

A Literature Review on Investment Decisions and Case Analyses

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ABSTRACT

Existing studies on investment decisions have found that for rational investors no matter how many decision-making methods or economic markets there are, the decisions they make when investing will maximize their interests. To analyze how stakeholders make investing decisions, in this paper, we firstly review the influencing factors and application models of investment decisions, including NPV method, IRR method, CAPM model and APT model. Then we put NPV and IRR methods into existing enterprises such as Suning and JD Logistics for further research.

Keywords: decision-making, Net Present Value, Internal Rate of Return, Capital Asset Pricing Model, Arbitrage Pricing Theory

1. INTRODUCTION

Investment decision-making is a prominent segment of production link, which can be categorized into either ‘micro decisions’ or ‘macro decisions’. Conducting economic analysis for investment is exceedingly critical to design and opt for appropriate investment projects which would have a prominent effect on investor’s welfare as well as the development prospect of the enterprise [1].

Nowadays, owing to the rapid growth of the human civilization and science and technology, more and more investment approaches are being brought about and the status of project investment for enterprises are becoming unprecedentedly important simultaneously. However, the risk of investment and difficulties of making decisions grow at the same time on the account of the specialties and uncertainties of projects, so the analysis in accordance of the indicators is essential.

Research have already taken large consideration into the pros and cons of different indicators like NPV and IRR and so forth, as well as analyzed the practical use of it through empirical research. We focus on the ‘micro decisions’ and aim to do a literature review which summarize some frequently used investment decisions indicators, influencing factors and application models, additionally, we also gather some practical cases of enterprises using these indicators and models.

The paper proceeds as follows. After description of the definition and relative metrics of NPV (Section 2.1) and IRR (Section 2.2), we make a comparison between them and explain the Excel algorithm of IRR. Next in Section 2.3 and 2.4, we introduce CAPM and APT model evaluation respectively. In section 3.1 and 3.2, we summarize the actual cases of enterprises application of these two indicators, and briefly explain the possibilities of applications other indicators in the next part so as to prove the importance of investment indicators in enterprise activities. We conclude the paper with a summary and a discussion of implications of investment decisions indicators to enterprises.

2. THE INFLUENCING FACTORS AND APPLICATION MODELS OF INVESTMENT DECISIONS

2.1 NPV method

2.1.1 Definition of NPV

The difference value, between the present value of future cash inflow (revenue) and the present value of future cash outflow (expenditure) is referred to as the NPV, which is short for the net present value. During the project evaluation, it is a fundamental index of the NPV method. The NPV is derived by converting the net

present value and anticipated net present value of each period's capital outflow. This predicted discount rate is based on the enterprise's lowest rate of return on investment, which is the investment's lowest permissible limit. The following formula is used to determine NPV:

$$NPV = \sum_{t=1}^n \frac{CF_t}{(1+r)^t} - C_0 \quad (1)$$

According to Equation (1), t is the current period when the cash flow generated, r is interest rate, CF_t is the cash flow in period t and C_0 is the initial investment.

In general, if the calculation result is negative, i.e., $NPV < 0$, it indicates that this scheme is not feasible in decision-making, because it means that there will be no profit flowing into the company. On the contrary, $NPV \geq 0$ indicates that this scheme is practical when making decisions, because the future rate of return of the investment project is higher than or equal to the cost of capital. Therefore, when presented with various investment plans and needing to make a selection, investors might compute the Net Present Value of each project separately and compare the findings. Only when the Net Present Value of a project more than or equal to 0 and the amount in figures is large is the investment project that investors should consider investing in it [2].

2.1.2 Relative merits of NPV method

The NPV method, as a cash flow discount method, may objectively and immediately quantify the project's price and the absolute additional value of wealth given to investors by the capital account, i.e. income. It combines risk components into capital project decision-making through the minimum rate of return. There will be no multiple Net Present Values of the same project under fixed interest rate risk if the projects are mutually exclusive. However, because the project's Net Present Value is computed using a predetermined interest rate, the NPV approach cannot accurately reflect the project's real revenue level in a dynamic and changing environment, therefore it is not suited for comparing independent investment plans. At the same time, the Net Present Value cannot be used to make direct decisions when the initial investment or life of two mutually incompatible investment projects differs.

