The Review for the Development of IRR's Implication

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ABSTRACT

In the past 70 years, IRR has been plucked from obscurity to turn into the optimum choice in evaluating the value of an investment for corporations. Although we cannot deny its popularity, it has many problems that cannot be ignored. Among them, the serious one is its reinvestment assumption. MIRR makes up for its deficiency in reinvestment, while XIRR covers its timing shortage. Getting knowledge of IRR, XIRR and MIRR can help us have a deeper understanding of the project's profitability. As investors, we can ask the corporation to provide MIRR rather than IRR to show us the true ability of the financial management. After learning about XIRR, we can get the rate of return on any day. This review would benefit the existing researchers to find a motivating field for IRR method development.

Keywords: IRR, MIRR, XIRR, limitations, difference

1. INTRODUCTION

NPV is the present value of the investor's future cash flow. IRR is the internal rate of return, which measures how much profit an investment makes without considering things such as interest rates or inflation. Both NPV and IRR are widely used now to measure the financial attractiveness of investing opportunities. NPV is specific data to tell you how much you can earn in the future. If NPV is greater than zero, we reckon the project is worth investing in. If NPV is less than zero, we definitely will reject the project. If NPV is equal to zero, we think it has no indifference with others. If IRR is greater than the rate requested by the investors, the investment has financial attractiveness.

Ryan and Ryan's study [1] of Fortune 1000 companies has shown us that 85% of corporations use NPV to evaluate their investment decisions. Sixty percent use IRR. NPV and IRR have an overwhelming advantage in this field. But some studies also indicated that executives prefer IRR to NPV because of its percentage appearance.

Even so, the disadvantage of IRR cannot be omitted. It is very necessary to modify it. During the calculation progress, we can easily find that MIRR is often lower than IRR. But in the Kelleher and Maccomark's [2] survey, the statistic clearly told us only 20% of executives from corporations, hedge funds, and venture capital firms were aware of the weakness of IRR. This is very dangerous. The higher outcome misleads the investors. Moreover, the executives created unrealistic and unreachable expectations for themselves and shareholders. Beaves [3] noted the limitations of IRR.

It is the high time that the superiority of MIRR should appear. What is also essential is explaining the MIRR in correct ways. At present, in the spreadsheet programs, only Excel provides the calculation of MIRR, but it is not equipped to deal adequately with the cash flows involved. Only when more programs accept the calculation of MIRR, can it provide more convenience for people. In such a way, people are willing to use MIRR.

After considering how the cash flow affected IRR, another factor-time needs to be thought about. XIRR can only be used in certain situations. The specific date of investment must be clearly known. Excel also provides the calculation of XIRR, but fewer people do not even know about it, not to mention how to use it.

This passage will introduce the limitations of IRR and the reasons. IRR mainly has three problems. It omit calculating reinvestment rate should be considered prior . MIRR can deal with this problem perfectly and make the number become single simultaneously, so the next part will describe how MIRR works and why it is better. The following is to talk about the definition of XIRR and the difference between XIRR and IRR.

2. THE PROBLEMS OF IRR

The internal rate of return has been used to estimate capital projects. But the textbooks have warned us the IRR is not perfect. It can only be used as an auxiliary method. [4] C. A Magni indicated eighteen drawbacks of IRR [5]. It contains two main problems. One is that IRR can be multiple in one project. That leads to IRR being no more useful in estimating the profitability of the project. The other one is that the calculation does not consider the reinvestment, which could make a bad project look better and a good one look great. These two problems mean IRR must be modified in the next. But apart from these two problems, some other problems need to be mentioned.

2.1. IRR may be multiple in a different situation

The following examples will illustrate the reasons for the first problem. We assume that now there is a project A, the fund at the beginning was -1000$, the cash flows in the next four years were 800$,1000$,1300$and -2200$ as shown in the form (Table 1).

Table 1. The cash flow of Project A

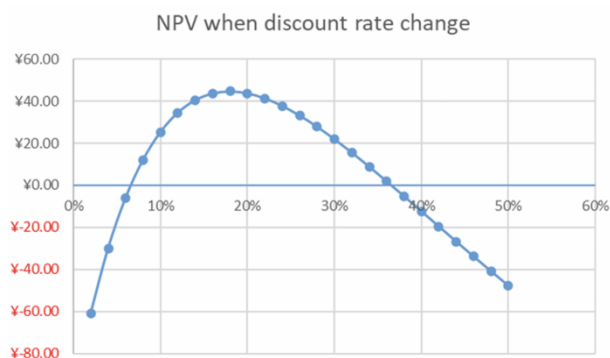| Project A					
Year	0	1	2	3	4
Cashflow	-1000	800	1000	1300	-2200

Figure 1. The trend of NPV with different rate

Based on Figure 1, we have already known that IRR is the discount rate that makes NPV equals zero, so we can conclude from the picture that the first IRR equals 6.60%, the second IRR equals 36.55%. The conclusion here is if there is another year of negative cash flow, there may be more than one IRR in one project

2.2. IRR may be the same in different projects

IRR ignores the scale of the project. We now own two projects C and D. The information of them is given in the tables.

