The Effectiveness of NPV and IRR Used in Fundamental Financial Markets

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ABSTRACT
In financial markets, investors often use internal rates of return and net present value to evaluate the value of alternative projects. In this paper, the income of two independent projects will be calculated to decide which project is more worthy. By comparing the calculation results of net present value and internal rate of return, we can visualize the investment results. Using these models, investors can see the results of their investments accurately and clearly. Besides, there is a contradiction between net present value and internal rate of return when investment projects are compared and selected. This paper makes a deep comparative analysis on the causes of contradictions and explores the causes of contradictions. The advantages and disadvantages of net present value and internal rate of return are analyzed, respectively. Investors should pay more attention to these disadvantages when investing and reduce the company's investment risk and investors to increase the profits.

Keywords: *internal rate of return, net present value, cash flow, investment*

1. INTRODUCTION

Net present value and internal rate of return are two indicators that investors often use when making investment decisions [1-3]. The future rate of return of the project is estimated. Based on two independent market data, this article analyzes its NPV and IRR separately and makes investment decisions for the project by concluding [4-6]. However, whether the use of NPV and IRR is effective, whether the investment conclusions made using this model are reliable, and the comparison of the two models are the main content of this paper. This article studies the pros and cons of NPV and IRR and explains the contradictions found when using NPV and IRR to help investment decision-makers make accurate investment decisions when investing in the actual financial market [7].

In this article, I mainly discuss the implication of the NPV method based on an empirical case. Besides, the sensitivity analysis is also conducted by the different discount rates. I compare the differences between NPV method and IRR method, obtaining some advantages and disadvantages.

The remainder of the article is organized as follows. In Section 2, I present the data of the investment project. In Section 3, the IRR method and NPV method are shown. In Section 4, I consider the data analysis. Then, I discuss the advantages and disadvantages of IRR and NPV based on the case study in Section 5. Finally, the conclusion is presented in Section 6.

2. DATA

The following data shows the cash flow of two mutually exclusive projects, A and B, over a period of 4 years. Both A and B invested $430 in the first year.During the 4 year ,project A earn $230,$179,$124,$94, and project B earn $70, $138,$240 and $260.Apparently , the cash flow of A has a decreased tendency. However, the cash flow of B has an increasing tendency.

Table 1. Cash flow of project A and B ($)

Project	CF0	CF1	CF2	CF3	CF4
A	-430	230	179	124	94
B	-430	70	138	240	260

3. METHOD

3.1. Discount Rate

Discount rate is the rate of interest used to determine the present value of the future cash flows of a project. For

projects with average risk, it equals the weighted average cost of capital but for project with different risk exposure it should be estimated keeping in view the project risk.

Capital budgeting techniques such as net present value, internal rate of return, discounted payback period and profitability index are based on the concept of time value of money. In net present value, we discount the future incremental cash flows of a project to time 0 and then subtract the initial investment to see if we the project adds value or not. In internal rate of return technique, the IRR is compared with a rate called the hurdle rate which represents the cost of capital of the company and the risk of the project and the project is accepted only if the IRR is higher than the discount rate. The result we get from all the techniques is sensitive to the discount rate which makes it the most important input in capital budgeting process.

3.2. Internal rate of return (IRR)

Internal rate of return (IRR) is an objective evaluation index to measure long-term investment income, also known as IRR. Represents the discount rate when the net present value is zero. The computational formula of IRR is $0= \sum_{t=0}^{n} \frac{NCFt}{(1+IRR)^n}$.Usually, the higher the IRR, the better the income of the project will be [8]. The lower the IRR, the worse the income of the project will be. Enterprises often encounter investment decisions in the process of production and operation [9]. The funds owned by enterprises are limited, so it is necessary to choose the best way to use them, which often involves choosing an optimal scheme from multiple alternative schemes to make the most effective use of the funds. This requires technical and economic evaluation of the economic benefits of investment and then investment decisions. Only a technically reasonable and economically feasible scheme will bring good benefits to enterprises. There are many kinds of economic evaluation methods for investment projects, and the internal rate of return method is an essential method.

According to these data, calculate the IRR of A and B, respectively.

A:

$$-430+\frac{230}{(1+IRR)}+\frac{179}{(1+IRR)^2}+\frac{124}{(1+IRR)^3}+\frac{94}{(1+IRR)^4}=0$$

IRR A= 20.44% (1)

B:

$$-430+\frac{70}{(1+IRR)}+\frac{138}{(1+IRR)^2}+\frac{240}{(1+IRR)^3}+\frac{260}{(1+IRR)^4}=0$$

IRR B=18.84% (2)

3.3. Net present value (NPV)

NPV is the net present value of a project. The present value of current and future benefit minus the present value of current and future costs [10]. The computational formula is of NPV is NPV = $\sum_{t=0}^{n} \frac{NCFt}{(1+i)^n}$（i is discount rate).When discount rate variate ,the net present value will change .When calculating the NPV, It's important to pay attention to the time value and discount the cash flow to gain the right conclusion.