2.2 IRR method

2.2.1 Definition of IRR

The Internal Rate of Return, or IRR, is a number that fluctuates based on the project. When the investment amount, construction and operation periods, and cash flow are known, it may be determined. Because it doesn't need identifying external elements ahead of time, it's called IRR. It's the discount rate when the investment project's NPV is zero, i.e. the real discount rate. The

breakeven cost of capital, as opposed to the artificially determined benchmark discount rate, is represented by the IRR. It is people's goal to maximize profit from investment projects as well as their expectation of future investment returns. In general, if the IRR is greater than or equal to the benchmark discount rate, the project is viable [3].

2.2.2 Relative merits of IRR method

The IRR method has the benefit of being able to link a project's income over time with its total investment and establish its rate of return, which can then be compared to an industry benchmark rate of return on investment to see if the project is viable. When borrowing is utilized for construction and the borrowing requirements (i.e., interest rate) are unclear, the IRR method may be used to eliminate borrowing requirements and acquire the IRR as the upper limit of permitted borrowing rates. Under traditional cash flow, IRR has only one value (i.e., cash outflow at the beginning of an investment project, and then followed by cash inflow). Nevertheless, if the cash flow is non-traditional, with cash outflow at the beginning and subsequent cash inflow and outflow, there might be several Internal Rates of Return, and the IRR isn't relevant at this time. A reinvestment assumption is also included in the IRR calculation. For example, if the investment project's IRR is 20% and the financing cost in the company is 10%, the reinvestment assumption indicates that if the money that is produced by the project is spent on other investments in the market, the business may still earn a 20% return. In practice, however, this assumption is difficult to achieve. It is difficult for us to discover projects in the market that have the same rate of return, i.e. 20%. As a result, the reinvestment hypothesis is a flaw in IRR itself, since it may exaggerate the project's return rate and offer misleading information to investors.

2.2.3 Comparison between NPV and IRR method

Because IRR is a relative metric while NPV is an absolute figure, there are certain inconsistencies. Due to its huge size, a plan with a low Internal Rate of Return may have a significant Net Present Value, making it more worthy of building. When there are two or more projects, the NPV of project A may be greater than that of project B, but the IRR is lower. From the perspective of NPV, A should be accepted, however from the perspective of IRR, B should be accepted. It's difficult to choose between absolute value and relative value at this stage because there are two possibilities. As a result, while assessing and comparing various schemes, the Internal Rate of Return and Net Present Value must be considered simultaneously.

2.2.4 Excel algorithm of IRR

Using IRR index value to evaluate the feasibility of investment decision-making scheme requires a more reasonable index evaluation system. Under the solution method of IRR index value evaluation, the solution formula is:

$$\sum_{t=1}^n \frac{CF_t}{(1+IRR)^t} - C_0 = 0 \quad (2)$$

Different from the solution formula of Net Present Value, in Equation (2), IRR is the internal rate of return required.

In the calculational process of IRR index value, there are two methods: traditional method and excel function formula. The calculating principle of these two methods is also completed in full accordance with the solution formula of IRR, and the calculation of data is also carried out in accordance with the connotation of the original formula. The calculation of IRR is the process of solving the univariate n -th equation, that is, when the NPV is 0 what is the percentage of IRR. The calculation of any method is inseparable from the support of this original computing formula. In the calculating process, what is required to meet is to obtain the investment life of the invested project and scientifically, reasonably and accurately predict the net cash flow of each period in the future. At the same time, it is also very necessary to predict the initial investment amount of long-term investment projects [4].

In order to avoid the complexity and inaccuracy of calculation when manually solving IRR, and to meet the improvement of the accuracy requirements of financial data of enterprises or individuals, we should combine the powerful data processing function of Excel in practical work and research and apply Excel to all aspects of the financial management system. In this way, the scientific nature of investment decision-making can be greatly improved, and finally promote the long-term development of investment decision-making projects.

2.3 CAPM model evaluation

2.3.1 Definition of CAPM

CAPM model is an acronym for Capital Asset Pricing Model. Based on portfolio theory and capital market theory, it was created in 1964 by American academicians William Sharpe, John Lintner, Jack Treynor, and Jan Mossin. The CAPM model looks at the relationship between asset returns and risk assets in the securities market, as well as how the equilibrium price is formed. It is the foundation of modern financial market pricing theory and is widely used in the domains of investing and corporate finance.

