A Systematic Review of the Significance of the Development of Fisher's Model in Financial Analysis

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ABSTRACT
This paper is to help anyone who is not familiar with the Fisher model build a comprehensive understanding of the Fisher model. We reviewed the past papers, analyzed, and concluded some advantages and limitations of the Fisher model. We found that this model only functions properly under strong conditions like perfect market and other few conditions. Despite having limited usage, we can still see this model give us a good intro to financial analysis that describes a one-period linear consumption model.

Keywords: *Fisher Model, Fisher separation theorem, Powerlaw, Top-down Model, Bottom-Top model.*

1. INTRODUCTION

Fisher model is a limited linear model that provides information about one's consumption plan in a single period. This is a very basic model for anyone new to financial analysis. Understanding the Fisher model would help one understand the investments and other business tools better. This paper will provide information about the Fisher model by a historical introduction, some comparisons with other investment tools, implications of this model, and our analysis of this model. In the history part, we will provide information about the Fisher model itself. We also mentioned the scholars that have contributed to this model. In the comparison, we introduced the features of the Fisher model and compared the Fisher model with Power law, Bottom-top model, and down-top model. This paper provided an example illustrating the difference between Fisher Model and these models and concluded the differences. We suggest some implications of the Fisher model, including the Fisher Separation Theorem and its limitations and application in the real world. Examples and graphs are provided to assist the illustration. Finally, we provide our discussion and some benightment helping readers better understand the Fisher model, and we concluded. We hope we can provide a general understanding of helping the newcomers better comprehend this model, thus having a better financial analysis time.

2. THE HISTORY OF THE FISHER MODEL

About the history of the Fisher Model, from two directions, we have a brief introduction about who came up with this model, fisher model and fisher separation theorem, and how this economist put it forward, based on what economic phenomenon and economic theory. Also, we looked up some other economists who used the fisher model and fisher separation theorem to extend their point of view.

2.1. The first time that this model appeared in economics.

The theorem is named after American economist Irving Fisher, a professor at Yale University and one of the earliest neoclassical economists, who developed it in 1930 [1, 2]. Fisher's separation theorem is also known as the portfolio separation theorem.

Fisher's separation theorem states that the first thing that any corporation needs to do is to increase its present value as much as possible. The theory compared management's focus on productive opportunities with its

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shareholders' focus on stock market opportunities. The fisher separation theorem thinks that maximizing a company's benefits is the most significant responsibility for the company's management. Still, we will notice that the management's duty conflicts with the first goal of shareholders, maximizing their profits, which improves the return of sale shares and increases dividend payment as possible as they can. However, Fisher argues that once the corporation wants to succeed, the company must ignore the shareholders to go for maximum corporation value.

The portfolio separation theorem proves that the best investment decision is independent of consumer preference, which means that in the perfect market, those choices decided by management will not depend on the shareholders' preference.

Because there generally have one more shareholder in one company, and those shareholders all have different preferences, which means that they need to choose the best project to investment, and fisher model came up based on that thinking, aiming to invest based on maximizing present value, which means it can achieve maximizing shareholders' interests without thinking different shareholders' preference.

2.2. Different economists using fisher model

We find that an economist called Richard MacMinn wrote a book called The Fisher model and Financial Markets [2]. Richard MacMinn noticed that while the Fisher model had been used in several corporate finance texts to note the foundations of the net present value rule, e.g., (Brealey and Myers 1991) [3], it had not been developed further in textbooks as a perspective for students of the finance discipline. This work represents an attempt to articulate corporate finance from a common perspective and model. By generalizing the Fisher model to include risks, it is possible to exposit and prove the classic corporate finance theorems and to establish a common foundation for the discipline.

The Fisher model is generalized here along the lines first used by Arrow and Debreu, i.e., see (Arrow 1963) and (Debreu 1959) [4]. A simple two-date Fisher model is constructed in a framework with all risk-averse agents and risks. The risks are the contracts exchanged now and paid then.

