Comparative Study of Techno-economic Evaluation Methods: NPV and IRR as Examples

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Abstract. The NPV method and the IRR method are two methods that enterprises often use when making investment analysis. NPV and IRR are the most used indicators for financial feasibility evaluation of investment production, but there are many conflicts in practical application. This paper compares the two evaluation indicators, explains the reasons for the contradiction with specific examples, and analyzes what more scientific evaluation indicators should be used in different situations. The meaning of this research is to find out the way of using NPV and IRR to make technical and economic evaluation on different projects. Technical and economic evaluation refers to the evaluation of the economy of the project scheme by using a series of evaluation indicators and criteria in a certain procedure and manner, so as to determine the economic feasibility and rationality of the project scheme, and to select the best investment project scheme that is technologically advanced and economically reasonable. In the technical and economic evaluation, the criteria for evaluating economic benefits should be reasonably determined.

Keywords: NPV; IRR; Evaluation; Comparative.

1. Introduction

In the actual operation, many enterprises have investment failures, and this phenomenon is popular. The economic evaluation of projects has important practical significance for enterprises and government management. Specifically, enterprises can choose more favorable project investors through economic evaluation to minimize the cost of investment, which can improve the regulatory efficiency for government management departments. Based on this, this paper attempts to make a comparative analysis from the perspective of NPV and IRR, and explore the effectiveness of performance evaluation in the process of project investment. This paper chooses to study NPV and IRR because it plays a great role in investment decision making. In the process of project selection, the company can make a judgment to maximize its income through these two indicators; however, there are some differences and advantages and disadvantages between the two indicators. The purpose of this paper is to rationally analyze how to better use these two indicators to make the right decision, which is the decisive factor for the investment of companies and individuals. In this article, it first shows the introduction of the basic definition of NPV and IRR, besides, is the information of the research and topic. Secondly, this paper refers to and analyzes the methods and data of Bili Bili. The advantages and disadvantages of NPV and IRR are analyzed in detail. Finally, the conclusion part summarizes the full text and puts forward of this paper.

2. NPV and IRR

This aarticle will discuss the application comparison of NPV and IRR in tradeoffs in decision-making. First, NPV means the margin between the present value of future cash inflows and the present value of future cash flows. It is a basic index for evaluating projects, and it belongs to financial management indicators [1]. In making decisions, we should consider cash flow, future remuneration and NCF. NCF represents the net cash flow in the financial statements, and is an important indicator to measure cash flow in the financial statements of enterprises. It is of great practical value for

enterprises to measure the operation effect. In real life, for the management and operation of a company, the net cash flow of an enterprise is one of the important indicators to measure the efficiency of capital operation. A good net cash flow is an important embodiment of the operation of an enterprise. The most direct way to calculate NCF is to subtract cash cost and income tax from operating income. In a product decision with only one opportunity cost, products with the NPV value which is positive will be adopted, while products with NPV (which is smaller than 0) cost will not be adopted. In the selection of multiple alternatives, the product with the greatest NPV will be adopted. The condition for calculating NPV is that the cash flow must be considered as a certain consistent amount. When doing the calculation of NPV, the cash flow should be discounted according to the predetermined discount rate, which is over than the rate of return on the product. When the NPV is positive, it means that the actual rate of return is bigger than the expected rate of return, so the plan is feasible. When the NPV is negative, it means that the actual rate of return is lower than the expected rate of return, so the scheme is not feasible. When the NPV is 0, it indicates that the actual rate of return of the scheme is equal to the return on investment. Therefore, the economic basis of NPV is the residual income after returning the investment plan exceeds the basic return. Secondly, we need to understand the IRR, IRR is internal rate return. It is the discount rate when the total PV of cash inflows equals the total value of cash outflows and the NPV equals to 0 [2-4]. It is an aspired rates of return, the larger the indicator, the better benefit it has. It refers to the valuation of time value by investors, including their subjective wishes [5-7]. At present, investment methods such as funds, stocks, real estate, gold and futures have been well-known and used by much business. However, many people's understanding of the impact on investment is restricted to the absolute amount of income, lacking scientific judgment. For them, the IRR is an indispensable tool [8].

3. Case Description

This section will analyze the finical report of BiliBili in the 2021. The total net turnover reached 4495.3 million yuan (US $696.2 million), an increase of 72% over the same period in 2020 [9]. The average monthly active users (monthly active users) reached 237.1 million, while the mobile terminal monthly active users reached 220.5 million, an increase of 38% and 44% respectively over the same period in 2020. The DAL users reached 62.7 million, an increase of 24% over the same period in 2020.The monthly average paid users reached 20.9 million, an increase of 62% over the same period in 2020 (See Table 1).

