Comparison of NPV and IRR and conflict resolution

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ABSTRACT

This essay mainly describes the application and difference between NPV and IRR, and finds out which one should be used more conveniently in different situations from the analysis of the two decision-making methods. The advantages and disadvantages of the two decision-making methods and how enterprises should choose them are described in detail. According to the information and papers on the Internet, we have explored these two decision-making methods and found new decision-making methods. Starting from the calculation methods and theoretical characteristics of NPV and IRR, taking the advantages and disadvantages of NPV and IRR in the middle, at the end of the essay it is found that ordinary calculation cannot get relatively accurate results in three special cases. At this time, the best choice can be obtained through various calculations and comparisons. The research significance of this essay further studies the relationship between NPV and IRR and how to help enterprises and individuals make more accurate, faster, more beneficial and profitable decisions in investment decisions.

Keywords: Keyword 1NPV, Keyword 2 IRR, Keyword 3 financial market, Keyword 4 comparison

1. INTRODUCTION

Enterprises often face a variety of difficulties when facing fierce competition with others. In order to make decisions more efficient, it is significant for them to analysis data then wisely solving enterprise problems, identifying opportunities and avoiding risks. This article aims at discussing the characteristics and limitations of two methods to analysis data--net present value and internal rate of return. NPV (net present value) and IRR (internal rate of return) are two frequently used indicators in finance and financial analysis, for example, in the process of project evaluation, we would use the NPV and IRR to evaluate a project should be accepted or give up. However, these two methods sometimes conflict, so the research on this problem has certain significance. We looked up a lot of papers on finance and business management, mainly about financial NPV and IRR estimation, comparison and analyses between them and so on. According to the data we have searched so far, scholars have carried out relevant studies on NPV and IRR mainly from the following aspects: calculation of the value, benefits and deficiency analysis, the application of the two methods in different fields and how to solve the confliction. They made analysis from multiple

perspectives. As they are both kinds of evaluation standard index of economic effect, we firstly finding characteristics and limitations of NPV and IRR, then compare the benefits and drawbacks of these two methods respectively, also we found the appropriate solutions to deal with the problems faced when they conflict. Our objective is to better understand their advantages and disadvantages, and in the final, we will summarize the actual application of conflict resolution, and some special situation would be introduced.

2. MAIN BODY

2.1 Research finding characteristic of NPV

To analyze the profitability of an investment we can use net present value (NPV). It comparatively considers the time value of the cash flow of the investment project, which is calculated by misusing the present value of cash outflow from the present value of cash inflow. It would always be positive because if cash flows are negative, according to the forecast, in the future, no profit would be made in the predicted years, and even the profit and loss cannot be reached, this kind of business is sure needs to be given up. As the discount rate is related to the risk,

the investment risk is considered, and the greater the risk, the higher the discount rate, vice versa. Its formula is:

$$\text{NPV} = CF_0 + \frac{CF_1}{1+r} + \frac{CF_2}{(1+r)^2} + \frac{CF_3}{(1+r)^3} + \cdots + \frac{CF_n}{(1+r)^n}. \quad (1)$$

The calculation of the net present value method by using this formula is troublesome and difficult to understand and master, especially if the data is complicated. In order to make the calculation much easier, we can use Excel to calculate the value of net present value, for instance, if we have a project with an initial investment of 3000, in the first year the cash flow is +200 then -50 in the second year. For discount rates 0,10%,20%,30%, we can use Excel to calculate the net present value in these different situations.

Table 1 NPV with different interest rates

Interest Rates	0	10%	20%	30%
CF_0	3000	3000	3000	3000
CF_1	200	200	200	200
CF_2	-50	-50	-50	-50
NPV		2855	2609.95	2403.28

Efficiency evaluation of investment projects in market economy ought to be based mainly on the use of indices based on discount method. These indices, in spite of being known for many years, in many cases are used incorrectly. The discount technique used in the indices requires the selection of a uniform moment of time for which cash flows are discounted as well as the inclusion of the total value of planned/realized investment along with its residual value [9]. The thing we can easily see from these data is that the higher the discount rate, the smaller the value of NPV. To some extent, net present value is prior to other capital budget methods, because it includes all the cash flow of the project, other capital budget method might ignore a particular period after of cash flow, such as payback period method. NPV can not only be used in the financial market, but also in the scientific area, as an example, it can compare the conflict between the government's guidance plan and the actual calculation, put forward the suggestion of the government's allocation of renewable energy subsidies. Therefore NPV is generally accepted by economists as being theoretically unassailable in that, if one wishes to maximise profits, the use of NPV always finds the correct collection of projects [6].

$$\text{NPV} = \frac{(Rt - Ct) - Tr(Rt - Ct) + Dt}{(1+i)^t * (1+np)}$$

where Rt presents the total operating revenue by the end of phase t[Taiwan Power Company (TPC) purchase amount], the currency value of said phase; Ct presents the total operating cost by the end of phase t (power generation cost), and currency value of said phase. Tr is tax rate. Dt is discount. i presents capital cost rate. p is inflation rate.