In order to find the real market portfolio, scholars also put forward the following four basic assumptions:

(1) Because investors are rational and risk cautious, they choose assets with a high anticipated return and a low standard deviation. As a result, investors can create a successful portfolio (this point along the line before it is effective).

(2) Borrowing money at risk-free interest rates is an option for investors. As a result, investors may choose their investment leverage based on their level of pleasure. The asset market line will thus be a ray with the risk-free interest rate as the origin.

(3) Investors are in a market that is working. They all have access to the same data, can estimate the future value of securities, and make the same decisions and judgements.

(4) In the market, there are no taxes or transaction expenses. People can freely acquire and sell all of the securities. The CAPM model conveys a wonderful notion in simple terms based on the aforementioned assumptions: in a competitive market, the anticipated risk is precisely proportionate to the β coefficient [5]. Its form is:

$$E(R_i) = R_f + \beta_i(R_m - R_f) \quad (3)$$

According to Equation (3), $E(R_i)$ represents the predictive return of security i in the market portfolio. R_f is risk-free return rate and R_m is the market return rate.

According to the CAPM model's requirements, the β coefficient is not only a risk indicator for measuring the risk of an asset system, but also a risk assessment tool for measuring the volatility of a security or an investment portfolio in relation to the general market. When the β coefficient is larger than 1, it signifies that the investment product's volatility is higher than the market portfolio's, indicating that it is more hazardous than the market portfolio and may be classified as aggressive stock. When the β coefficient is smaller than one, the converse is true, and these equities are referred to as defensive stocks. When the β coefficient is equal to 1, the stock is considered neutral and moves in lockstep with the market portfolio.

2.3.2 Limitation of CAPM model

The most significant benefit of CAPM is that it is simple and straightforward. It splits the price of every risk security into three components: risk-free return rate, risk price, and risk calculation unit, and organically mixes them. Another benefit of CAPM is that it is easy to implement. Competitive bidding allows investors to examine and pick various financial assets based on the absolute risk instead of overall risk. Investors in the financial markets have regularly utilized this method to address basic investing decision-making challenges.

Despite the fact that the CAPM model is frequently employed in financial markets such as securities trading, it still has certain drawbacks. To begin with, the CAPM model's ostensible prerequisites do not correspond to reality: (1) the complete market hypothesis assumes that the actual scenario includes transaction costs, information costs, and taxes, resulting in an incomplete market. (2) homogenous expectation hypothesis: investors' expectations are not homogeneous, causing the securities market's line information to create a range. The concept of securities market line (SML) is introduced here, which is used to represent the link between the predictive return of all portfolios and the risks of single risk assets. The risk-free interest rate serves as the intercept, while the market risk premium serves as the slope. The abscissa is the systematic risk measurement β coefficient, while the ordinate is the anticipated return. (3) the assumption that the cost of borrowing is equal to the risk-free interest rate is incorrect: in reality, the lending rate is higher than the risk-free interest rate. (4) the assumption that the rate of return distribution is normal, which is not always supported by the facts.

Secondly, the CAPM model should only be used to marketable capital assets, but HR functions are not always tradable. Furthermore, the computed beta coefficient shows historical volatility, whereas investing stakeholders are worried about the security's future price volatility. Finally, risk-free assets and market portfolios may not exist in actuality.

2.4 APT model evaluation

2.4.1 Definition of APT

Arbitrage Pricing Theory (APT) is a valuation model for asset prices and an alternative Capital Asset Pricing Theory (CAPM). According to the APT model, asset returns fluctuate as a result of system risk. System risk, on the other hand, is represented by a number of distinct and independent components, such as market factors, liquidity factors, industry factors, group factors, and so on; earning capacity is linearly proportional to these factors. It is founded on 3 fundamental assumptions: (1) securities returns can be described using a factor model; (2) there are already enough securities in the market to disperse risks; and (3) in a perfect securities market, there are no arbitrage opportunities.

This model's conclusion is comparable to the capital asset pricing model's, as both models describe a similar market relationship. This gives us a new perspective, or a confirmatory approach, for analyzing the market's balanced risk-reward relationship. The general form of arbitrage pricing model is:

$$r_i = r_f + \sum_{j=1}^k (\delta_j - r_f) * b_{ij} \quad (4)$$

According to Equation (4), r_i represents the predictive return of security i in the market portfolio and r_f is risk-free return rate. $\delta_j - r_f$ is the unit risk premium for factor j and b_{ij} is the sensitivity of security i to factor j .

