investment Decisions

Yutong Zhang*

School of Economics and Finance, Anhui University of Finance and Economics, Anhui, 233030, China

*Corresponding author: 20180841@aufe.edu.cn

Abstract. The continued operation of a company cannot be separated from the right economic decisions. When making investment decisions, NPV and IRR models are often used due to their excellence. However, the two models sometimes yield different results when comparing and selecting investment projects; After researching the relevant literature, in this article, we give a detailed introduction to the NPV and IRR models, and illustrate the economic implications of the two models. However, in practical applications, the NPV and IRR models do not always produce the same outcomes, and in certain cases, contradictions can arise. This paper analyzes the reasons for the contradiction between the two through case studies, and analyzes the applicability of the two models in order to better apply them. The study found that the IRR model produces inaccurate results because of its own insensitivity to situations when it comes to comparing projects of different sizes, different return patterns or comparing projects of investing and financing. But the NPV model, due to the simple calculation of the indicators, is consistent with the financial management objectives of the enterprise, the investment assumptions are relatively reasonable, and there is no problem of multiple solutions or no solutions. When using the IRR indicator and the NPV indicator, when conflicting results are obtained through the use of the NPV indicator and the IRR indicator, the NPV indicator should be chosen to assess the viability of investment projects.

Keywords: Investment Project, Net present Value, Project Comparison and Selection, Internal Rate of Return.

1. Introduction

1.1 Research Background and Motivation

The advent of the post-epidemic era has slowed down the economic development of many countries. With the diversified development of the market, the survival of enterprises is facing increasing challenges. In the development of an enterprise, there are many investment projects to choose from. In various industries, if an enterprise wants to obtain higher returns, it is inseparable from the correct investment decision, and the decision-making will inevitably face the analysis and selection of investment projects. How to weigh the pros and cons of each project and choose a better project requires an economic evaluation of each project.

There are generally high criteria for the feasibility of the project investment and the scientific decision-making since the project investment duration is relatively lengthy and the capital expenditure is relatively huge. Businesses must employ various evaluation metrics and analysis techniques, and decision-making processes can be made more scientifically by doing quantitative analyses of project viability. Dynamic indicators are among the various evaluation indicators that can more accurately assess and contrast project plans. The two most frequently used dynamic indicators are the internal rate of return (IRR) index and net present value (NPV) index, both of which are highly representative and scientific. This paper analyzes and discusses NPV and IRR, and on this basis, analyzes the main reasons for the contradiction through specific cases, and finds the appropriate situation for the application of the two methods, so as to ensure that enterprises adopt appropriate methods for investment projects under different circumstances. Evaluation methods, improve the scientific and accuracy of decision-making, and help companies make the most correct investment decisions.

1.2 Literature Review

Free cash flow, according to Jensen, is the cash flow that remains after a company has invested in all viable positive NPV projects. This theory is put to the test by Lang et al. (1991) using a sample of significant investments made by businesses, specifically choices to take control of other businesses through tender offers [1]. A guided tour of the significant recent advancements in the increasing field of study on deterministic and stochastic project network models with discounted cash flows is provided by Herroelen et al. (1997) [2]. Global SA is introduced in the area of investment project appraisal by Borgonovo et al. (2006) [3]. The difficulties of using conventional valuation procedures in emerging markets are discussed by Pereiro (2006), who also provides an account of how CFOs, financial consultants, and private equity funds address these difficulties in Argentina, a significant emerging economy in Latin America [4]. Kierulff (2008) demonstrate how MIRR deals with weaknesses in NPV and IRR [5]. Osborne (2010) describe a new approach to the debate [6]. The objective of Caroline et al. (2018) is to assist investors in determining whether business hotels in Banjar City are feasible [7]. Giranza et al., (2018) identify which facility attains greater profitability [8]. Harahap et al 's investigation looks into ways to make Indonesia's palm oil biodiesel business more cost-competitive [9]. Over the years, an enormous amount of contributions aimed at resolving these deficiencies have been produced as a result of economics and management scientists to come up with a comprehensive answer to this long-standing problem. By shifting the typical viewpoint, Magni(2010) provides a comprehensive solution to this long-standing unresolved issue: the IRR calculation is disregarded, and the assessor has the choice to classify the project as a borrowing or an investment [10].

1.3 Research Contents and Framework

This paper introduces the research background of this field through the study of relevant literature, and conducts research with the motivation of seeking better investment decisions. The article first introduces the principles and methods of using the two evaluation models and their importance in investment decision-making. Next, through the contradictions presented in the comparison of different types of investment projects, the differences between the NPV and IRR models and the reasons for the contradictions are drawn. Finally, it analyzes the applicable situations of the two models, and puts forward feasible suggestions for enterprises to choose the optimal investment decision.

