Application Analysis of Internal Rate of Return Capital Budgeting Method in Project Investment Decision-Making

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Abstract. Capital budgeting is crucial for a company to make the right investment decision. Among the typically used evaluation methods, the net present value and the internal rate of return are the mostly commonly used and preferred. This paper aims to focus on IRR, providing a comprehensive view of IRR that includes its basic characteristic, advantages and disadvantages when using it as the investment creation, as well as the improvements of its modified version MIRR, there will also be a comparison between the NPV and IRR to illustrate their difference. The study could enable the audience a comprehensive understanding of IRR in project appraisal, and whether to choose IRR or NPV as the investment criterion under different circumstances of the project or base on their own preferences. This research can provide more comprehensive and more realistic economic evaluation decision-making information, making the project economic evaluation more scientific.

Keywords: Capital budgeting techniques; NPV; IRR.

1. Introduction

Nowadays, when it comes to making investment decisions in corporate finance, the process of capital budgeting is crucial to a company's success; it helps the company to choose the investment which would ensure the financial stability, growth, and profitability of the corporation [1]. According to Al-Mutairi et al. (2018), investment decisions are based on capital budgeting, which is a planning mechanism for allocating resources among various projects [1]. If possible, a company would take any investment opportunities that generate greater shareholder value and profit. But in reality, the company only have a limited amount of capital for investing in new projects, thus by using capital budgeting techniques, managers can determine the optimal investment that will leads to the best return under that certain period. For capital budgeting practices, there are five methods that commonly used for evaluating investment project, which are the Payback periods, Accounting rate of return (ARR), Profitability index (PI), Internal rate of return (IRR), and Net present value (NPV). The PBP and ARR are non-DCF methods while the rest are DCF methods, meaning that the latter three does consider time value of money and the former two does not. Among them all, it is widely accepted that NPV and IRR are the most popular and favored budgeting methods. Therefore, this paper is mainly focused on addressing the analysis of IRR, the improvement of its modified version, and a comparison with the NPV method in investment appraisal. Providing a comprehensive overview of the IRR method is the goal here, and as well as helping readers to correctly use IRR to evaluate investment opportunities.

As for the remainder of the paper, it is organized as follows: Section two contains two parts; first part is the introduction of IRR investment theory, i.e., how to calculate and use it, its advantages and disadvantages. The second part is the improvements made by MIRR, the short comings of this modified version, and the comparison between IRR and NPV methods. Then the conclusion will be made in Section 3 along with the limitations of this paper.

2. Literature Review

2.1 The Investment Criteria of IRR

2.1.1 The IRR Investment Theory

According to Paltrinieri, N., & Khan, F. I. (2016), an investment will break even at a given rate when the present value of all future cash flows equals the initial investment, which is called the internal rate of return (IRR) [2]. Financial managers prefer it since it is expressed in percentage terms, they can simply make a comparison between the IRR and the required rate of return, in other words, to estimate the potential profitability of an investment project [3]. Upon discounting back at IRR, the project's present value of future net cash flows will be equal to zero. The expression is:

$$CF_0 + \sum_{t=1}^{n} \frac{CF_t}{(1+IRR)^t} \quad (1)$$

Where CF_0 is the initial cash out flow, CF_t is the project's net cash inflow at period t, and n is its lifespan.

As a project's IRR is obtained by calculation, to make decisions based upon that result, it will be compared with the project's hurdle rate or the cost of capital. Under the circumstances of an IRR exceeds the hurdle rate, the capital investment has returned more than what was invested, in other words, shareholders' wealth will increase, while an IRR below the hurdle rate represents a loss for shareholders [3].

2.1.2 The Advantages of IRR

First off, for capital budgeting, IRR is frequently used to compare the ROI of investing in a new company with the ROI of expanding the current operation. The IRR could be used by an automobile manufacturer to determine if it makes more sense to open a new factory or expand and renovate the existing one. Despite the fact that both options may add value to the company, making a decision based on internal rates of return is a more logical approach.With that being said, it is worth noting that due to the fact that IRR does not take discount rate changes into account, it's usually unreliable for projects over a long term since discount rates are expected to fluctuate over time.