Table 2. The cash flow of Project C

Project C					
Year	0	1	2	3	4
Cash Flow	-1000	350	450	600	750
Discount Rate	15%				

We can calculate that the NPV is 467.94$ and IRR is 33.66% in Table 2. This table introduces the detailed cash flow of project C.

Table 3. The cash flow of Project D

Project D					
Year	0	1	2	3	4
Cash Flow	-10000	3500	4500	6000	7500
Discount Rate	15%				

We can also figure out from this sheet that NPV equals 4679.37$ and IRR equals 33.66% for Project D based on the information in Table 3.

Under this circumstance, the IRR of project C is the same as the one of project D. That means IRR is no more useful in evaluating the value of the projects, so people prefer NPV to IRR.

2.3. IRR ignores the reinvestment and reinvestment rate

This problem we can also understand by an example. If you have 120$ now, there are two methods you can earn money. The first one is investing in one project B, whose IRR is 10%. The second one is saving it in the bank whose interest rate is also 10%. We both assume the period is one year. After one year, we can get 120$ from project B and 121$ from the bank. Now we see the difference. The key point is we do not consider the revenue during the period, so we can think about

whether we use the revenue for reinvestment or draw the money during the period, the IRR will be influenced.

$$PV = \frac{c_1}{(1+IRR)^{t1}} + \frac{c_2}{(1+IRR)^{t2}} + \cdots + \frac{c_3}{(1+IRR)^{tn}} \quad (1)$$

According to the formula of IRR, we can see that we have already assumed that the investment rate is IRR every year. However, this assumption is not realistic. If the internal rate is higher than the investment rate of the interim cash flow, the investment can be overestimated, and the company may give credit to itself. That is one of the reasons why some people like net present value better than the internal rate of return.

As we have known the problems with IRR, we make improvements on it. It is MIRR that is more accurate and real than IRR.

3. MIRR METHOD

Kierulff H. thinks MIRR is a better measure than IRR. [6] But, executives have avoided MIRR for many reasons. According to the study of Burns and Walker the Fortune 500[7], MIRR was used only 3% of the time and, although it uses a more realistic reinvestment rate, it was considered "difficult to understand and compute.' However, Ryan and Ryan's [1] suggest that on account of strong theoretical support and its appearance in spreadsheet programs, MIRR will gain acceptance over time, just as NPV has.

The modified IRR is the discount rate that invests equals to the future value of the cash flow from the investment. It will also make NPV equals to zero.

The formula of MIRR:

$$MIRR = (\frac{FV}{PV})^{\frac{1}{n}} - 1 \quad (2)$$

MIRR can solve the problem of multiple rates of return. Compounding the cash flow from the investment can counteract the negative part by the positive part, so only one sign will change when negative to positive happens.

MIRR will equal NPV when the rate of investment and reinvestment is equivalent to the discount rate of NPV. Both of them are good indexes in this situation. When MIRR is not equal to NPV, MIRR will be better as it can explain the reinvestment of cash flow at a different rate. As Kharabe and Rimbach [8] noted. Both MRR and NPV can be used to evaluate projects. Still, the MRR, when interpreted as the interest rate paid by a project or alternative, indicates project efficiency not provided by NPV. But the MIRR is influenced by the discount rate-MARR. So MIRR is sorely appropriate for single project evaluation [9].

McDaniel et al. [10] pointed out that we should separate finical payments from other cash flows, for the marginal cost of capital "measures the cost of meeting

obligations to the capital providers". IRR cannot deal with this problem because it is determined by the amount and timing of the cash flows. When Excel calculates MIRR, it will discount negative cash flows back to the present, even if the flows represent a mix of positive and negative flows

4. XIRR METHOD

MIRR compensates IRR in terms of cash flow accuracy, while XIRR compensates for the limitation of IRR in terms of time. When we calculate the internal rate of return, we do not need to emphasize the time interval of the cash flow. But when we use XIRR, the cash flow must be monthly, and the time intervals must be the same.

XIRR and IRR are used in different circumstances. If they can be applied under the same condition, the annual interest rate calculated by XIRR will be accurate than the outcome of IRR. Because the time series of XIRR is exact data, the one that belongs to IRR is estimated.

Compared with IRR, the formula of XIRR applies to a wide range. It is suitable for the same or different time intervals, and the investment amount of each period is fixed or not fixed, but the specific date of the fixed investment date must be known. If the specific date is not clear, you cannot use this formula. The formula calculates the annual interest rate, so there is no need to converse. As long as you know the exact date and its corresponding cash flow, you can calculate the annual interest rate of the investment.

The formula of internal rate of return is applied when the time interval must be the same and the investment amount in each period is fixed or not fixed.

However, there is one point that needs to be clarified. XIRR is a compound annual growth rate rather than the average annual return. Therefore, it cannot be simply understood as the average annual return of investment. XIRR is the calculation of compound interest.

