Investment Decision Analysis Based on NPV, IRR, and the Fisher Separation Theorem

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ABSTRACT
In today's society, investment decision-making has become one of the main decisions of every large-scale company. The management and shareholders of the company conduct reasonable analysis and vote for high-quality investment plans. The paper mainly shows the impact of economic models on project decision-making, and mainly summarizes the relationship between the economic model NPV and IRR and its application loopholes in actual situations. The final results of the paper show that the economic models NPV and IRR have their own advantages and disadvantages, and they need to be used reasonably according to the situation. Second, investors do not have to follow economic models to make decisions. When faced with investment decisions, they should adapt to the current situation.

Keywords: *NPV, IRR, Fisher model, neoclassical economics, neuroeconomics*

1. INTRODUCTION

Contemporary is an era of economic prosperity. Many companies and enterprises are facing investment problems [1-2]. Investment is also regarded as one of the company's main decisions [3].

In this essay, my opinion is how to weigh the pros and cons, and maximizing the interests of the company and shareholders is the ultimate goal of an investment. But in theory, investment decisions in today's financial markets are only for maximizing the company's value [4-6]. Rationally speaking, investment decisions must follow the results of the economic model, which means that investment decisions do not need to consider the personal wishes of consumers, but only need to consider how to maximize the value of the company. This is the Fisher separation theorem that will be mentioned in this article [7]. But this situation only appears in perfect capital markets.

In this article, Fisher's separation theorem will also be questioned [8]. This article mainly elaborates the pros and cons of NPV and IRR economic models in investment decision-making, as well as the irrational explanation and analysis of Fisher's separation theorem.

In this paper, I will elaborate on three points, namely: i. Economic models of the pros and cons of investment decision-making (NPV and IRR); ii. Fisher separation theorem; iii unreasonable investment decision-making. In the first point, I analyzed NPV and IRR separately and summarized their advantages and disadvantages in actual investment. The second point, This article will elaborate on unreasonable investment decisions, that is, neuroeconomics, and propose that investment should not only pay attention to the results of economic models, but also pay attention to the psychological willingness of investors.

In authoring this article, I consulted a lot of materials and provided written evidence to support my argument. And conduct thinking analysis and in-depth research to elaborate their own personal views.

When writing the article, I looked up a lot of materials and provided documentary evidence to support my argument. And carry out thinking analysis and in-depth research to explain my personal views. The structure of the whole paper is composed of a large-scale argument, a small-scale argument, and a final summary analysis.

2. ECONOMIC MODEL NPV AND IRR

2.1 NPV

To better analyse reasonable investment decisions, investors began to use the NPV method to rationally consider investment decisions. The NPV method is determined by calculating the costs and benefits of each investment period. The term is usually one year, but it can

be measured quarterly, half a year or several months. After calculating the cash flow in each period, the present value (PV) of each period is realized by discounting its future value with a regular rate of return (the rate of return specified by the market). Assuming that the net present value of the investment is positive, it means that the result of the investment can increase the value of the enterprise; conversely, if the net present value of the investment appraisal is negative, it means that the investment will reduce the value of the enterprise and should not be accepted. Of course, a positive net present value does not mean that this investment proposal should be accepted, and there may be other investment opportunities with higher net present value. And what is the formula for NPV? How will we calculate NPV? To calculate NPV, you need to estimate the future cash flow for each period and determine the correct discount rate. That is:

$$\frac{Cash\ flow}{(1+i)^t} \quad (1)$$

If you analyse a long-term project with multiple cash flows, the formula for the project's net present value is:

$$\frac{R_t}{(1+i)^t} \quad (2)$$

2.2 IRR

Regarding investment decisions, the NPV method has certain loopholes and defects. To enable investors to obtain investment decisions more accurately, economists have introduced the IRR index. IRR is an index used to estimate potential investment profitability in financial analysis [9]. IRR is a discount rate. In discounted cash flow analysis, the net present value of all cash flows, NPV, is equal to zero. Simply put, IRR is the annual growth rate expected from the investment. IRR calculation relies on the same formula as NPV. But IRR is not the actual dollar value of the project.