2. Methodology

2.1 NPV Model

In the NPV (net present value) method of capital planning, the present value of cash inflows and outflows are divided by each other. Whose equation is:

$$NPV = \frac{NFC_1}{1+R} + \frac{NFC_2}{(1+R)^2} + \dots + \frac{NFC_n}{(1+R)^n} - I_0 \quad (1)$$

Generally speaking, NPV model is commonly used to maximum return, when NPV value becomes larger, the return will grow as well. The situation of $NPV > 0$ indicates that the project's investment rate of return is greater than the project's capital cost, indicating that the project is feasible; and $NPV < 0$ demonstrates that the project's investment rate of return is lower than the project's capital cost, indicating that the investment project is not practical. For a single or several independent projects, the project will be chosen only when NPV is positive, and the project with the greatest and most positive NPV will be chosen for initiatives that are mutually exclusive.

The discount rate, which is the project's needed rate of return and indicates the return that the firm's investors may anticipate to earn if they invested in other equally risky securities, is an important element in the method. The NPV model accounts for all cash flows, and properly adjusts for time

value of money and the project's risk through using required rate of return. It also Works equally well for independent and mutually exclusive projects. And at the same time, for company aspect, It gives a clear indication of how much a capital project will raise the firm's worth and is in line with the objective of maximizing stockholder value. However, there is premise that when we want it to be more accurate. The discount rate has to keep the same and the exact cash flow of each year is known correctly. The exact interest rate and future cash flow is hard to be certain sometimes. So it is often used for project with large amount of money and have to be carefully considered.

2.2 IRR Model

The main challenge in using net present value practically is figuring out the investment discount rate. The very first method will be to figure it out according to the capital cost, and the other is to figure it out according to the minimum capital profit rate needed by the business for the investee or the capital opportunity cost. Companies frequently base their discount rate determination on the opportunity cost of capital because it is challenging to evaluate the cost of capital. Internal rate of return refers to the discount rate that can make the net present value of an investment project equal to zero, or the discount rate that can make the sum of the present values of future cash inflows and outflows equal. It displays the investment project's overall profitability. figured out as follows:

$$\frac{NFC_1}{1+IRR} + \frac{NFC_2}{(1+IRR)^2} + \dots + \frac{NFC_n}{(1+IRR)^n} = I_0 \quad (2)$$

IRR on a project is the project's expected rate of return. As IRR increases, a project becomes more profitable. There are also rules for independent and ME projects when using IRR. Basically speaking, the project is acceptable when IRR is larger than the hurdle rate. It is well adapted for independent projects, but for mutually exclusive projects, we will accept the one with the highest IRR and greater than the hurdle rate at the same time. Just like NPV, it accounts for all cash flows, considers time value and risk. But it might be misleading in comparison of projects in different situations.

3. Results and discussion

3.1 The Situation Where the Evaluation Results of NPV and IRR are Consistent

If the initial cash flow of a project is investment, and only once during the investment's validity period does the cash flow's sign change, at the same time the investor only judges whether an investment project is feasible or not, or compares multiple investment projects with the same return model, The conclusions reached by the IRR approach and the NPV method are consistent. When the above conditions are met, the IRR-NPV curve is as follows:

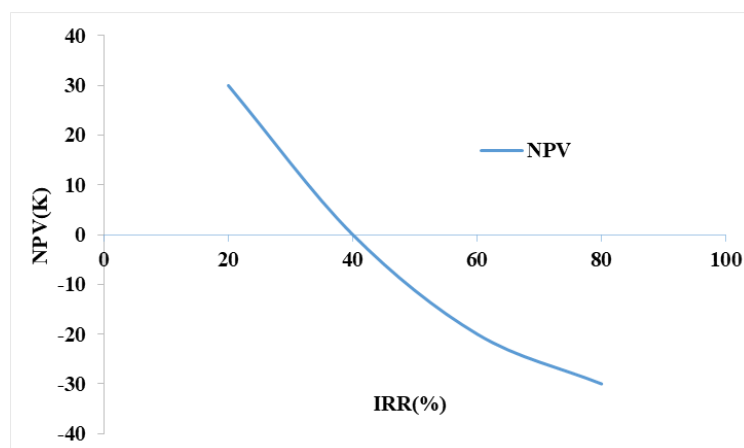


Figure 1. IRR-NPV curve of investment project.

3.2 The Situation Where the Evaluation Results of NPV and IRR are Different

The IRR model and NPV model are two crucial metrics for assessing investment initiatives. They all take decision analysis into account when using the time value of money evaluation approach. However, the findings reached by the two indicators are in agreement when determining whether a single investment strategy is realistic. The two indications could produce inconsistent results when choosing the best investment strategy out of a number of mutually exclusive ones. It is evident how to choose evaluation indicators in the decision-making process for investments thanks to the comparative analysis of these two evaluation indicators.

When choosing an investment strategy, sometimes the two metrics NPV and IRR can produce conflicting results. The causes are listed below.