Moreover, companies can evaluate share repurchase programs by using IRR. The company's own stock may have a higher IRR than any other immediate use of capital, such as opening new outlets or acquiring other businesses, when this situation occurs the company should repurchase its own shares as there's no better investment than investing in itself. According to A. Gallo (2016), IRR method calculates the return on invested capital genarated by cash flows of the project and expressed it in percentage terms, therefore in presentations to non-financial audiences, analysts commonly use IRR, because the concept of which is intuitive and easy to understand, as it gives the return of a project [4]. Furthermore, according to Arjunan (2017), IRR can be estimated by a new method based on capital amortization schedule (CAS) without using discounted cash flow method. In a CAS, the cash inflows is apportioned towards recovery of the return of capital and return on investment and the balance is the terminal year closing balance, and his finding shows that the interest rate makes cash inflows equal to the return of capital is equal to IRR, which indicates that IRR express the highest return on investment possible in percentage term and truly reflects the full potential of the cash inflows from investment to recover the return of capital [5].

2.1.3 The Disadvantages of IRR

To begin with, the reinvestment rate assumption for IRR method requires all the intermediate cash flows generated by the project to be invested again at the actual IRR instead of the company's required rate of return or hurdle rate. In reality, the hurdle rate won't be stay constant to the IRR over times, therefore as the true reinvestment rate for the intermediate cash flows becomes lower than the IRR, the measures will overestimate the return on investment. According to Kelleher, J. C., & MacCormack, J. J. (2004), when assessing two mutually exclusive projects with identical cash flows,

risk levels, durations and IRRs, if using IRR as the only criterion, it seems that there's no difference in choosing between them. However, without examining the relevant reinvestment rate for intermediate cash flows, the manager could accidently select the one with a lower reinvestment rate which will generate a lower return. It could lead to major capital budget distortions if multiple projects of the company are mistreated like this [6]. Secondly, when it comes to the non-conventional investment, i.e., investment with cash flow stream that will have negative cash flows more than once, using IRR method to evaluate it can yield multiple IRRs since the sign of cash flows will change more than once. According to Bora, B. (2015), this is due to the fact that these projects contain both lending and borrowing features together, if shown in figure, an upward slope that is typical of a loan (borrowing) is the first part and in the second part, the slope will be downward, as with an ordinary investment (lending). Under this circumstance, the NPV curve is cut twice along the horizontal axis, resulting in two IRRs, which both are meaningless and the project only worthwhile when its hurdle rate is in the interval [7]. Thirdly, if reconsider the first advantage of IRR above. Although it gives the return of a project in percentage is easy for nonfinancial users to interpret, it cannot reflect the scale of investment since it represents a ratio rather than absolute value. Therefore, the IRR could be misleading when comparing projects with large differences in scale. When ranking two projects, one with a small sum of capital invested that has a slightly greater return in percentage comparing to another with a much larger invested capital, the IRR will indicate investors to choose the former instead of the latter, and obviously the larger project will provide a better profit [8].

2.2 Comparison between IRR and Other Investment Methods

2.2.1 The Improvements of MIRR

According to Mackevičius, J., & Tomaševič, V. (2010), MIRR is an internal rate of return that discounts the future cash flows generated by a project back to the same amount of the present value of investments, the reinvestment assumption here is that all the intermediate cash flows need to be invested again at the company's hurdle rate, and the initial cash outlay will be financed at the company's cost of finance [9]. The expression for MIRR is:

$$MIRR = \sqrt[t]{\frac{FV^+}{FV^-}} \tag{2}$$

Where FV+ represents the company's future positive cash flows at its hurdle rate, and FV- represents the present values of the negative ones at its cost of finance, and t is the total periods of the project. When MIRR exceeds the hurdle rate, the project is an attractive option to invest in, and when it's lower than the hurdle rate the project should be turned down. The MIRR formula is designed to generate one positive root, which indicates that it can eliminate the problem of multiple IRRs for non-conventional investment. And comparing with the IRR theory where all the intermediate cash flows generated by the investment will be reinvested at IRR itself, MIRR uses the hurdle rate as the assumed rate to reinvest, meaning the reinvestment rate can be adjusted during different stages of a project to more accurately reflect the actual profitability [9]. When the initial outlays for the projects are same, the NPV and MIRR methods will rank similarly to one another, which solve the conflict ranking problem to make IRR and NPV ranking consistent [10].

