Proceedings of the 8th International Conference on Economic Management and Green Development
DOI: 10.54254/2754-1169/132/2024.18446

Research on Capital Asset Pricing Models: Literature Review and Possible Optimization

Yiran Liang[1,a,*]

[1]*Accounting College, Harbin University of Commerce, Harbin, Heilongjiang Province, 150000, China*
a. haikquu_813@163.com
**corresponding author*

Abstract: The Capital Asset Pricing Model (CAPM) assists investors in understanding the relationship between asset returns and risks, so as to provide the basis for investment decisions. Developed based on portfolio theory and capital market theory, CAPM mainly studies the relationship between the expected return rate of assets and risk assets in the security market, and how the equilibrium price is formed. This paper aims to discuss the basic principle and theoretical basis of CAPM, its use methods and specific functions, as well as its advantages and disadvantages in the process of use, and summarizes its optimization possibilities in terms of functions. The paper reviews and outlines the theoretical framework and practical techniques of CAPM, alongside the latest findings in research. Then, this paper extends the topic to the advantages and disadvantages of the functions found so far in the research and use process, finds effective frontier areas combined with related research articles, and proposes some possible optimization methods. In addition, in view of the different situations, this paper introduces the concept of CAPM.

Keywords: Capital Asset Pricing Models, Functional Optimization, Pricing Theory, Pricing Calculation.

1. Introduction

The Capital Asset Pricing Model (CAPM) stands as an iconic and well-known framework utilized by economists and investors to explore the connection between market risk and anticipated returns. Developed progressively in the 1960s, the model has consistently sparked debate among professionals. Rooted in the foundational theories of asset portfolio and capital markets, this field primarily explores how securities markets balance the expected returns of assets against their risks, leading to the formation of equilibrium prices. It serves as a cornerstone of pricing theory in contemporary financial markets and is extensively applied in investment decision-making and corporate finance. This paper will provide a concise overview of the evolution of the CAPM and its relevance to contemporary stock markets, followed by an exploration of potential enhancements to the model.

The paper focuses on the historical development of CAPM and its current role in global stock markets. Additionally, it will explore potential enhancements and future advancements for CAPM. Currently, investors have the capability to engage with international stock markets, including but not limited to NASDAQ and the Shanghai Stock Exchange. Before the creation of CAPM, investors lacked clarity on how risk influenced a company's cost of capital. Over time, pioneering work by

DOI: 10.54254/2754-1169/132/2024.18446

leading economists led to the integration of CAPM into financial theories, offering investors enhanced methods for forecasting the risks and potential returns of their stock investments. This paper will outline the historical evolution of the CAPM. Unfortunately, the development of models is always slower than the growth of the market. Most models are out of date, and so is CAMP. This paper combines theoretical analysis with empirical analysis to provide suggestions on the optimization of CAPM functions today and the possibility of continued use.

Since 1958, Modigliani and Miller came up with the famous Modigliani Linnimiller Model, which inspired Mr. Treynor, an MBA candidate [1]. During his studies at Harvard, he authored a pioneering paper titled "Market Value, Time, and Risk," which laid the groundwork for the CAPM. His research caught the attention of Miller and Modigliani, who provided guidance on his work. Treynor further developed his ideas at the Massachusetts MIT, where he refined his concepts into the paper "Towards a Market Value Theory of Risk Assets." Simultaneously, William Sharpe was also researching portfolio theory. Around 1960, Modigliani suggested that Treynor and Sharp exchange their notes. Sharpe approved of Treynor's ideas but was surprised that Treynor had not published his work. In 1964, the CAPM was introduced by William Sharpe. This model was subsequently refined over time by John Lintner, Jan Mossin, and Fisher Black. For his contributions to economics through the development of CAPM, Sharpe was awarded the Nobel Prize in Economics in 1990.

Unexpectedly, Treynor did not receive the recognition he deserved. Treynor commented, "I believe Sharp will publish my paper, so why should I bother publishing it myself?" Nevertheless, Treynor's substantial contributions will forever be acknowledged.

2. Fundamental Theories

2.1. Fundamental Theories

The CAPM derives from the Markowitz model. It acknowledges that the problem of inefficient portfolios identified by Markowitz remains consistent [2], with Markowitz's assumptions seamlessly integrated within the CAPM framework.

1. Investors generally pursue greater wealth, viewing it as a source of utility. Since wealth depends on the rate of return on investments, it follows that utility can be effectively seen as linked to the return rate.