3.2.1 When the Initial Cash Flows are Different

Projects whose cash flow is start with lending cannot be compared with who starts with borrowing. IRR model is not suitable for comparison of investment project and financial project, since the IRR-NPV curve will show different trends in different situations as follows.

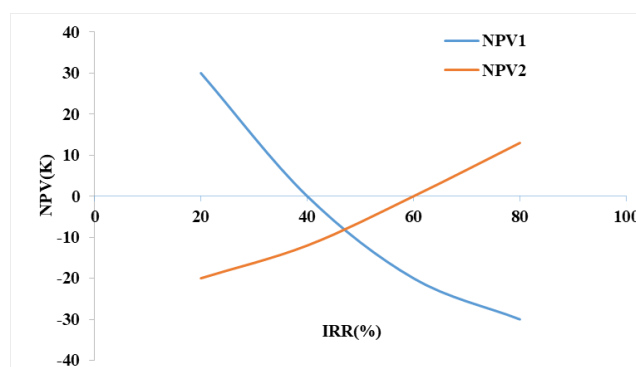


Figure 2. IRR-NPV curve of financial project(NPV1) and investment project(NPV2)

The initial flow direction of funds is different. For investment projects, as the internal rate of return increases, the present value of future cash inflows decreases, thereby reducing the net present value of the project. When financing projects, the present value of upcoming cash outflows drops as IRR rises, increasing the NPV of the project. IRR cannot therefore compare two distinct sorts of objects.

3.2.2 When the Cash Flow Changes its Sign More than once During the Validity Period of the Investment

Two models can be used at the same time only when the future cash flows shows the same trend, if future cash flows turn positive and negative alternately, the trend of IRR-NPV curve will also change, which will result in more than 1 or 0 intersection of horizontal axis with the curve, and will result in more than 1 or 0 value of IRR. Just like the following graph.

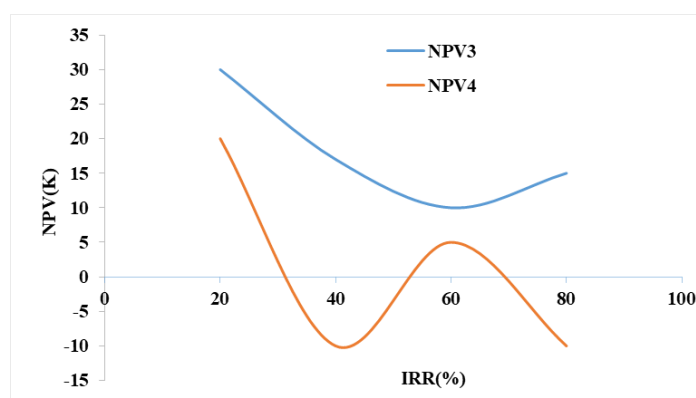


Figure 3. Situation that result in 0 value of IRR (Project 3) or result in 3 values of IRR (Project 4).

3.2.3 When the Projects are of Different Investment Scale or Return Models

The IRR model is not suitable for comparisons between projects with different scales or different project return patterns. Due to the IRR model is insensitive to capital size and return patterns. Due to the limitations of data search, a typical cash flow will be assumed here as a case.

Table 1. The flow of funds for projects A and B

Project	CF ₀	CF ₁	CF ₂	CF ₃	CF ₄	CF ₅	...	IRR(%)	NPV at 10%
A	-4500	3000	2500	2000	0	0	...	33	1796
B	-4500	900	900	900	900	900	...	20	4500

Just as what is shown from project A and project B. In the case of different return patterns, the longer the future cash flow persists, the greater the impact of the change in IRR on the present value of the future cash flow. For projects with long duration, the risk increases when the interest rate increases. IRR model gives opposite result from NPV, so it can be misleading in this situation.

4. Conclusion

When choosing an investment plan, two frequently used evaluation indices for investment plans are the IRR index and the NPV index. The judgments reached by the two evaluation indicators are compatible under the circumstances. However, when an enterprise chooses an investment plan, There are frequently certain components that fall short of the requirements. For instance, if the investment project's starting investment is different or the investment return model is inconsistent, the results drawn by the two evaluation indicators will be inconsistent. This forces us to pick one of the two options.

From current research, since the calculation of the NPV indicator is simple, consistent with the financial management objectives of the enterprise, the investment assumptions are relatively reasonable, and there is no problem of multiple solutions or no solutions, when using the IRR indicator and the NPV indicator, the NPV indicator should be chosen to assess the viability of the investment project when conflicting outcomes are found. During the research in this paper, due to the limitations of data extraction, the actual operation data of the industry cannot be obtained, and only typical data is used for analysis, which has limitations. Therefore, only theoretical analysis is carried out for limited situations. In the future, it will be combined with the actual operation of the company and to discuss the situation, thereby increasing the relevance of the research.

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