2.4.2 Comparison between CAPM and APT model

In practice, the assessment of value is the most significant aspect of the CAPM model. People cannot understand the predicted value of investors because the value is predictive. They can only utilize additional historical data to estimate the value in the previous sample period and use it as the forecast value. The first issue to address in the actual use of the APT model is determining the model's interfering elements. In practice, factor analysis is typically performed to identify the influencing aspects in a portfolio before determining the type of arbitrage pricing model to utilize. After that, regression analysis of historical data is used to evaluate the sensitivity of each contributing element.

When the specific application modes of the CAPM model and the APT model are compared, both models share the same underlying flaw: the forecast value is replaced with the historical value. The variation is clear, and it has a significant impact on the model's prediction function. In terms of the model's applicability, CAPM may be used to a wide range of businesses, particularly those with low cost of capital accuracy requirements and managers who lack the expertise to compute the value at risk independently. However, APT is best suited for businesses that demand great precision when calculating capital costs. It is only ideal for the larger organizations that are able to assessing their own risk variables and risk values due to the intricacy of its theory [6].

3. CASE STUDY

3.1 Application of NPV rule

Investment decisions indicators play important roles during the business process of enterprises. Take NPV (net present value) as an example, which refers to sum of the cash flows of each period discounted by the established discount rate, and minus the initial cost of the investment in the end. It can be easily known that projects with positive net present value could be selected because of its underlying benefits, and the larger the better. The effective and efficient way to obtain positive net present value is to lower the cost and increase the cash flows of each period as much as possible through various specific methods.

NPV, this commonly used index is exceedingly significant for investors to make relevant decisions for the purpose of gaining advantageous competitiveness and firmly survive in the uncertain market.

The enterprises can augment the cash flows through constantly providing differentiated products or services, developing core technologies and setting high-technology barriers and so forth [7]. Take DJI as example, which devoted to forming market segments with precisely positioned services, upholding the concept and direction of independent innovation and maximizing cost superiority simultaneously in order to realize positive net present value [7]. Suning as a corporation which mainly specializes in managing online shopping platform whose rich diversities of products cover traditional home appliances, general merchandise and so forth, analyze its strategies and tactics with the goal of gaining positive net present value. In addition, the concrete route is to improve core technologies and provide first-rate services to customers, collaborate with other corporations, and create brand differentiation [8]. Moreover, the strategy of the famous JD Logistics corporate aims at positive net present value, too. They attached importance to the research of core technologies, producing like Qinglong logistics distribution system, UAV and so on, they differentiated the products and services as well and most importantly, they timely updated the hardware equipment [9].

However, it was also pointed that NPV rule has numerous defects during the process of making investment decisions for the enterprises, such as the uncertainty of the cash flows in the future, which is influenced by the waving microscopic market conditions, also the selection of the discount rate is not accurate enough and it ignores the flexibility of the investment activities. As a result, the operation of rules or models which have been introduced above might cause certain deviations and face challenges of the economic situations, which is an urgent problem needing further concentrations and solutions.

3.2 Application of IRR rule

IRR, whose full name is internal rate of return, refers to a discount rate when the net present value of the project equals to zero. Investors and the managers of the enterprises can make decisions and judge the feasibility of projects through comparison between IRR and the established base discount rate i_0 , projects with positive difference between IRR and i_0 can be selected.

It was indicated that IRR is the lowest rate of return that an investment project should achieve and the maximum cost of capital that the project return can bear. The IRR also measures the bearing capacity of financing interest rate for real estate companies as well as further reflects the financing ability of them. On one hand, the real estate enterprises may dare to borrow loans from capital market when IRR is high enough while on the other hand, the project could hardly reach the expecting investment level considering its financing cost and situation of cash flows when IRR seems too low. Based

on this, a four-dimensional managing method with the core of IRR for real estate enterprises has been put forward and gradually taken into practice so as to achieve the goal of improving IRR and satisfying the shareholders' investment return [10]. Furthermore, in order to improve the effectiveness of cash flows management and maximize IRR of projects, the enterprise needs to combine the process of operation management with IRR index, then accurately judge the balance point between project profit and speed of turnover, implement more precise investment decisions and product positioning.

