An Analysis of the Applicability of Pricing Models in the Chinese Stock Market

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Abstract: The stock market in China has an important position in the world, but it has not been able to find a pricing model suitable for the market. This paper reviews the history and development of various pricing models, analyzes relevant research on their application in the Chinese stock market, and discusses the applicability of various pricing models. It is found that the applicability of the capital asset pricing model (CAPM) in China is low; the applicability of the Fama-French three-factor model and the Fama-French five-factor model is better than CAPM, but there is significant controversy over the advantages and disadvantages of the two. It is also found that the applicability of the five-factor model may have regional differences in different markets, and there may be differences in redundant factors in different markets. It is proposed that future research should obtain more accurate market data, explore new influencing factors, and build a pricing model more suitable for the stock market in China by combining the characteristics based on more advanced data analysis technology.

Keywords: CAPM, three-factor model, five-factor model, Chinese stock market

1. Introduction

In 1952, portfolio theory and the concept of risk were put forward for the first time, which laid the foundation for modern investment theory [1]. By optimizing investment portfolios, it enables investors to achieve the optimal balance between risk and return to a certain extent. In the following decades, different pricing models have emerged to try to explain the pricing of assets and the return on investment. In the 1960s, the capital asset pricing model based on the portfolio theory was developed [2]. CAPM is a linear single-factor model composed of market risk factors. CAPM establishes the relationship between expected return and risk and puts forward that return and risk are consistent, which is also widely recognised in modern investment theory. In 1993, the Fama-French three-factor model was put forward. On the basis of the CAPM model, market value factor and book-to-market ratio factor were added as compensation for the factors that were not reflected in the market risk factor in CAPM [3]. In 2015, they further expanded the three-factor model and put forward the Fama-French five-factor model, which has become a relatively mainstream pricing model in the world [4].

With the acceleration of China's market opening to the outside world and the promotion of capital market reform, pricing models widely used in the world have been gradually applied. Many scholars

have conducted empirical analyses of the applicability of various pricing models. Due to the particularity of the financial market, the practice of pricing models in China may be different from those in other markets. China implemented the new regulations on asset management in 2022, and the income of wealth management products has been poor in the past year, so it is particularly important to find a pricing model suitable for the market in China. Due to the unique characteristics and challenges, the application of different pricing models is facing limitations and challenges, so it is necessary and of practical significance to explore the applicability of various pricing models in China. This paper summarizes the development history of pricing models, analyses the typical models and their applicability in China, and looks forward to the future trend of pricing models so as to provide readers with a more comprehensive perspective and way of thinking.

2. Historical Development of Pricing Model

2.1. Portfolio Theory

Markowitz portfolio theory links returns to risks. The expected return represents the return, the mean represents the expected return rate, and the variance and covariance represent the risks of a single asset and a portfolio respectively. Therefore, a mean-variance (covariance) model is proposed. Based on the theory that investors are risk averse and prefer returns, Markowitz put forward Efficient Frontier, a portfolio set that can satisfy two conditions: maximum expected returns and minimum expected returns. Due to its idealistic assumptions, portfolio theory itself is greatly limited in practice, and its assumptions of market efficiency are often not valid in real life. However, this theory is still of great significance to modern investment theory.

2.2. CAPM

Markowitz put forward the concept of risk but did not quantify the relationship between risk and return. Sharpe and Lintner put forward the CAPM. They believed that when the market reaches equilibrium, risk determines the price of assets. The model considers that the expected return rate of assets is directly proportional to the market risk premium. On the basis of Markowitz, Sharpe and others introduced risk-free assets and recombined it with portfolios on the Efficient Frontier to form the Capital Allocation Line, thus obtaining the optimal portfolio. The model contains a market risk factor, and the relationship between factors is linear. The equation is as follows:

$$E(R_i) = R_f + \beta_i \times [E(R_m - R_f] \tag{1}$$

Where $E(R_i)$ represents the expected return rate of assets, R_f is the risk-free rate of return, and $E(R_m)$ is the expected rate of return of the market.