2.1.1 LIMITATIONS OF NPV

NPV only calculates up to the point of positive cash flow, but after the breakeven, the cash flow is negative. In making its decision, it does not consider the non-cash benefits generated by the project. What's more, owing to the changeable economic conditions, the assumption about the cash generated by the project may not always fairly. Sometimes a company has limited funds, but there are several alternatives. In this case, if each option requires the same amount of investment, the option with the highest net present value is chosen, because the greater the NPV, the greater the investment return, thus the better the option. But if each proposal requires a different amount of investment, then proposals are ranked using an index called profitability index, it is calculated as the ratio of the present value of future expected cash flows divided by the initial amount invested in the project. The proposal with the highest profitability index is considered to be the most attractive one.

Profitability index=(PV of future cash flow)/(initial investment)

2.2 RESEARCH FINDING CHARACTERISTIC OF IRR

The internal rate of return is the profitability of the investment project itself, reflects its internal profit level, is a relative index. Furthermore, it is the discount rate at which the total present value of inflows equals the total present value of outflows (net present value equals zero), taking time value into account. At this point, one might say, if the net present value is 0, isn't that not making money, isn't it pointless to calculate the internal rate of return. Of course not. Because the IRR calculated by different projects is different, in the case of zero net present value, of course, the higher the IRR is better. And it has a formula as:

$$\frac{CF_t}{(1+IRR)^t} = \$0 \text{ (NPV)}$$

T means time, CF_t is the cash flow in year T, NPV is the net present value.

It also shows the ability the project investment returns can withstand currency depreciation and inflation which is IRR of 5% means that the project can withstand inflation of 5% per year during operation. An example is as follows.

Table 2 Compare net cashflow of project X and Y

| Year	Expected net cashflow(NPV)	Expected net cashflow
	Project X	Project Y
0	-1000	-1000
1	100	700
2	600	500
3	800	200

2.2.1 LIMITATIONS OF IRR

Firstly, it doesn't mean the level of absolute returns so that often leads to miscalculations. Some projects have higher IRR but lower absolute returns. Just like stock investment, a 10 yuan per share ticket, even if it rises to limit up, will not increase its net returns as much as a 500 yuan stock, which rises by 2%. And it can be explained by a diagram:
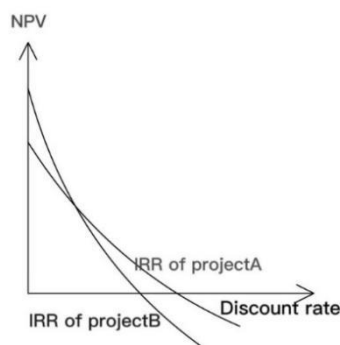
Figure 1 Analysis of the relationship between NPV and Discount rate

As shown in the figure, The NPV curve decreases with the increase of the discount rate, which is a monotonically decreasing function of the discount rate. The intersection of the NPV curve and the vertical axis represents the net present value of the project without considering the time value of capital. The intersection of the NPV curve with the horizontal axis represents the discount rate (IRR) applied when the net present value of the project is zero. The intersection of THE NPV curve and the IRR curve indicates that when the discount rate is Re, the net present value of the two projects is equal [10]. And project A has A higher IRR, but when the discount rate is at the left end of the intersection, project B has A higher net present value and better earnings. Therefore, to judge the investment value of a project, IRR should not be regarded only but must be closely combined with other indicators for comprehensive analysis. Besides, there may be more than one IRR for the same project. For example, in the diagram below, if the relationship between NPV and the discount rate is shown as a curve. In reality, projects with positive and negative net cash flow are most prone to this.
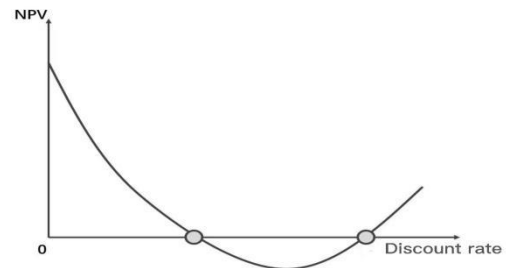
Figure 2 Analysis of NPV and Discount rate in another case

Also, the reliability of IRR depends on a number of assumptions, the most important one is: the rate of return on reinvestment equals IRR. Assume a project with an investment of $10 billion at the end of 2019, and it made $8 billion in 2020, $4 billion in 2021, calculated that the IRR is 14.83%. If the $8 billion in 2020 is reinvested at a 5% rate of return, significantly lower than the IRR's 14% rate, the total return by the end of 2021 is 124.(As shown).

Table3 Return from reinvestment in year 2020 and 2021

	Year2020	Year2021	Total
Return	80	40	120
Return from reinvestment	84	40	124

And the compound rate of return is 11.36%. At this point, the compound rate of return is no longer equal to IRR, and our familiar basic formula is incorrect. (Zvibodi's "Investment Science" discusses the same problem with examples when dealing with the bond yield to maturity.).