The risk-averse agents exchange the risks and behave self-interested to maximize expected utility subject to any relevant constraints. Introducing stock to allow the transfer of money from now to then increases the dimension of the problem. Otherwise, it leaves the standard constrained maximization problem, so common in standard microeconomic theory, in place. The classic Fisher separation result is that the agent selects the scale of an investment project independent of any preferences for consumption now versus then. It follows from the notion that more is preferred to less, i.e., self-interested behavior.

The investment scale selected by the agent is also the scale that maximizes net present value, and so the classic Fisher separation result provides the foundation for that rule. The Fisher model has been extended here to include risks and risk-averse agents. So it is natural to consider how the self-interested proprietor or chief executive office will behave.

After specifying the compensation scheme, the chief executive officer has a decision problem involving selecting a portfolio of securities on a personal account and an investment decision on the corporate account. The corporate objective function, equivalently, the rule used by the manager in making decisions on a corporate account, follows as a separation result from this analysis in much the same way that the classic Fisher separation result did. For some compensation schemes, the corporate objective function maximizes current stock value subject to relevant constraints; hence, the analysis provides the foundation for the corporate objective function. What is more, it shows the connection between current shareholder value and net present value.

The analysis will show that the corporate objective function derived from this kind of analysis is not always current shareholder value. The compensation scheme will determine the objective function used by the manager. If the manager is compensated with stock options, then the objective function becomes the maximization of the value of the stock option package. The maximization of stock option value can result in the manager's acquisition of too much risk [2].

3. THE COMPARISON OF THE FISHER MODEL

This part analyses the comparison of the Fisher model and other investment models. The comparison reflects the advantages and disadvantages of the Fisher model and other investment tools like the top-down model and bottom-up model. The comparison advises the investors to use the combination of the models to get a more accurate result in estimating certain businesses. Thus, it could help investors to make decisions and let shareholders get more returns.

3.1. The Features of Fisher Model

Fisher's model is one of the linear models of small group communication proposed by B. Aubrey Fisher, the professor of communications at Utah University and author of many books based on small group communication and decision making [5]. Fisher model is a one-period model (t0 and t1), and it is certain about the future(t1). In addition, individuals could maximize their utility based on their consumption (allocation), and investment projects are independent and divisible. Under

the perfect and complete market, the Fisher Separation Theorem states, that consumer preferences and investment decisions can be separated. Because investors would choose the project with a higher return, the optimal investment program is the same for all individuals. Although using the Fisher model can solve some problems, it has many limitations. The Fisher model can only be used under a very strong hypothesis, the perfect capital market (PCM). For example, In the PCM, the interest rate of loans and savings must be the same, which is impossible in real life. The difference in the interest rates will cause borrowers and depositors to make different decisions, in which the investment decision and the consumption decision cannot be separated.

Other investment models will be used for financial analysis to predict investment projects more accurately.

3.2. Comparison of top-down model and bottom-up model

When evaluating a new business opportunity for which no private sales data yet exists, top-down modeling enables business financial analysts to make predictions about the specific opportunity based on the size of the new market and forecasts about how much of that new market they will be able to to cover [6]. Top-down modeling is useful when predicting the market share of a new product and its impact on the present market. In addition, this model can also be used for further forecast. The top-down model separates the big problem into details and solves them gradually. It can help finance business finance analysts make investment decisions with a little adjustment in some potential factors. However, it has its limitations. Using a top-down model may not be possible to break a problem into a set of smaller problems, and it will be more complicated to analyze a project. Government-funded projects, for example, cannot be broken up. The government's decision must act upon all other parts of the construction. The government, as the main body, decides the completion of the project. If the project is separated, the project cannot be completed because of the loss of the main body, which is the government. Similarly, there is a bottom-up model based on the plenty of data in the project. The bottom-Up Model identifies and resolves the smallest problems and then integrates them to solve the bigger problem [7]. However, it needs more time and manpower to get results. This approach is normally used to prepare a sound financial budget based on actual results, inside knowledge, and future expectations. Due to its resource insensitivity, its use in forecasting is normally limited to one to three planning cycles in a year [6].