However, as the MIRR requires estimation on the cost of capital for decision making, the calculation of which can be subjective and being manipulated by the project manager, therefore causes the shareholders wealth not fully optimized. It should also be noted that MIRR does not measure the rate of return internal to the original investment, because it takes the reinvestments of intermediate cash flows into account; this indicates that MIRR is more like an IRR of a portfolio investments. And the expected return on other investment alternatives should never intervene the investment decision of the original investment [11].

2.2.2 The NPV Method Comparison

The net present value (NPV) means net value of all present value of future cash flows plus the initial cash outlay in period zero (usually negative). When cash inflows and outflows being discounted back to the present value at a risk-related rate that consistent with the project, the sum of this present value is the NPV.

$$NPV = CF_0 + \sum_{t=1}^{n} \frac{CF_t}{(1+r)^t} \quad (3)$$

Where CF_0 is the initial cash out flow, CF_t is the project's net cash inflow at period t, n is its lifespan and r is the discount rate.

According to Mackevičius, J., & Tomaševič, V. (2010), if the NPV is positive, it is being considered an effcient investment at that discount rate, thus accepting this opportunity will result in the increase of the business value. In contrst, a negative NPV is ineffective and a loss equal to that amount will be suffered by the investor. When the NPV equals to zero the project breaks even, and investors seldomly undertake these projects in practice because they believe it could result in financial losses with even the slightest changes in the market condition, these projects will only be accepted if such risk is being eliminated and there's no better alternatives that can create more profit [9,12]. According to A. Gallo (2014), as future cash flows are discounted back into today's value, the NPV accounts for time value of money, and it's important to consider the TVM incase of investments being calculated only with the current value and result in overvaluation [13]. Moreover, because it's an absolute measure of the project's profitability, investors can use it easily to compare mutually exclusive projects with different sizes, while IRR is a ratio that represents the return of a project in percentage, ignore the relative size. Also, the NPV formula is linear whereas the IRR formula isn't, which means when projects produce non-conventional cash flows, NPV method can be reliable while IRR method facing the issue of multiple IRRs. However, the NPV method relies on an estimated discount rate, which is not possible to accurately apply a percentage number to a project in order to represent its risk premium, and as the rate assumed today applies to the future returns, when interest rates spike in a later period, the estimated return for that period will be overvalued [13]. NPV also can't factor in unforeseen expenditures that either come before or after, or during the project.

3. Conclusion

An overview of the basic concepts, pros, and cons of the IRR method is presented in this paper and a comparison with the NPV method is being made. The two methods reflect the investment's economic value from different angles, the former is in percentage terms thus it's simple to understand, and the latter is in absolute terms therefore mutually exclusive projects with different sizes can be easily compared. The comparison can provide some ideas to readers whether to choose IRR or NPV as the investment criterion based on their own preference. It is worth to note that when they draw inconsistent results, due to the simple calculation of the NPV indicator, the consistency with the enterprise's financial objectives and the more realistic reinvestment rate, NPV is a superior indicator to choose for evaluating the investment project's feasibility. The MIRR as an improved alternative for IRR uses more realistic indicators and therefore can resolve some issues of IRR, but it also have its own short comings as one of the indicators is quite subjective and can be manipulated. Although the other three methods, the payback period, the accounting rate of return, and the profitability index are not addressed in this paper, these are also valuable topics that can be further explored. Enterprise project investment is the ultimate source of value creation and plays an important role in financial management activities. This article has a certain practical value for the review of investment. However, this paper also has certain shortcomings. This article only explains and introduces the review of a part of the project investment decision evaluation index system. At the same time, there is also a lack of verification of some actual data. In the future, the content can be enriched by expanding the research field and adding empirical data verification. Still, the research in it has

important practical significance for the project investment decision, which might help others who are doing research on investment decision making and capital budgeting in corporate finance. At the same time, it has important theoretical and practical significance for enterprise investment decision and capital budget management, and lays a certain technical foundation for project decision-making, so as to effectively and reasonably utilize and allocate enterprise resources to maximize value.

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