β_i measures the systemic risk of assets, which represents the relationship between assets and markets. The calculation equation of is as follows:

$$\beta_i = \frac{\text{cov}(r_i, r_m)}{\sigma_m^2} \tag{2}$$

CAPM puts asset pricing theory into practical application, which has had a far-reaching impact on finance, but it still has many limitations. CAPM model is based on many assumptions, but assumptions are often difficult to hold in the real world. Secondly, the stock market cannot be effectively explained by a single market risk factor. In the follow-up empirical research, the effectiveness of CAPM has also been questioned. Some studies claim that CAPM cannot predict the accurate expected rate of return. On the basis of CAPM, some scholars have also made extensions

and improvements. ICPAM and CCAPM proposed by Merton and Lucas are also extensions of CAPM. Ross proposed Arbitrage Pricing Theory (APT) in 1976. APT needs fewer assumptions than CAPM, and its fundamental assumption is that there is no arbitrage opportunity in the securities market. It is proposed that asset prices are driven by multiple factors, rather than a single market risk factor [5]. APT has been recognized by many scholars since it came out, and factor model has gradually become the most significant research method in the asset pricing field.

2.3. Fama-French Three-factor Model

With the deepening of research, scholars found that β in CAPM cannot interpret the difference between different stock returns, and β should not have a linear relationship with returns. Fama and French selected the stock data from the NYSE, Amex, and NASDAQ from 1963 to 1990 as samples and found that market value and book-to-market ratio can explain the differences that CAPM cannot explain [6]. In 1993, Fama and French tested stock returns by time series regression method and put forward the Fama-French Three-factor model, which explained excess returns jointly by market risk factor, market value factor, and book-to-market ratio factor. The equation of the model is as follows:

$$R_{it} - R_{Ft} = \alpha_i + b_i(R_{Mt} - R_{Ft}) + s_i SMB_t + h_i HML_t + e_{it} \tag{3}$$

Among them, SMB_t (small minus big) represents the market value factor, which measures the difference between the small market value portfolio and the large market value portfolio. HML_t (high minus low) represents the book-to-market ratio factor that measures the difference between a high book-to-market ratio portfolio and a low book-to-market ratio portfolio. $(R_{Mt}-R_{Ft})$ is a market risk factor, which is the same as the factor in CAPM and is used to measure market changes. $R_{it}-R_{Ft}$ is the excess return of the portfolio.

In the follow-up research results, the Three-factor model can better explain the rate of return than the CAPM model. Market risk factors can reflect the systemic risk of stock; market value factors and book-to-market ratio factors reflect the unique non-systematic risk of the company. Fama-French Three factor model is a widening of the traditional CAPM single-factor model, and it is also a relatively mainstream pricing model now. After that, scholars also try to add new factors to better explain the benefits. For example, in 1997, Carhart also expanded the Three-factor model and added momentum factors to form the Carhart four-factor model [7].

2.4. Fama-French Five-factor model

The emergence of the Fama-French Three-factor model makes the revenue better explained, but there are still problems that cannot be explained. Fama and French improved the original three-factor model by adding a profitability factor and an investment factor to the model and creating a new Fama-French Five-factor model. The equation of the model is as follows:

$$R_{it} - R_{Ft} = \alpha_i + b_i(R_{Mt} - R_{Ft}) + s_i SMB_t + h_i HML_t + r_i RMW_t + c_i CMA_t + e_{it} \tag{4}$$

Among them, RMW_t (robust minus weak) stands for profitability factor, which is the difference between high profitability portfolio and low profitability portfolio. CMA_t (conservative minus aggressive) represents the investment factor, which is the difference between the portfolio of conservative investment style companies and the portfolio of aggressive investment style companies.

The follow-up research of scholars found that the applicability of the Fama-French Five-factor model has great regional differences, and its performance in different regional markets is quite different. There may be redundant factors in the model. Scholars are also exploring new factors through practice in order to have a better explanation for the benefits. As the second largest economy

in the world, market in China often has a significant impact on the global market, and its importance is obvious. Therefore, it is very important for the market to find a pricing model with high applicability.

3. Applicability in China

China's stock market developed late, and it is dominated by a public-owned economy. Markets tend to be more volatile, and there is strong state interference. Shi Donghui used CAPM to test the Shanghai market and found that the Shanghai market has high systemic risk and that there is a nonlinear relationship between systemic risk and return. There are non-systematic risks that cannot be eliminated, which shows that CAPM cannot explain the benefits well [8]. Sun Gang tested the constituent stocks of the SSE 30 Index as samples and also found that there are irrevocable non-systematic risks, which also proves that CAPM has poor applicability to China's market [9].