So how to calculate IRR?

i. Using the formula, set the NPV to zero and solve for the discount rate (i.e., IRR).

ii. The initial investment is always negative because it represents an outflow.

iii. Each subsequent cash flow may be positive or negative, depending on the estimated value that the project provides or needs as a capital injection in the future.

This is how IRR is calculated. However, due to the nature of the formula, IRR cannot be easily analysed and calculated, and IRR must be calculated through trial-and-error calculations or using programming software. In terms of capital planning, a popular solution for IRR is to compare the profitability of establishing new businesses with the profitability of expanding existing operations. For example, a real estate company can use IRR to decide whether to open a new building or renovate and expand an existing building and greening. Although both of these projects may add value to the company, they are likely to be a more logical decision under the IRR. Note that because IRR does not consider changes in discount rates, it is usually not sufficient for long-term projects where discount rates are expected to vary.

IRR is also useful for companies to evaluate stock repurchase plans. Obviously, if a company allocates a large amount of funds to buy back its stock, then the analysis must show that the company's own stock is a better investment, that is, it has a higher IRR than any other funds used, such as creating new outlets or acquiring others. company.

For example, individuals can also use irr when making financial decisions, using premiums and death benefits to evaluate different insurance policies. The consensus is that a policy with the same premium and a higher annuity is preferable. Life insurance has a very high irr in the early stages of the policy-usually more than 1,000%. Then, it will decrease over time. This irr is very high in the early stages of the policy because if you only pay the premium once a month and then die suddenly, your beneficiary will still receive a one-time benefit.

Another common use of irr is to analyse the return on investment. In most cases, the returns in the advertisement will assume that any interest payments or cash dividends are reinvested in the investment. If you don't want to reinvest the dividends but need these dividends as income for payment if the dividends are not assumed to be reinvested, should they be paid, or should they be left in cash? What is the assumed return of cash? Irr and other assumptions are especially important for instruments such as annuities because the cash flow of annuities can become complicated. Finally, irr is used in the calculation of mwrr.

Today, IRR has been widely used as an international method for calculating the utility and cost of investment choices. One of the reasons is that it not only considers the decisions of individuals and families but is also used to measure the net benefits and profits of social activities based on taxation and social costs.

2.3. Advantages and disadvantages of npv& irr in investment decision-making

As a method of project evaluation, NPV certainly has certain advantages and risks, so I analyzed the advantages and disadvantages of NPV separately. Let me first introduce the advantages: First, as a method of discounting cash flow, NPV can objectively measure the price of the project; second, NPV can measure the absolute wealth added value that capital projects bring to investors; third, NPV introduces risk factors into capital project decision-making through the lowest rate of return.

Therefore, in general, when projects are mutually exclusive, NPV can provide an effective basis for decision-making, and there will be no multiple NPVs. So next, this article will elaborate on the disadvantages of NPV: First, NPV ignores the rate of return of the project, which is not easy to make decisions; second, NPV cannot directly reflect the actual rate of return of investment projects from a dynamic perspective, and the calculation is more cumbersome; third, The discount rate is difficult to determine. In general, in the case of different project investment amounts, it is impossible to determine the project with the highest investment efficiency. These are the advantages and disadvantages of NPV.

Like NPV, the IRR method also has its own advantages and disadvantages. Next, I will elaborate on its advantages: IRR can link the income during the life of the project with the total investment, point out the project's rate of return, and facilitate it in the same industry. Benchmark investment yield comparison to determine whether this project is worthy of construction. The disadvantages of IRR are as follows: First, IRR cannot distinguish whether a project is an investment or financing; second, IRR cannot reflect the size of funds; third, IRR cannot distinguish the time series of funds. In general, IRR is a ratio, and it cannot be used alone. These are the pros and cons of IRR.