2.3 SPECIAL SITUATION

In most situations, using NPV and IRR will get the same result but there are some situations use NPV and IRR will get a very different outcome. Firstly when the symbol of cash flow changes many times during the investment period, we usually assume that in the investment period, the cash flow changes the sign only once. But in some times, if there is an extra investment in the period, then the cash flow sign may change in several different symbols. For example, if the company is considering program C, its' cash flow forecast is shown in figure1.4.

Table4 Cash flow forecast

Time period	0	1	2	IRR	NPV
Cash flow	-1	2.6	-1.68	20%or 40%	-0.02428

If the company asset cost is 15%, then two IRR is larger than the asset cost. Depending on the IRR calculation rules, the program should be work and acceptable. But in another way, it depends on the NPV calculation rule and if the NPV has a negative value, the company should reject this program. It will make a conflict between NPV and IRR. The reason why will this happens is because in the different periods it has a different symbol, negative and positive. And the change of the symbol will change the function and result in a deviation between the final results of NPV and IRR. In the event of asset cost is higher than IRR, using IRR to compare and analyze the decision will make conflict, using NPV to calculate will solve this question.

Secondly when the initial investment amount is not equal. When the company has to decide which program is better, there may have two different data of two programs and usually, two programs will have the different initial capital. For instance,

Table5 NPV versus IRR of program D and E

Time period	0	1	2	3	IRR	NPV
Program D	-1000	505	505	505	0.24	256
Program E	-11000	5000	5000	5000	0.17	143

According to the table, if both program assets cost is10%, these two programs both can choose. However if only one can choose one, depending on NPV calculation rules should choose program E but if depends on the IRR calculation rule should choose program D. Therefore there may have a conflict.

Thirdly when the calculation period of the project is different :

Table6 NPV versus IRR of program A and B

time	0	1	2	3	4	infinity	IRR	NPV(when r=0.1)
Program A	-100	60	40	40	0	0	20.6%	17.62
Program B	-100	50	15	15	15	15	15%	50

If program A and program B are not mutually exclusive and the asset cost is 13% and according to the judgment criteria of net present value index and internal rate of return index, these two programs both meet selection criteria. With another aspect, if these two programs are mutually exclusive and need to pick one. If depends on the NPV rules should pick program B and if depends on the IRR rules should pick program A. That was the conflict. The reason why this will happen is the cash inflows of the two projects occur at different times. The cash flow of project B is relatively concentrated and occurred in the previous period. When the discount rate is high, the recent cash flow will have a great impact on the present value, and project B will have more advantages than project a. On the contrary, when the discount rate is low, the impact of long-term cash flow on net present value will begin to increase, and project a will have a comparative advantage.

Therefore, in comparison between NPV index and internal rate of return index in most cases, the conclusions drawn by NPV index and internal rate of return index are consistent. But in some special cases, these two indicators will give different conclusions.

3. CONCLUSION

To conclude, we find that NPV and IRR can be used in scientific calculations, and that NPV and IRR are complementary. NPV judges whether a project is profitable, while IRR judges the efficiency of a project. One cannot be without the other. However, NPV does not

take into account the profit earned by the project, and there are some projects with high IRR but low absolute return, which have limitations. In some special cases, when the sign of cash flow changes several times during the investment period, when the initial investment is not equal, and when the calculation period of the project is different, the two indicators will come to different conclusions.

REFERENCES

[1] Next Generation Excel®: Modeling in Microsoft® Excel® for Analysts and MBAs (for Windows® and Mac® OS), Second Edition

[2] Moyer, C. R., McGuigan, J. R., Rao, R., & Kretlow, W. J. (2012). Contemporary Financial . Management. Natorp Boulevard: South-Western, Cengage Learning. [3] C. Baier, J-P. Katoen, Principles of Model Checking, MIT Press, 2008.

[3] Jai-Houng Leu (2010) Market potential prediction for renewable energy, application in Taiwan by lanchester's rules, financial NPV and IRR estimation, Journal of Information and Optimization https://baijiahao.baidu.com/s?id=17114315182149 86340&wfr=spider&for=pc&searchword 、

[4] Image by Sabrina Jiang © Investopedia 2020

[5] https://www.studymode.com/document/46331985

[6] Hawkins C J , Pearce D W . Comparison of NPV with IRR[M]. Macmillan Education UK, 1971.

[7] ZhaoZ J. Comparison and Analyses between NPV and IRR[J]. Journal of Liaoning Provincial College of Communications, 2011.

[8] TorriesT F. NPV or IRR? Why not both?[J]. Mining Engineering, 1998, 50(10):69-73.

[9] NPV vs IRR - Overview, Similarities and Differences Conflicts

(corporatefinanceinstitute.com)

[10] P Merło. Implications of Discounting Methods and Relations between NPV, IRR and MIRR for Efficiency Evaluation of Investment Projects. 2013.

[11] JianY U. The Comparison and Analysis Between the Rule of NPV and IRR[J]. Journal of Xiangfan University, 2004.