

The Recent Progress and State-Of-Art Applications of CAPM Model

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Abstract. Conventionally, CAPM model is widely used to estimate the value of securities, but it is not efficient in Chinese securities market due to the non-systematic risk. Therefore, this paper aims to analyze the development of CAPM multi-factor model and multi-effect Asset pricing (e.g., the Fama French multi-factorial model). Primarily, this paper introduces the background and function of CAPM model. Afterwards, it is pointed out that more factors need to be considered to improve the performance of CAPM model. Therefore, Fama-French models of three-factor and five-factor are demonstrated. The paper analyses the evolution of CAPM multi-factor models and indicates that the CAPM model is unable to well explain the long-run premiums of small-size company stocks in Chinese market. Finally, the paper discusses the limitation of this research and look forward the further research. These results shed light on the future development of financial pricing models.

Keywords: CAMP Model; Fama-French model; Multifactorial Model; Big Data.

1. Introduction

According to modern financial theory, Markowitz proposed the mean-variance portfolio theory and believed that investors liked the mean value and hated the variance [1]. The CAPM model proposed by Sharpe, Lintner, Mossin, et al., measures the gains obtained by assets as securities market lines [2-4]. Based on the model, the CAPM model only explores the β return, which concludes that the reasonable return of the asset only includes the β return, both regard the α return of the asset as a pricing error. However, since the 1980s and 1990s, a large number of scholars have found that a phenomenon in the market deviates significantly from CAPM, naming this phenomenon as a market vision. As time goes by, more and more scholars have had more and more in-depth research on this non-systemic risk, and have gradually managed to improve the practicability of CAPM model in the field of asset pricing.

Generally, the interior of the company or specific existence in an industry, and can be eliminated through other means. In fact, the CAPM model is built on the Markowitz model, which has following assumptions:

- Investors all follow the principle of dominance (i.e., when investing two stocks with the same risk level, choose the party with relatively large investment return; in the two stocks with the same return rate, choose the party with relatively small investment risk level).
- The more assets the investors have, the better.
- Investors can analyze the probability distribution of the investment return rate as a normal distribution.
- The volatility of the return ratio is used to evaluate the size of the investment risk.
- Expected return ratio and investment risk are the two priority indicators in the investment strategy.

With this in mind, the premise assumptions of the CAPM model can be declared as follows:

- There is no inflation situation in the capital market with a fixed discount ratio.
- Investors can borrow funds without limit (the cost of borrowed funds is calculated at the risk-free discount rate).
- Other expenses incurred in the investment are negligible (including tax expenses).
- Information in the capital market can be shared to every participant free of time.
- Investors have the same investment expectations

- All investors participating in the market have the same investment period (only one investment period)

The CAPM model is calculated as follows:

$$E(R_i) = R_f + \beta_i E[(R_m) - R_f] \quad (1)$$

With this in mind, the premise assumptions of the CAPM model can be declared as follows:

Where R_i refers to the expected yield of the assets; R_f refers to the risk-free interest ratio, which is usually expressed by the tax interest rate for one year; β_i refers to the coefficient of the kind of assets. The β coefficient can indicate the size of the system risk of investment a certain asset. In the CAPM model, it is used to explain the relationship between the yield of certain assets and the market combination of the market; R_m refers to the expected yields expected in the market in the market; $E[(R_m) - R_f]$ indicating that the market is expected to reduce the risk interest ratio.

However, since the asset pricing research in China has developed short, there is no effective theoretical model. Previously, scholars have been trying to test the applicability of CAPM model in China in the 1990s. Other scholars are also trying to use more and updated sample stock data to study the applicability of CAPM models.

The rest part of the paper is organized as follows. The Sec 2 will introduce the CAPM model. The Sec. 3 will continuously discuss the Fama-French model based on the CAPM model. Afterwards, the limitations and future prospects will be demonstrated in Sec. 4 and 5. Eventually, a brief summary is given in Sec. 6.

Table. 1 Results of the regression for typical stocks selected from [8]

Stock name	Ping A Bank	Vanke A	ZTE	OCT A	TCL Group	Zoomlion
α	0.0036	0.0010	-0.0007	0.0036	0.0021	0.0061
	(0.0024)	(0.0026)	(0.0032)	(0.0037)	(0.0032)	(0.0034)
β	0.9504	1.0711	0.6994	1.1302	0.9407	1.1711
	(0.0688)	(0.0742)	(0.0938)	(0.1079)	(0.0938)	(0.0970)
<i>Residual standard error</i>	0.0324	0.0350	0.0441	0.0508	0.0441	0.0453
R^2	0.51	0.53	0.23	0.37	0.35	0.45
F	190.9	208.1	55.62	109.8	100.6	145.7