3.3. Comparison of Power Law

Another model is power laws. It is the most promising numerical analysis method used in financial models. It is like the mathematical functions to describe the proportional movement between two assets. For example, when the circle's radius doubles, the circle's size increases to four times. Power laws are used in corporate financial forecasting models to describe returns from internal business activities [2]. Companies use this technique to demonstrate long-term profitability trends and baseline returns on profitability levels under the influence of significant external events. This technique helps internal financial analysts understand the benefits associated with inputs when building such predictive models. The understanding gained from this approach is used to guide resource allocation, capital purchases, marketing, and other types of internal investment business decisions.

3.4. Conclusion of Different Investment tools

According to the analysis above, we could witness that every model has its advantages and disadvantages. The top-down model can separate the large problem into small problems to get the best solution. Similarly, the bottom-up model needs numerous data, and it could get a more accurate result. Although using Fisher separation theory and Fisher model has some limitations, it still can help us with theoretical analysis. Perfect and complete capital markets allow shareholders to separate consumption and investment decisions. Each person can choose to take on as much risk as possible or distribute their wealth over time. The financial analysts could use the combination of the models to make investment decisions.

4. THE IMPLICATION OF THE FISHER MODEL

We talk about the Fisher model. Fisher separation theorem is proposed by Irving Fisher (1867-1947). It points out that in the perfect capital market (PCM), corporate investment decisions and consumption decisions of economic entities can be separated from each other. Investors can freely adjust their consumption according to their preferences without being affected by firms' investment decisions. This model is used in different situations for economic research and as a cornerstone in corporate finance [8]. For example, it justifies the principle of corporate optimal investment decision (for instance, the use of NPV rule).

4.1. The separation theorem and corporate shareholder decision

Specifically, according to Fisher's separation theorem: the decision-making of corporate shareholders (consumers) involves two separate steps:

(1) The first step is to let the holding company follow the goal of maximizing stock value to make business decisions (investment/ dividends);

(2) The second step is to borrow or lend in the capital market to convert the dividend stream provided by the company into a consumption stream that can meet their preferences. Then, according to the tangent point of the indifference curve of different shareholders and the market opportunity line, the optimal consumption decision of each shareholder is obtained.

4.2. The Application of separation theorem in Business World

In addition, the separation theorem has been proved widely applied in capital structure, dividend pay-out, and other corporate activities in the real world. For instance, since Fisher's separation theorem suggests that firms' investment decision is independent of their financing decision, Modigliani and Miller (1958) show that in a frictionless market, the firm's value is not affected by financing decision as well. DeAngelo and Masulis (1980) relax the assumption of no tax and show interest tax shields determine the optimal capital structure. In terms of dividend payout policy, Fisher's separation theorem shareholder risk and consumer preferences can be satisfied in the financial market through lending and borrowing. While the signaling theory proposed by Myers and Majluf (1984) argues that investors can only judge whether the investment decision can produce sufficient cash flow through the company's dividend policy and therefore evaluate the value of stocks. Empirically, Li and Lie (2006) find corporate dividend pay-out ratio and change decisions depend on the dividend premium in the stock market. James (1999) examines and finds agency cost problems can be reduced in the family business with more efficient investments.

4.3. The Dividend Pay-out policy

According to the signaling theory [9], investors can only judge whether the investment decision can produce sufficient cash flow through the company's dividend policy and, therefore, evaluate stocks' value. If the company can continuously and stably pay dividends, it means that it is in good operation, and the investment can generate sufficient cash flow. However, the improvement of corporate governance and information quality during the past decades has reduced the degree of information asymmetry between investors and companies. It has become a new trend for listed companies to pay fewer dividends (Figure 1). The world tech industry leaders, Google, Amazon, and Facebook, are more likely to use their available capital to invest in high-growth projects rather than distribute to shareholders.