The above summarizes the advantages and disadvantages of IRR and NPV, and then I will compare them. In capital budgeting, many different methods can be used to evaluate projects. Each method has its unique advantages and disadvantages. Most managers and executives prefer to use percentages rather than dollar figures to observe the company's capital budget and performance. In these cases, they tend to use IRR or internal rate of return rather than NPV or net present value. However, using IRR may not produce the best results. IRR results are usually simple, which is why it is still commonly used for capital budgeting. But for any long-term project, with multiple cash flows at different discount rates, or projects with uncertain cash flows, in fact, for almost all IRR projects, IRR is not always an effective measure. This is where NPV comes in. The NPV method is inherently complex and requires assumptions at each stage. So NPV can be used to determine whether investments such as projects, mergers, or acquisitions will add value to the company. So in fact, both IRR and NPV can be used to determine the desirability of the project and whether it will add value to the company. One is used as a percentage, and the other is expressed as an actual cash figure. Although some people like to use IRR as a measure of capital budgeting, it does have problems because it does not consider changing factors, such as different discount rates. In these cases, it would be more advantageous to use the net present value. So, after the summary, NPV and IRR have their own advantages, but they need to be used in appropriate occasions and situations.

3. FISHER SEPARATION THEOREM

3.1. Introduction and history

Fisher's separation theorem is an economic theory. This theorem is named after Owen Fisher, a neoclassical economist, and professor at Yale University. He developed this theorem in 1930. It is published in his work interest theory. Owen Fisher (1867-1947) was an economist trained by Yale University. He made many contributions to neoclassical economics in practical theory, capital, investment, and interest rate research. Neoclassical economics regards the relationship between supply and demand as the main driving force of the economy. Fisher was a prolific writer: from 1912 to 1935, he produced 331 documents, including speeches, letters to newspapers, articles, reports to government agencies, notices, and books [10]. Together with interest theory, the essence of capital and income (1906), and interest rate (1907), it is a pioneering work affecting several generations of economists.

Fisher's works and theories have influenced many other economists and economic theories, including Modigliani Miller's theorem. Fisher's separation theorem assumes that given a perfect capital market, the company's investment choice is independent of its owner's investment preference, so the company should only be encouraged to maximize profits. In other words, in this theory, investment decision and consumption preference can be separated, but in fact, each shareholder has his consumption preference. They have different consumer preferences due to their age. For example, young shareholders will choose high-risk and large cash inflows. Middle-aged shareholders are more inclined to invest safely. The elderly will choose the projects with the least risk. Therefore, everyone has different consumption preferences. However, all the objectives of the company's investment are how to maximize the shareholder value of the company, so that the company and shareholders can obtain more benefits. This is precise because all the objectives are the same, but there may be differences because shareholders prefer consumer decision-making. Therefore, in order to maximize the company's value, Fisher's separation theorem assumes that in an effective capital market, the company's investment choice is separated from its owner's investment preference. In other words, the company should not care about the utility preference of shareholders for dividends and reinvestment. Therefore, the company's motivation is only to maximize profits. The theorem holds that it can be optimized by adjusting the capital market. Once the company value is maximized, the capital market can be used to meet the consumer preferences of investors. Therefore, the company should aim at the optimal production function and bring the maximum possible profit to shareholders. By ignoring shareholders' desire to maximize the value

of the company, the company will eventually bring greater long-term prosperity to managers and shareholders. This is the core goal of the theorem. Fisher's separation theorem is an important point of view, which is widely considered to lay the foundation for many financial theories.

3.2. The Irrationality of Fisher's Separation Theorem

I think this theorem is unreasonable in that it only exists in a perfect capital market, but the reality is that it is impossible to have a perfect capital market. Fisher's separation theorem emphasizes the following three key issues:

i. Separation of company investment decisions from representative initiatives (including shareholder propositions).

ii. The company's investment decision is independent of the decision.

iii. The company's investment value is separated from the hybrid methods available for investment financing (including debt, stocks, or cash consumption).

However, in real life, most companies not only consider profit when choosing investment projects. Many companies will underinvest when investing, and companies have to 4. abandon projects with a net present value greater than zero. Secondly, Fisher's separation theorem holds that "when choosing an investment, do not consider the attitude of the company or shareholders." This theory does not care about the wishes of shareholders, but only about the company's opportunities, but everyone has their own willingness to consume. Not everyone is pursuing the interests of the company, and more people may be more willing to pursue their own interests. Shareholders will consider risk aversion, worrying that excessive risk investment will increase the risk of the transfer of company control and the risk of bankruptcy. I think this is reasonable. Therefore, conflicts between shareholders are inevitable. This is the biggest irrationality of Fisher's separation theorem.