2. CAPM Model

Yang and Zheng notes selected 50 stocks in Shanghai A share market. They intercept sample stocks in the research range from September 2014 to September 2019, and then did the regression analysis by comparing the stock yield and composite index yield. The result is that more than half of the sample stock β coefficient between 0.8-1.2 [5]. However, in the analysis of the determination coefficient of the 50 selected sample stocks, the majority of the sample stocks (the proportion of systemic risk in the total risk of the sample) was less than 0.5, and although some stocks were between 0.5 and 1.0 in the experiment, they were only slightly more than 0.5 and far less than 1.0. Meanwhile, Shi stated that the positive linear relationship is not exited between stock risk and return, also the systemic risk has poor impacts on the relationship [6]; Chen and Song drew similar conclusions on the furniture industry based on CAPM model [7]. Xiao and Hu selected 193 component stocks in CSI 300 market and conducted regression analysis that the sample stocks of 39.9% is more than 1, indicating that the market yield is higher than stocks so investors are not all risk avoid [8]. However, according to the estimated results, 76.68% sample stocks' R^2 are less than 0. 5, indicating poor optimal model fit.

Table. 2 Return and risk regression results from [9]

Variable	Coefficient	Std. Error	T-Statistics	Prob.
<i>C</i>	-0.208889	1.208271	-0.172883	0.8684
<i>BETA</i>	0.386157	1.401513	0.275529	0.7922
<i>R-squared</i>	0.012495	<i>Mean dependent var</i>		0.115241
<i>Adjusted R-squared</i>	-0.152090	<i>S. D. dependent var</i>		0.726520
<i>S. E. of regression</i>	0.779813	<i>Akaike info criterion</i>		2.552793
<i>Sum squared resid</i>	3.648650	<i>Schwarz criterion</i>		2.572653
<i>Log likelihood</i>	-8.211172	<i>Hannan-Quinn critter.</i>		2.418843
<i>F-statistics</i>	0.075916	<i>Durbin-Watson stat</i>		0.311295
<i>Prob(F-statistics)</i>	0.792153			

Chen and Feng obtained a similar conclusion based on the random selection of individual stocks on the stock market [9]. In Table 2, it can be seen that the coefficient of the risk premium of individual stocks is about 0.386, but the fit degree is very small, and the β coefficient and the risk premium of individual stocks failed the T and F test, so the relationship is not significant. Based on the above analysis, we can know that the applicability of the β coefficient obtained from the data estimation is not strong, which indicates that the implementation of the model is not sufficient.

Similarly, the study on stock portfolios in CSI 300 found that, as illustrated in Fig 1, the average value was 0.82, the minimum value was 0.72 and the maximum value was 0.9. The CAPM model had high goodness of fit and showed better applicability. Therefore, if considering the applicability of CAPM to individual stocks should consider more factors.

Zhou and Ma randomly selected 100 stocks in Shanghai stock market during the three years (2017-2019) [10], and used time series and cross section test methods respectively. The results showed that the effectiveness of CAPM model in Shanghai stock market was not supported. Xiao empirically tested the applicability of CAPM model in China's securities market [11], and finally concluded the theory that there is only weak applicability in Shanghai market.

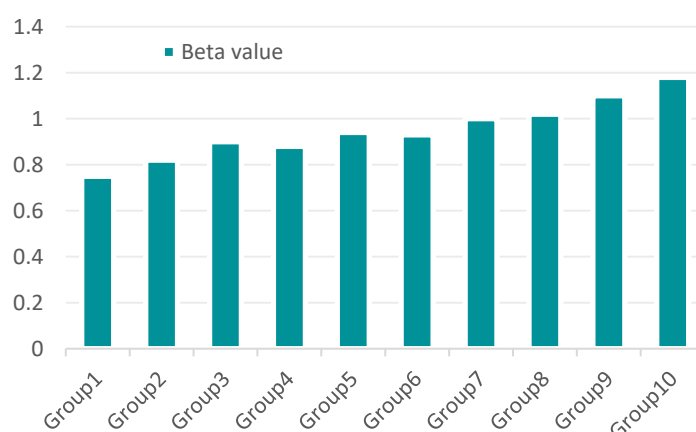


Figure 1. Statistical chart of beta value of stock portfolio [9]