Make the independent item decision, when the NPV≥0, the project is feasible., the project is possible. When the NPV＜0， the project is not viable, the company decides to invest when its NPV is above 0. When making mutually exclusive project decisions, the investment projects with a net present value greater than 0 choose the investment project with a more considerable net present value.

Calculate the NPV of each project for discount rates of 0, 10, 20, and 30%.

When the discount rate is equal to 0%.

NPVA=-430+230+179+124+94=197 (3)

NPVB=-430+70+138+240+260=278 (4)

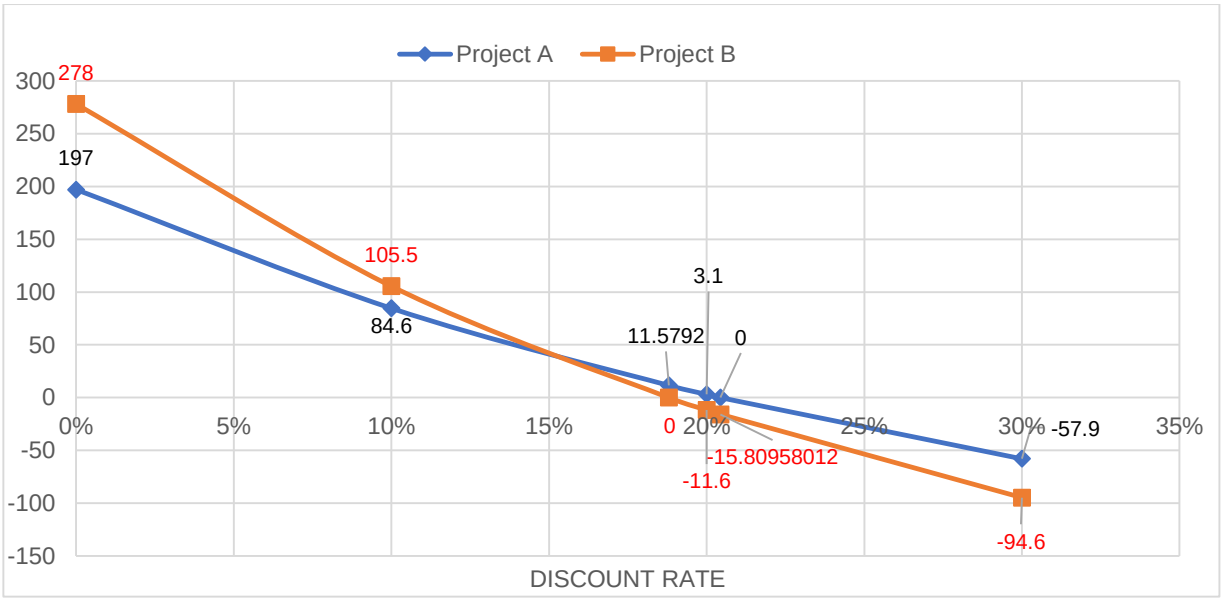

Fig1. NPV of cash flow

When the discount rate is equal to 10%.

NPVA =

$$-430+\frac{230}{(1+10\%)}+\frac{179}{(1+10\%)^2}+\frac{124}{(1+10\%)^3}+\frac{94}{(1+10\%)^4}$$

$$= 84.6 \quad (5)$$

NPVB =

$$-430+\frac{70}{(1+10\%)}+\frac{138}{(1+10\%)^2}+\frac{240}{(1+10\%)^3}+\frac{260}{(1+10\%)^4}$$

$$= 105.5 \quad (6)$$

When the discount rate equal to 20%.

NPVA =

$$-430+\frac{230}{(1+20\%)}+\frac{179}{(1+20\%)^2}+\frac{124}{(1+20\%)^3}+\frac{94}{(1+20\%)^4}$$

$$= 3.1 \quad (7)$$

NPVB =

$$-430+\frac{70}{(1+20\%)}+\frac{138}{(1+20\%)^2}+\frac{240}{(1+20\%)^3}+\frac{260}{(1+20\%)^4}$$

$$= -11.6 \quad (8)$$

When the discount rate equal to 30%.

NPVA =

$$-430+\frac{230}{(1+30\%)}+\frac{179}{(1+30\%)^2}+\frac{124}{(1+30\%)^3}+\frac{94}{(1+30\%)^4}$$

$$= -57.9 \quad (9)$$

NPVB =

$$-430+\frac{70}{(1+30\%)}+\frac{138}{(1+30\%)^2}+\frac{240}{(1+30\%)^3}+\frac{260}{(1+30\%)^4}$$

$$= -94.2 \quad (10)$$

Use all the data points at hand to plot the NPV functions on a graph with NPV on the vertical axis and discount rate on the horizontal axis.

4. DATA ANALYSIS

According to the graph plot, I can easily get the investment conclusion. First of all, investors accept project A when the discount rate is less than 20.44% and invest in project B when the discount rate is less than 18.84%. Except this, when the discount rate is between 0% and 15.29%, the NPV of B is higher than A, would the company choose project B. However, when the discount rate is greater than 15.29% and less than 20.44%, A's NPV is higher than B, investing project A. And when the discount rate is equal to 15.29%, these two projects would be indifferent to the company.