2. Investors are aware beforehand that the distribution probabilities of returns on investments remain consistent.

3. Investment risk is determined by the variance or standard deviation in the rate of return on investments.

4. Key determinants of investment choices include anticipated returns and associated risks.

5. Investors adhere to the principle of seeking optimal benefit, meaning they opt for securities offering higher returns when faced with equivalent risk levels; conversely, they select securities with minimal risk for a comparable return.

Additional assumptions of CAPM:

6. Funds without limit may be borrowed or lent at the risk-free discount rate, denoted as R.

7. In the market, there exists a single efficient frontier because all investors concur regarding the expected probability distribution of returns for any given security.

8. Every investor operates with an identical timeline for their investments, which spans only a single period.

9. Every investment within a portfolio can be divided endlessly, allowing for the inclusion of fractional shares.

10. Taxes and transaction fees are minor considerations.

DOI: 10.54254/2754-1169/132/2024.18446

11. All investors enjoy prompt and complimentary access to sufficient information about the market.

12. Inflation remains unchanged, and there is no alteration to the discount rate [3].

13. Investors share identical financial anticipations, meaning they hold uniform expectations regarding the expected returns, standard deviations, and covariances among different securities.

Initially, the assumption is that investors act rationally and allocate their investments in line with the Markowitz model's principles, choosing portfolios that lie along the efficient frontier. Additionally, it is presumed that capital markets operate with perfect efficiency, free of any impediments that might deter investment activities.

2.2. Calculation Method

In a balanced capital market, the price of risk remains uniform, and any investment altering the market composition has a consistent marginal impact, meaning the reward for each additional unit of risk introduced is identical. Based on the definition of β, this scenario leads to the formulation of the capital asset pricing model when the market is in equilibrium:

$$E(ri) = rf + im(E(rm) - rf) \quad (1)$$

The CAPM can be characterized as follows:

1. The anticipated return on a specific security is comprised of two elements: a risk-free rate and a risk premium, which serves as the reward for assuming risk.

2. The magnitude of the risk premium is influenced by the beta value. As the beta increases, so does the level of personal safety risk, necessitating greater compensation.

3. Beta quantifies the systemic risk associated with individual securities, without offering any risk compensation for risks that are not systemic [4].

The variables can be defined as follows:

$E(r_i)$ - denotes the anticipated yield of asset i.

R_f - represents the rate of return that is considered risk-free.

β_{im} - quantifies the inherent risk associated with asset i, known as the beta coefficient.

$E(r_m)$ - signifies the expected return of market m.

The market risk premium, $E(r_m) - R_f$, refers to the excess return of the market over the risk-free rate.

A valuation model that accounts for the presence of an asset, like a stock, as a form of capital. Imagine the stock market: an investor may allocate their funds across the entire market through a diversified investment vehicle, thereby eliminating non-diversifiable risks. Despite ongoing fluctuations in the economy and stock market, investors are likely to engage in risky ventures that are not diversifiable. Consequently, the returns anticipated by these investors exceed those of risk-free investments.

Assume that the average expected return in the stock market is denoted by E(rm), and the risk-free rate is represented as rf. For any given asset, such as a corporation's stock, the expected return is represented by Ri. Given that the market's risk-free rate is Rf, the risk premium for this particular asset is calculated as E(ri) - rf. The CAPM illustrates how the excess return of an asset correlates with the excess return of the market. This is expressed by the equation $E(r_i) - r_f = \beta_{im}(E(r_m) - r_f)$, where β represents a fixed coefficient known as the asset's beta. The coefficient β indicates how responsive an asset's return is to shifts in the market, serving as a measure of the asset's systematic risk that cannot be mitigated through diversification.[4] With the value of β known, the appropriate discount rate for calculating the asset's present value can be established. This rate, representing the

DOI: 10.54254/2754-1169/132/2024.18446

anticipated return on the asset or any similar risky asset, is calculated as follows: the risk-free rate (Rf) plus β times the market risk premium (Rm-Rf).

3. Functions of CAPM

The primary applications of the capital asset pricing model include valuing assets, budgeting the cost of capital, and allocating resources.

3.1. Asset valuation and Capital cost budget

When assessing the value of assets, the CAPM primarily serves to evaluate if a security's market price has been inaccurately set due to errors.