Since the advent of the Fama-French Three-factor model, Chinese scholars have tried to verify it in China's market. Huang Xingwang et al. used it to test the applicability of China's A-share market and the result showed that, compared with the American market, there was a significant scale effect in China's market, but its value effect was not significant [10]. Yang Kun and others studied the volatility of stock returns in the Chinese A-share market. After studying, they found that the scale effect and value effect of the A-share market were significant. This significance is particularly evident in small companies and high-value investment portfolios. It also verified that the three-factor model has the same explanatory power under different grouping situations [11].

According to Liu Yuanyuan's research, the model has better explanatory power than the conventional CAPM. The author found that the return rate of large-scale companies (the top 30% of market value) is higher than that of small-scale companies (the bottom 30% of market value), which is contrary to the scale effect. In February, small companies have higher yields than big companies. The author thinks that the reason for this phenomenon may be the unique Lunar New Year in China. Investors may choose to sell stocks for consumption before the New Year, and then buy investment positions after the New Year, which causes the upward trend of the market [12]. Li Hui et al. studied the stock markets of China and the United States between July 1994 and June 2013 to examine how the three-factor model applied differently in the two markets. In contrast to the US market, the China A-share market's market risk factor has a higher impact, the scale effect is more explicative in small-cap firms, and the book-to-market ratio factor has a little impact. he author thinks that this may be because Chinese citizens prefer to believe in the development prospects of national policy orientation rather than individual companies [13]. In conclusion, the three-factor model has stronger applicability in China compared to CAPM, and has been recognized by scholars. Among them, market risk factors and market value factors have stronger explanations.

In 2016, Zhao Shengmin and others found that the three-factor model is more appropriate for China's stock market than the five-factor model with profitability factor and investment factor, and that profitability factor and investment factor may be redundant factors, using monthly A-share yield data from Shanghai and Shenzhen stock markets from January 1995 to December 2014 [14]. Liu Lanlan et al. tested the Fama-Macbeth cross-sectional regression method. The investment factor and market value factor were found to be significant when the five-factor model was verified, however the other three factors were weakly significant and had just little explanatory power [15]. Li Zhibing et al. verified that the five-factor model has greater explanatory power than CAPM, the three-factor model, and the Carhart four-factor using monthly data from the China A-share market from July 1994 to August 2015 [16]. Guo et al. tested China's stock market with a five-factor model and concluded that market risk factors, market value factors, book-to-market ratio factors, and profitability factors all have good explanatory power for the excess returns of China's stock market, but the explanatory power of investment factors is weak [17]. Zhang Xindong et al. made an empirical analysis of the

monthly earnings data of A shares from 1999 to 2017 and found that adding profitability factors to the three-factor model can greatly improve the explanatory power of the model. The investment factor cannot contribute to the explanatory power, and it is considered that the investment factor is a redundant factor [18]. Ouyang Hongbing uses turnover rate to measure liquidity based on the five factor model. He added liquidity factors and established a six factor model. It was found that the six factor model is more effective in explaining income than the three factor and five factor model [19].

4.   Discussion

CAPM's applicability has been proven to be low in China's market, while the applicability of three-factor and five-factor models is still inconclusive. However, some Chinese scholars believe that investment factors are redundant factors in China's market, which is different from the conclusions obtained by Fama and French in the global market. China's market is complex and huge, and scholars also try to add new factors according to the characteristics of China's market in order to achieve better explanatory power. China's market is highly volatile, and there are strong irrational factors in the behaviour of market participants, which may lead to the inability of existing pricing models to accurately predict asset price fluctuations. The institutional environment of China's market is different from that of the international market, with relatively high government intervention and a relatively low opening degree of the capital market, which may have an impact on the asset price formation mechanism. Future research needs to consider new influencing factors such as China's market situation, stock liquidity, fixed asset ratio, irrational factors, etc., and also consider many factors such as the market institutional environment in China, etc., and use more data sources and more advanced data analysis techniques to obtain more accurate market data and build a pricing model that is more suitable for the market in China based on these data.

5.   Conclusion

Fama-French five-factor model is still a relatively new research field, but its advantages over the three-factor model are not obvious in both the global market and China's market, and the redundancy of investment factors found in China's market is also worthy of scholars' consideration. Because of its uniqueness, the explanatory power of various models in China's market is bound to be different from that in the global market. The future research direction should be to develop new pricing models according to their characteristics. With the growth of computer power in the future, scholars will be able to make more effective use of stock market data for research and find out more effective factors for China's market so as to achieve a better interpretation effect. There may be some limitations because this paper cannot collect all the research on China's market and there is no empirical analysis. With the increase of related research in the future, after considering other influencing factors, it may get better results and explore a model with higher applicability.

Acknowledgment

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