However, compared to NPV rule, IRR seems to present less accurate and owns more amount of loopholes. You need to consider the incremental project when two projects have different initial investment and complicatedly calculate the modified IRR when projects have unconventional cash flows, and so forth.

3.3 Application of other indicators in investment decisions

Except for dynamic indicators like NPV and IRR, mathematical models are also used to help investors make investment decisions. In addition, they can also establish their own indicators based on the specific situations and classify them into some categories like social aspect, economic and cultural dimensions etc., and definitely they can subdivide continuously.

For example, in terms of evaluation index system of large medical equipment investment in public hospitals, they can research the domestic literature related to the evaluation indexes of large-scale medical equipment investment decisions in the recent 10 years from 2011 to 2020, count the evaluation indexes listed in each literature, sort out and analyze the logical relations among the indexes and use data perspective function of EXCEL to evaluate. Then, they need to figure out the indicators consistent with the design principles of this study. The equipment department, finance department and other relevant departments repeatedly discussed the above indicators and optimize the indicators by deleting redundant indicators and merging the same or related indicators and summarize as a preliminary indicator system. After all this steps, they can consider demands environment and regulation environment from social aspect, the organization feasibility, social and economic benefits from hospital aspect, technical advancement, after-sales service guarantee, and development trend at home and abroad from equipment aspect [11].

4. CONCLUSION

Three methods are mainly adopted during the process of investment decisions making so as to compare and differentiate projects and decide which ones to pursue: IRR (Internal rate of return), payback method and NPV

(Net present value). However, NPV is more frequently used than others on account of it considers the time value of money and provides a concrete number.

In conclusion, through the above influencing factors and application models, the investment decisions indicators are important elements for stakeholders to consider in the duration of investment activities, but surely benefits accompany with potential problems and mistaken possibilities which needs extra remedial measures and further considerations. Nowadays various investment indicators are largely used in numerous areas of economic management. So, how to scientifically use dynamic indicators to analyze the projects in practice and eventually have an ideal result is a question which is worthy of more research.

Hospital as an Example, Guangxi University,2021.
(in Chinese)

REFERENCES

- [1] A. Virlics, Investment Decision Making and Risk, *Procedia Economics and Finance*, 2013, pp. DOI: [https://doi.org/10.1016/S2212-5671\(13\)00129-9](https://doi.org/10.1016/S2212-5671(13)00129-9)
- [2] C. Yan, On the Application of NPV Method in Capital Budget, *Financial word*, 2013.(in Chinese)
- [3] F. Zhang, Analysis of NPV and IRR, *Investment and Financing*, 2017. (in Chinese)
- [4] J. M. Liu, On the Necessity of Solving IRR Index in Excel Environment, 2019. (in Chinese)
- [5] W. F. Sharp, Capital Asset Pricing: A Theory of Market Equilibrium under Conditions of Risk, *Journal of Finance* 19, 1964, pp. 425-442. DOI: <https://doi.org/10.1111/j.1540-6261.1964.tb02865.x>
- [6] R. Stephen. A, The Arbitrage Theory of Capital Asset Pricing, *Journal of Economic Theory*, 1976, pp. 341-360. DOI: [https://doi.org/10.1016/0022-0531\(76\)90046-6](https://doi.org/10.1016/0022-0531(76)90046-6)
- [7] L.L. Liu, Analysis of Innovative Enterprise Strategy Based on NPV rule: Take DJI as an Example, *Times Finance*, 2019. (in Chinese)
- [8] L.T. Lu, Analysis of Corporate Strategy Based on NPV rule: Take Suning Shopping as an Example, *The Chinese Market*, 2020.(in Chinese)
- [9] L.Q. Han, Jingdong Logistics to Positive Net Present Value as the Goal of the Company Strategy, *Technology and Market*, 2019.(in Chinese)
- [10] X.B. Zhu, Real Estate Project Management with IRR as the Core, *Residential and Real Estate*, 2020.(in Chinese)
- [11] L.L. Ye, Construction and Application of Evaluation Index System for Investment Decision of Large Medical Equipment in Public Hospitals: Take K