4. DISCUSSION

4.1. Neoclassical Economics

Neoclassical economics is a broad theory, which focuses on the relationship between supply and demand as the driving force behind the production, pricing, and consumption of goods and services. It appeared around 1900 to compete with early classical economic theories. The main assumption in early neoclassical economics is that the most important factor determining the value of products or services is the utility to consumers, not the cost of production. In other words, the first concern of consumers is to maximize personal satisfaction. This method was developed in the late 19th century based on the works of William Stanley givens, Carl Manger and Leon Varus. Neoclassical economic theory is the basis of modern economics and also supports the creed of Keynesian economics. Although the neoclassical method is the most widely taught economic theory, it has its critics. Critics believe that the neoclassical method cannot accurately describe the real economy. They insist that the assumption that consumers act rationally when making choices ignores the vulnerability of human nature to emotional response. Some critics also accuse neoclassical economics of inequality in global debt and trade relations, because the theory believes that labor rights and living conditions will inevitably improve due to economic growth. Followers of neoclassical economics believe that there is no upper limit on the profits that smart capitalists can obtain because the value of products is driven by consumers' perceptions. The difference between the actual cost of the product and the selling price is called an economic surplus.

However, this idea can be said to have led to the 2008 financial crisis. Before the crisis broke out, modern economists believed that there was no price ceiling for synthetic financial instruments because investors believed that the growth potential of the real estate market was unlimited. Economists and investors were wrong. The market for these financial instruments collapsed.

Finally, in general, neoclassical economics stipulates that the value of a product or service is often higher than its production cost. Although the classical economic theory holds that the value of products comes from the cost of materials plus the cost of labor, neoclassical economists believe that consumers' view of the product value will affect their price and demand. Finally, this economic theory points out that competition leads to the effective allocation of resources in the economy. Supply and demand forces create market balance.

4.2. Neuroeconomics

Besides,I conduct an extension on project evaluation. For instance, neuroeconomics.

For the method of project evaluation, I think it is not limited to the rational evaluation of the data model, but also consider that some investors will make irrational decisions. Such investors are reluctant to choose to follow the conventional forecasts of economic models. They tried to explain this problem from the perspective of neuroeconomics. Neuroeconomics attempts to link economics, psychology, and neuroscience to better understand economic decision-making. Critics of the rational choice theory say that in the ideal world, people will always make the best decisions to bring the greatest benefits and satisfaction to themselves. However, we do not live in a perfect world. We live in reality. People are

often influenced by external conditions and emotions and do not follow the correct choice in theory.

Similarly, the economist Richard Taylor pointed out that the assumption of human beings as rational actors is further limited. Taylor's psychological accounting thought shows that although all dollars have the same value, people value some dollars more. They may drive to another store. A $20 shopping can save $10, but they won't drive to another store. A $1000 shopping can save $10. Therefore, I think the best investment choice should not only consider the economic model but also consider personal preferences.

5. CONCLUSION

The research background of this paper is that how to weigh the advantages and disadvantages and maximize the interests of the company and shareholders is the goal of an investment. To solve this problem, this paper mainly expounds on the advantages and disadvantages of net present value (NPV) and internal rate of return (IRR) economic models in investment decision-making, as well as the irrational interpretation and analysis of the Fisher separation theorem.

According to my research, I draw four conclusions: 1. To better analyze reasonable investment decisions, investors begin to use the NPV method to consider investment decisions rationally. 2. The NPV method is determined by calculating the cost and income of each investment period. 2. There are some loopholes and defects in the net present value method in investment decision-making. To enable investors to obtain investment decisions more accurately, economists introduced the internal rate of return index. Internal rate of return is an index used in financial analysis to estimate the profitability of the potential investment. 3. Net present value and internal rate of return have their advantages, but they need to be used in appropriate occasions and circumstances. 4. Fisher's separation theorem is an economic theory. In this theory, investment decision and consumption preference can be separated. 5. So this article believes that this theorem is unreasonable, because it only exists in a perfect capital market, but there can be no perfect capital market in reality. 6. Expand neoclassical economics and neuroeconomics.

My future research plan will continue to study how to weigh the pros and cons to invest, find more effective methods to better avoid risks, and maximize the return on project investment. Secondly, the deficiency of this paper is that I did not find many practical cases to prove my argument, and only provided a small part of literature and data.

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