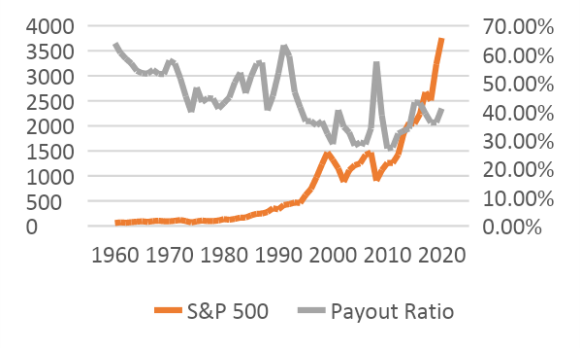

Figure 1. S&P 500 price and dividend pay-out history from 1960 to 2020

Gugler [10] finds that the investment of non-dividend pay-out companies in new technology R & D is much higher than that of dividend companies. In addition, for companies that do not pay dividends but increase R & D investment, their stock P/E ratio and P/B ratio are generally higher than those with more dividends. Companies that exercise growth opportunities through R&D development can buy back the shares held by shareholders at a high price to protect the interests of shareholders. Thus, the total value of existing shareholders increases with the rise of stock prices, which is consistent with Fisher's theory.

4.4. The separation of management and ownership

Fisher separation theorem suggests that all shareholders agree on value-added investment decisions with the aim of profit maximization. However, it has been argued that the separation of management and ownership may not necessarily lead to efficient investment in firms due to the existence of agency costs issues.

On the one hand, managers may be motivated by opportunism and make decisions according to the standard of maximizing personal interests (such as empire-building incentives in the short term). The company's investment may deviate from the optimal level. For instance, in emerging economies with relatively large state ownership, managers have incentives to direct companies to achieve inefficiency objectives for political purposes [11].

To make the objectives between shareholder and manager more consistent, it is necessary to design a series of corporate governance mechanisms to supervise and motivate the managers to reduce the agency cost and curb inefficient investment. In addition, the stock option is widely used as a form of managers' compensation, which enables managers to participate in corporate decision-making, profits distribution, and risk sharing as shareholders work diligently for the company's long-term interests.

4.5. The failure of Fisher's separation theorem

Suppose there are transaction costs in the capital market, leading to the creation of financial intermediation services. In that case, this will receive service commissions by taking deposits at a lower interest rate and lending at a higher interest rate. The difference between the lending rate and borrowing rate leads to the failure of Fisher's separation theorem. As you can see in the following figure, shareholder 1 uses the lending rate to invest at point B, and shareholder 2 uses the borrowing rate to invest at point A. Without a consolidated interest rate, the shareholders will not hand over operational decisions to the managers.

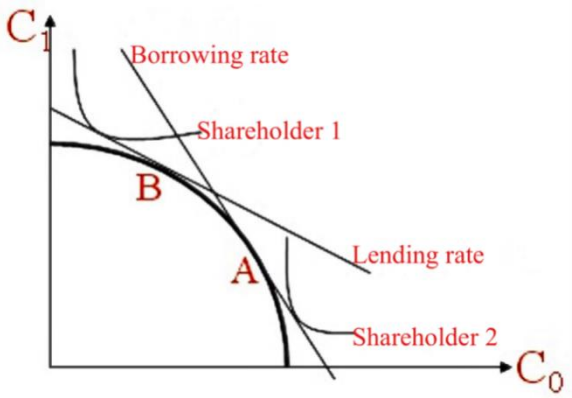

Figure 2. Use and treatment scheme of loan interest

6. CONCLUSION

As we have covered, the fisher model is an introduction model to the financial market. It is a one-period linear model that helps investors adjust their consumption plans to maximize profit. Brought by Irving Fisher, the Fisher model is applicable under strong conditions like the perfect market. It is also the foundation of companies' finances or value estimating of a stock. The Fisher separation theorem, a ramification of the Fisher model, helps investors analyze the risk and reward of serval investment projects. The Fisher model is straightforward to understand, thus being used in various situations, usually in microeconomics.

In this paper, we introduced the readers to the history and some implications of the fisher model. We also compared the fisher model with other investments. We think our results are basic. It is well enough for anyone who wants to research the Fisher model to scan throughout the paper. We think we will provide one a good understanding of the Fisher model and its limitations and advantages.

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