The CAMP posits that the expected return on a security is determined by the sum of the risk-free rate and the security's risk premium, which is calculated using the beta coefficient:[5]

$$E(ri) = rF + [E(rM) - rF]\beta i \quad (2)$$

With access to both the market portfolio's expected rate of return and the security's risk factor βi, it becomes possible to compute the expected rate of return, E(ri), for security i within the context of market equilibrium. Conversely, the market anticipates a specific value for the future income stream (comprising dividends and the final price) produced by the security. This anticipated value is linked to the initial market price of security i and its expected rate of return, E(ri), expressed as:

$$E(ri) = \frac{E(The\ dividend + The\ ending\ price)}{The\ beginning\ price} + 1 \quad (3)$$

In a state of equilibrium, both E (ri) values mentioned previously must be identical. Consequently, the initial price at equilibrium should be set as:

$$\text{The equilibrium beginning price} = \frac{E(\text{The dividend} + \text{The ending price})}{1+E(ri)} \quad (4)$$

By comparing the actual market price with the initial equilibrium price, any discrepancy indicates that the market price was incorrectly determined. Consequently, any price determined in error should necessitate a correction. This insight enables investors to generate superior returns. When the current market price falls below the equilibrium price, it indicates that the asset is undervalued, making it a prime candidate for purchase. Conversely, if the security's price exceeds its equilibrium, it is advisable to sell and reallocate the funds into other undervalued securities.

When treating the final price in the equation as the present value of forthcoming cash flows, the equation can also help ascertain if errors drive the security's market price.

3.2. Resource allocation

A key use of the CAPM in allocating resources involves choosing individual securities or portfolios with varying β coefficients. This strategy is based on market trend forecasts, aiming to maximize returns or minimize exposure to market risks [6].

The graph depicting stock market trends indicates that the beta coefficient measures how reactive a security or portfolio is to shifts in the market. Therefore, in periods where there is strong certainty about the onset of a bull market, it is advisable to choose securities or portfolios that possess a high beta coefficient. The genuine value of stocks as an investment choice is often underappreciated because their actual returns exceed anticipated returns. This indicates that stocks are reasonably priced and are expected to reach a fair valuation in the future [7]. Shares considered underpriced or overpriced influence investor interest in stock transactions, thereby setting the market price for these

DOI: 10.54254/2754-1169/132/2024.18446

shares [8]. High-beta securities are designed to enhance market yields and increase returns significantly. Conversely, in a bear market scenario, it is suggested to opt for securities or portfolios with low beta coefficients, which help minimize potential losses triggered by market downturns.

4. Significance

CAPM leads to a straightforward insight: the sole cause of superior returns for investors is the choice to allocate capital to riskier stocks. Undoubtedly, this model holds a predominant position in contemporary financial theory.

However, calculating the beta value within the CAPM presents the greatest challenge. During their analysis of stock returns from the New York Stock Exchange, the US Stock Exchange, and the NASDAQ market over the period from 1963 to 1990, Eugene Fama and Kenneth French discovered that beta values failed to sufficiently account for the stock returns throughout these years. There appears to be no clear correlation between a stock's beta and its returns over short periods. The evidence suggests that the CAPM may not be functioning properly in actual stock market scenarios.

Indeed, numerous research papers challenge the accuracy of the CAPM; nevertheless, it remains a popular tool among investors. While forecasting the behavior of specific beta stocks can be challenging, investors generally accept that portfolios composed of high-beta stocks exhibit greater volatility compared to market prices, irrespective of market trends upward or downward. Conversely, portfolios with lower-beta stocks tend to have milder fluctuations than those observed in the overall market.

This is crucial for investors, especially fund managers, who adjust their strategies based on market trends. During downturns, they can target stocks with lower beta values, and in rising markets, opt for stocks with a beta above 1.

Small investors need not calculate beta values for individual stocks or major markets, as many financial websites provide these values, according to the opinion of a consulted author.

The CAPM model is widely recognized and adopted within the field of valuation theory. Investment professionals employ this model for capital budgeting and various other financial determinations. Legislative authorities apply it to oversee and set the fee structures for fund community members; meanwhile, rating organizations utilize it to assess the performance of investment managers. Nevertheless, the model primarily focuses on examining how the returns of securities are influenced by shifts in the market portfolio, while neglecting additional variables.

5. Limitations of CAPM in the process of use

5.1. Model limitations

Firstly, the assumed conditions of the CAPM fail to align with actual circumstances: [9] On the one hand, the full market hypothesis considers the actual circumstances, including transaction fees, information expenses, and taxes, all of which contribute to market incompleteness. On the other hand, Homogeneity Expectation Theory suggests that while investors' expectations may vary widely, the SFML data actually represents a range. Additionally, the hypothesis that the borrowing rate mirrors the risk-free rate is contradicted by the reality that the borrowing rate is actually higher. What's more, it is presumed that the pay rate follows a normal distribution, although this may not accurately reflect actual conditions. Secondly, CAPM is typically relevant only to capital assets. Human assets, on the other hand, cannot always be bought or sold. And then, the investor is primarily concerned with the future fluctuations in the security's price, whereas the estimated coefficient β solely reflects its past volatility. Finally, in practical terms, neither truly risk-free assets nor market portfolios may exist.