Based on the question, I find a contradiction in this model.When discount rate =10%, NPV of Project A = 84.6 , IRR=22.44%, NPV of project B= 105.5, IRR=18.84%. If NPV is used to judge the two projects, project B is superior. If IRR is used to judge the two projects, then project A is superior. The two approaches clash.

5. DISCUSSION

5.1.Advantages of NPV

The advantage of NPV:(Positive NPV or NPV>0, then you can accept that project. NPV or NPV<0, you should not accept the project.)Only when the project's cash flow brings benefits, the value of the company will increase, which is worthy of investment by the company. There are some advantages of NPV. First of all, the time value of money is given more importance. Through calculating the present value, investors gain information

about cash flow. Depending on the computation, investors can make accurate and efficient investments. Besides, project profitability and risk factors are given high priority and considered both before and after cash flow over the life span. Calculating NPV considers these factors, making the investment more reliable. Except this, the NPV illustrates the efficiency with which a project uses capital and makes it easy to compare it with other industries, and investors can maximize their wealth through comparing NPV directly.

5.2. Disadvantages of NPV

The disadvantage of the NPV method is that the discount rate adopted is not easy to determine, and it is not suitable for the comparative decision of independent investment schemes with different investment amounts. Sometimes, NPV cannot directly decide mutually exclusive investment plans with different life cycles.

The net value rate method is not suitable for mutually exclusive schemes with unequal investment economic evaluation.

Table 2. Cash flow of project C and D ($)(discount rate =12%)

Project	CF0	CF1	CF2	CF3	CF4	IRR (%)	NPV (12%)
C	-27000	10000	10000	10000	10000	18%	3473
D	-56000	20000	20000	20000	20000	16%	4746

The internal rate of return of investment projects C and D are both greater than the cost of discount rate of 12%, and the net present value is greater than zero. If possible, both projects should be accepted. If only one of the two projects can be selected, project D should be selected according to the standard of net present value, while project C should be selected according to the standard of internal rate of return. The conclusions of these two judgment standards are mutually exclusive.

If there is A contradiction between the two judgment criteria, the incremental cash flows of project C and project D, namely D-C, can be further considered.

Table 3. Cash flow of project D-C ($)(discount rate =12%)

Project	CF0	CF1	CF2	CF3	CF4	IRR (%)	NPV (12%)
D-C	-29000	10000	10000	10000	10000	14%	1373

D-C is equivalent to additional investment on the basis of project D, and its internal rate of return is 14%, which is higher than the capital cost ratio. Its net current value is 1373, and IRR>0. Regardless of the criteria, additional investment should be accepted. Therefore, in the case of unlimited capital, choose item D (i.e., C+ (D-C)). Conversely, if the IRR of the D-C project is less than the cost of capital, the D-C project should be abandoned. Considering the additional investment, the conclusion of net present value and internal rate of return tends to be consistent.

Therefore, if the IRR of D-C project is lower than the discount rate, then the project with larger investment scale is better than the project with smaller investment scale. If the IRR of the D-C project is less than the discount rate, the project with smaller investment scale is better than the project with larger investment scale.

5.3.Advantages of IRR

The advantage of IRR is that it can connect the income during the life of the project with the total amount of investment and indicate the rate of return of the project to facilitate the comparison of the industry benchmark investment rate and determine whether the project is worthy of construction, and it is not affected by the industry benchmark yields whether is high or low and is more objective.

5.4.disadvantages of IRR

The disadvantage of IRR is that its calculated process is very complex, especially when a large number of the additional operation period of investment. If the company decides to invest more money in the project, there is no doubt that the cash flow will be negative, but the project itself does not cause the result.

And the IRR ignores the scale of a project because IRR can only represent net present value. It can only represent the ratio.In an investment portfolio, for example, a £10 share stock rose by the daily limit of only £11, and its net return was far less than a £50 share which rose by 5%.Another example: IRR only considers the profit level during the payback period of the project investment, but it is possible that a project may have a huge investment in the early stage, and the real return can only get a high cash inflow after the project is completed. Typical such as some unpopular film, TV copyright; A research project whose future development prospect is uncertain based on the judgment of existing conditions.

6. CONCLUSION

In the selection of investment plans, the net present value index and the internal rate of return index are two commonly used investment plan evaluation indicators. Under the established conditions, the conclusions obtained by the two evaluation indicators are consistent.

However, when companies choose investment plans, some factors often cannot meet the established conditions. For example, the initial investment of each investment project is different or the amount of cash flow and the time of occurrence are inconsistent, resulting in inconsistent conclusions between the two evaluation indicators. This requires us to choose between the two. Nevertheless, the net present value and internal rate of return indicators can still reflect the project's economic value from different angles, and under certain conditions, they are still important indicators for project selection.

There is also a contradiction between NPV and IRR, provided that when the discount rate is the same, the investment conclusion decided by NPV and IRR is different. By studying NPV and IRR, the assumptions of IRR are unreasonable, and the wrong reinvest rate makes the contradiction. It reminds investors to make conservative investments.

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