For instance, the capital is 10000$, and the daily asset profitability is 1‰. The annual rate of return is 36.5%, the average annual return is 36.5%, but when setting the specific date, the XIRR calculated is not the same according to the number of the date. The results are shown in the following table.

Table 4. The computations on a different date

	Date	Cash flow	
Capital	1/1/2020	$ -10,000	
Revenue	1/11/2020	$ -10,100	
	Numbers of date	XIRR	Average ROI
	10	43.76%	36.5%
Capital	1/1/2020	$ -10,000	
Revenue	1/1/2021	$ 13,650	
	Numbers of date	XIRR	Average ROI
	365	36.5%	36.5%
Capital	1/1/2020	$ -10,000	
Revenue	1/1/2022	$ 17,300	
	Numbers of date	XIRR	Average ROI
	731	31.4802%	36.5%

What can be concluded from this sheet is when the return on investment is fixed, XIRR may be different along with the number of the date. If the number is greater than 365, XIRR is higher than ROI. If the number is equal to 365, XIRR is equal to ROI. If the number is less than 365, XIRR is lower than ROI.

The essential difference between XIRR and ANNUAL ROI is the liquidity of funds. Two projects with the same rate of return have a high XIRR value, which is actually a measure of high liquidity. When using XIRR to automatically calculate the rate of return, make sure the net income list for each time period uses real cash flow numbers that can be reproduced and continuously add value. The data that continues changing is refused. That will be attributed to the inflated outcome. XIRR is of great importance in reflecting the time value of the cash flow.

5. CONCLUSION

IRR has been in the dominant position in the financial market for over sixty years. Its problems have gradually been known to the public. Investors usually interpret the internal rate of return as the annual equivalent. This easy analogy is the source of its intuitive appeal. But the truth is the IRR can be the index of the annual return only when there are no interim cash flows or when the reinvestment rate equals IRR. This is an unrealistic assumption.

Sometimes the internal rate of return is higher than the real rate of return. This may happen when the internal rate of return is higher than the investment rate of the interim. That means the measure overestimates the profitability of the project. Under this background, a modified internal rate of return gradually is invented by scholars. The second part mainly introduces the modified internal rate of return.

The modified internal rate of return can fix two main problems of the internal rate of return. MIRR can make sure there is only one in one project and make reinvestment assumptions better. It is a more accurate measure because its attractiveness relies on the invested money and the cash flow it generates.

Another index -XIRR, is generated from IRR. XIRR is often understood as the annual rate of return. But it is a more flexible way. The date can be shorter or longer, which means the time interval can be various. The management must be clear about the date connected with the investment. Otherwise, the formula of XIRR cannot be used.

In reality, many managements still choose IRR to take place of MIRR because IRR is often higher than MIRR. It can allure more investment. Even if MIRR is much better than IRR, it cannot achieve value if it is not widely used in the financial market. The government should roll out commercial policies to encourage the application of MIRR.

The future is to consider whether we can combine XIRR and MIRR to generate a new formula. It can fix two problems at the same time. In addition, more and more spreadsheet programs should accept MIRR and XIRR. When they become easy to use, more people will take them into account.

This article can provide an insight into IRR, XIRR and MIRR. It can help us learn more about the scientific research filed and the future development, with deepening the understanding of the orientation of improvement in this field.

REFERENCES

[1]. Ryan, P. A., & Ryan, G. P. (2002). Investment practices of the Fortune 1000: How have things

changed? Journal of Business and Management, 8(4), 355-364.

[2]. Kelleher, J.C & MacComark J.J (2004) Internal rate of return: A cautionary tale.

[3]. Beaves, R. G. (1988). Net present value and rate of return. Implicit and explicit reinvestment assumptions. The Engineering Economist, 33(4), 275-302.

[4]. Zhang Xiaoli. The Choice between NPV and IRR in Investment Decisions[J]. Journal of Central University of Finance & Economics, 2006, (8): P88-92

[5]. Carlo Alberto Magni. The Internal Rate of Return Approach and the AIIKR Paradngm: A Rerutation and a Corroboration[J]. The Engineering Economist, 2013, 58:73-111

[6]. Nikolay Yu. Kuakov, Anastasia blaset Kastro. Evaluation of nonconventional projects: GIRR and GERR vs. MIRR[J]. The Engineering Economist,2016,60: 183-196

[7]. Burns, R. M., & Walker, J. (1997). Investment techniques among the Fortune 500: A rationale approach. Managerial Finance

[8]. Kharabe, P, & Rimbach, A. (1989). MRR, IRR, and NPV as project tranking measures. Real Estate Review, 19(2), 74.

[9]. Min Xie, Wang Kun Chen. Research on the modified internal rate of return[J]. 2021 4087-4090

[10].McDaniel, W. R.& McCarty, D. E., Jessell K. A. (1988). Discounted cash flow with explicit reinvestment rates: Tutorial and extension. The Financial Review, 23(3), 369-385