DOI: 10.54254/2754-1169/132/2024.18446

5.2. Influencing factors

There are many factors that influence the results, the most significant of which are: firstly, the escalation in the price level; secondly, the variations in risk aversion; and finally, the adjustment in the stock beta value.

6. Conclusions

The CAPM, while imperfect, approaches risk assessment from an appropriate perspective. It offers a framework for assessing risk magnitude, assisting investors in determining if the extra returns justify the risks taken. This concept is inherent in traditional Marxist economic theory, which posits that asset prices oscillate around their intrinsic values and are finely adjusted in specific correlation. Upon analyzing the CAPM model alongside alternative frameworks, one can affirm its logical consistency, although it omits certain risk elements. This omission highlights that various risk factors influence the market, and the assumptions of the CAPM often do not align with actual stock market behaviors. The model frequently falls short due to its inability to consider numerous potential risks. Conducting further studies on additional risk factors might enhance the realism of the CAPM.

At present, this paper's consideration of the capital asset pricing model is not comprehensive, the relevant literature review is not enough, and the research status analysis is not deep enough. The professional knowledge learned in the undergraduate period is still general, and the methods adopted are also relatively simple. The current viewpoint may not be thoroughly analyzed, thus conducting a more futher analysis through future study and research is necessary, enabling more comprehensive and in-depth exploration and continuous improvement.

The discrepancy between the assumptions of the CAPM and real market conditions may introduce additional risk factors. Due to the widespread adoption of options and futures, not every investor behaves rationally or possesses identical information. Moreover, a significant number of investors are influenced by emotions, and when this group becomes large enough, it can impact market directions.

China holds the position of being the world's second biggest market, both overall and individually. However, its investment regulations prohibit short selling. This restriction might influence personal investment decisions and entail consideration of additional risk factors.

As a rational model with extremely strict hypothetical conditions, the CAPM model still presents many problems in its practical application in the stock market [10]. Given the weakness and efficiency of the Chinese stock market, and the fact that stock prices reflect only historical information rather than fully valid market assumptions, the following optimizations are possible:

1. Use several indicators to assess the risk of assets.
2. Seize the opportunity to invest in new upstream materials.

For example, in the current development of the industry, on average, the downstream development of China's panel industry is relatively fast, and the development of upstream raw materials is relatively large.

3. Focus on policies and conduct appropriate background checks for investment projects.

For instance, in technology-intensive sectors such as the panel industry, which significantly influences the prices of derivative products like mobile phones, investors should rigorously assess background information and conduct risk assessments.

4. Be flexible with rules and adapt strategies as needed.

DOI: 10.54254/2754-1169/132/2024.18446

References

[1] Xu TY,(2021)"Study on the Capital Asset Pricing Model(CAPM): literature review and possible improvements".In:3rd International Conference on Global Economy and Business Management (GEBM 2021),Suzhou,109-113

[2] Elton, Edwin J., and Martin J. Gruber. "Modern portfolio theory, 1950 to date." Journal of banking & finance 21.11-12 (1997): 1743-1759.

[3] Markowitz, Harry,(2006)"The mean value of portfolio choice and capital market --Analysis of Variance" , People's Publishing House,Shanghai

[4] Yang Lirong.(2013). "Corporate finance".Science Press.Beijing

[5] The relationship between return and market value of common stocks. (1981, March 1). Science Direct. Retrieved November 26, 2021, from https://www.sciencedirect.com/science/article/abs/pii/0304405X81900180

[6] Yuan Y,(2020),"Analysis of the application of capital asset pricing model" ,"The Public's Guide to Investing" ,NO.19 30-31

[7] Eduardus Tandelilin,2010 Portofolio dan Investasi: Teori dan Aplikasi Edisi 1. Yogyakarta: Kanisius;

[8] Dini Dinahastuti, Jajang Badruzaman and Euis Rosidah, Wursan,2019,Asian Journal of Economics, Business and Accounting, "Effect of Capital Asset Pricing Model on Stock Prices",13(3): 1-11

[9] Wu XQ,(2009),"Securities Investment",China Renmin University Press,Beijing

[10] Zhang YC,2022,"Validity of Capital Asset Pricing Model(CAPM):Empirical Research on the Panel Industry in China",In:The 6th International Conference on Economic Management and Green Development (ICEMGD 2022),San Francisco, California, USA,374-380