3. Fama-french model

As a matter of fact, there are also many scholars dedicated to improving the application of the CAPM model so that it can more reasonably and accurately reflect the real capital market. Based on studying the common shares of the New York Stock Exchange and NASDAQ-listed stocks between 1963 and 1990, Fama and French show that market risk does not effectively depict the average cross-section return of American stocks [12]. They add the company's market value and the book market value ratio to the market index, the results show that, the company's market value, B / M can explain

the risks that are not reflected in CAPM, the failed risk exposure is compensated by the excess return of the stock. Some subsequent studies have shown that the Fama-French three-factor model does not very well explain the average yield of stocks related to investment style and expected profitability. Later in the test, Yang et al. found that the investment of more factors could bring an increase in explanatory strength, but the interpretation effect of HML factors for the asset pricing model is insufficient, which is redundant in the model [13]. Jiang also selected the monthly data of gem listed companies in China from January 2017 to June 2019, and verified this view by comparing the regression results of CAPM and FF three-factor model [14]. The scale effect and the ratio effect of book market value of FF three-factor model were almost not significant. Aharoni found that the company's investment style was significantly negatively correlated with the company's expected rate of return [15]. Novy-Marx noted a positive correlation between the company's expected profitability and expected stock returns [16]. Fama and French formally proposed the Fama-French five-factor model in 2013, adding the company's investment style factor and profitability factor on the basis of the Fama three-factor model [17].

Meanwhile, many scholars are committed to the application and improvement of CAPM model. Some of the empirical research conclusions show that over a long period of time, the total income of small-scale enterprises is much higher than the results calculated by CAPM. In 1981, financier Banz first found that the yield of small companies was always higher than that of large companies, and named this phenomenon "small-cap stock vision" [18]. Subsequently, Chan and Chen considered the scale to overflow price as a prospect effect, and the profit prospects of large and small businesses are more sensitive to changes in the economic situation [19]. Fama and French of the University of Chicago then retested the theory, drawing American data from 1963 to 1990, and the final results repeated the vision. Chinese scholars Wang Wei and Zhou Yu paid early attention to the scale premium of small companies [20]. They found that small companies performed well compared with large companies throughout the year, with Yu Jian and Chen Xiaohong found through research that China's stock market is dominated by individual investors [21], due to information asymmetry and volatility. Xiong, Tu and Ma tested the Chinese market based on the five-factor model and found that the company size was one of the important factors affecting stock returns and showed a significant negative correlation [22]. In the meantime, negative correlation with the company premium, it was found that the smaller the company is likely to receive a premium return exceeding the expected rate of CAPM. Therefore, the use of CAPM model cannot well explain the long-term premium phenomenon of small-scale companies.

4. Limitation

He and Hu in China's Shanghai and Shenzhen markets between the linear relationship of stock portfolio value and yield [8]. According to the analysis, it is found that it is more obvious, but still show high yield stock portfolio bear lower risk, high risk stock portfolio yield is relatively low, that the market mechanism is not mature, there are still speculators involved.

The CAPM model is an IRR under systemic risk based on simplified assumptions about market and investment behavior, making the model ignore many real-world complexities. Nevertheless, the argument that capital asset pricing mechanisms are worthless seems too extreme. First, each model is a simplification of reality, which is often necessary for a useful model, meaning that the limitations of CAPM model are similar to those of other useful models. Moreover, the performances of the model are determined both from the perspective of the assumptions and regulations of usability of the model specification.

Contemporarily, the stock market is still manipulated by the inside information, and major shareholders occupy the rights and interests of minority shareholders from time to time. Liu and Yu studied the trading volume reaction in the market after the announcement of the financial annual report [23]. It is found that there was an extraordinary trading volume before and after the announcement of the financial annual report. Even during the announcement of the financial annual

report, the market trading volume still has a significant impact on the trading volume of individual stocks, indicating that the phenomenon of "following the trend" in the Chinese stock market is serious. This shows that investors in China's stock market are far from getting rid of the "big slip" mentality.

Within the scope of the research literature, the number of stocks generally selected in the literature is relatively small-, and the-time span is relatively small, resulting in inconsistent research results. The research scope of the literature is often dozens of more than a hundred stocks, the research time span is often a few months, failed to use the larger amount of data tends to get results in the opposite direction.

5. Future prospects

In securities trading, the amount of investment income is not only affected by systemic risk, but also affected by non-systemic risk. For example, stock listed companies may produce credit risk, financial risk and operational risk, which are part of the non-systemic risk, and will have an impact on the stock price changes. The existing research reference should be limited to the technology. Besides that, the existing research reference is small-, and the-time span is limited. Combining large data can explore more meaningful factors or lifting factor prediction accuracy. At the same time, big data and machine learning technology are also excessively fitted, i.e., exactly accurate description, and ignore the value of trend. Such problems will continue to optimize with continuous improvement of technology levels.

6. Conclusion

In summary, this paper introduces the CAPM model and then take a more in-depth discussion of its application. Based on the analysis systematic risk accounts for a small proportion of total risk and CAPM models should incorporate more considerations. The paper described the evolution of CAPM multi-factor model, and pointed out that small-size firms are more likely to earn a premium over the CAPM expected rate of return. The main limitation of recent research is the different between Chinese securities market and western securities market (e.g., speculation and herding phenomenon) are serious in Chinese securities market. These results offer a guideline for more comprehensive and accurate valuation of risky assets.

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