Table 1. TNT NL and NCF of BiliBili

	2018	2019	2020	2021
TNT	4128.931	677.922	11998.924	—
NET LOSS	—	1303570	3054017	6808739
NCF	—	5078842	8335419	30389152

From the perspective of net cash generated from operating activities, it was 753 million in 2020,-2647 million in 2021.From the perspective of net cash flow from investment activities, - 24.578 billion yuan was - 175.95% compare with the previous year. In the past 2021 year, more investment has been made in various fields. From the perspective of net cash flow from financing activities, 30.389 billion yuan+264.58% increase from the previous year. . Mainly for the secondary listing of Hong Kong shares of 19.288 billion yuan and the issuance of convertible bonds of 10.085 billion yuan. Considering that the stock price at the time of secondary listing was higher than the current status, although the current cash flow is relatively abundant, the subsequent refinancing will be more severe, and it is indeed time to improve the profitability of the company [10].

Above all, both NPV and IRR are important judged standard that help companies to make decisions. However, we select to using them which have different effect according to several of situations include time period and different types of projects. The NPV and IRR actually arrive at the

same investment decision. The IRR calculation is also based on the NPV, which takes into account the time value of money and is calculated using the present value of cash flows. However, NPV and IRR may get different results if there are mutually exclusive project (only one can be chosen). Assume that project A and project B are mutually projects.

Table 2. Comparison of NPV and IRR metrics for Projects A and B

	NPV ($m)	IRR
Project A	12.5	17%
Project B	4.8	22%

As shown in Table 2, based on NPV, project A with larger NPV should be selected; based on IRR, project B with higher rate of return should be selected. The two methods get contradictory decisions, so NPV should be followed at this time. Although the return rate of project B is higher, the main reason is that the size of project B is relatively small, the initial investment is relatively small, but the absolute value (NPV) brought to investors is less, even less than half of Project A. The results in Table 2 are crucial for analyzing the advantages and disadvantages of NPV and IRR. Next, this paper will further discuss the differences between them.

4. Analysis of Advantages and Disadvantages

For NPV, the time value of capital plays a key role in maximizing the enterprise value of the investment project in the whole life cycle. As far as IRR is concerned, it is the application of the time value theory of capital, that is, the opportunity cost sacrificed in the specific time of investment. For the comparative analysis of the two, the existing scholars hold different views. Based on the theoretical basis of NPV and IRR, combined with the case analysis of BiliBili, this paper summarizes the following points: Sometimes it is not possible to give accurate conclusions when measuring the NPV of project investment, because the investment amount of mutually exclusive projects is not equal, it is difficult to calculate the discount rate. NPV may not make the right decision when the life of the project is different [11,12]. For IRR, we can easily reinvest the investment profits into the same internal rate of return when we invest the funds into IRR after receiving the profits. This is relatively rare in reality. The NPV is the sum of the expected net benefits of the project in the future years discounted according to the opportunity cost of funds. The estimation basis of the net benefit flow and the opportunity cost of funds is our judgment of various uncertainties in the future based on the experience and information we have when calculating the NPV, including the demand prospect of the product, the price, the progressiveness and applicability of technology, the macroeconomic situation and the government's management policies. Therefore, when there are favorable or unfavorable changes beyond our judgment in the future, the decision-making information provided by the NPV indicator will be inaccurate [13,14].

5. Conclusion

The integrated application of Net present value and internal rate of return is not available in some situations, and the improvement of IRR is not always efficient, so special treatment should be given in some special circumstances. This paper aims to find out the way of using NPV and internal rate of return value to make technical and economic evaluation on different, projects in order to help the investor do better decision-making. The paper uses the cash flow data from the company named BiliBili as the base to do some basic analysis and calculations. Some method to measure the profitability like NPV and IRR is included. The result is that NPV can help us directly get the final value of the investment but it cannot give accurate decision if the amount of investment of mutually exclusive projects is not equal. IRR consider more complex elements like the interest rate but it has

several unrealistic assumptions. Moreover, the paper state an extra method called profitability index to do the selection in mutually exclusive projects to make the better investment. People who are concerning the problem of making investment choice and firms which are wondering the return on equity can use the method included in this paper to make better decisions and find the most proper investment due the particular situation to get maximum revenue. The importance of the research is that the measure of the profitability is the perpetual problem that the financial investment field wants to discuss and improve. The paper provides three basic methods which can be judge as the base of the calculation of reward on equity. In the future, this research can make some improvement on other methods which focus on different criterion and collect more data to create the data base and combine them with the computational models to make the calculation more precise and dependent. If an enterprise has sufficient funds to arrange multiple plans at the same time, that is, these plans are independent of each other. When adopting one plan, it does not exclude the simultaneous adoption of another plan. Then it can prioritize the plans with higher IRR, and then arrange the plans with lower IRR. This can improve the efficiency of the use of funds and maximize the value of the enterprise.

If an enterprise has limited capital and does not have enough funds to arrange several schemes at the same time, it can only choose one of them, that is, these schemes are mutually exclusive, then it is necessary to judge according to the NPV method, and choose the scheme with larger NPV to maximize the value of the enterprise.

The disadvantage of this paper is that it fails to cover all evaluation indicators, which may be a defect. In the future, the actual project can be selected for comprehensive evaluation with multiple indicators to further improve the research content.

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