

Research on the Comparison of Asset Pricing Models Applications in Emerging Markets

Pengzhao Lyu^{1,*†}, and Shirley Peng^{2,†}, Lihong Zhong^{3,†}

¹Business School, Imperial College London, London, United Kingdom

²Sauder School of Business, University of British Columbia, Canada

³Computer Department of Zhuhai College, Jilin University, China

*Corresponding author: shirelyy@student.ubc.ca

† The authors contributed equally

Abstract. Fama et al.'s factor model better describes the changes in the data of the cross section concerning stock yields than the capital asset pricing model. The stock data about the emerging markets (1992-07~2022-8) are adopted for the purpose of checking this three-factor model by Fama et al. in emerging securities markets. It proves that in the emerging securities markets this three-factor model is valid, and makes an empirical study on the stability of the regression coefficient of this kind of three-factor model and the forecast ability of the pattern. The research provides a certain basis for portfolio selection, prediction, decision-making and performance evaluation, and have theoretical value and application value.

Key words: asset pricing; emerging market; Fama French three factor model; capital asset pricing model.

1. Introduction

There are many asset pricing models. At present, there exist three-factor and five-factor models by Fama French which are mainly used. The three factor model believes that the return ratio on the portfolio is affected by the premium of the marketplace risk, this marketplace value scale and P/E rate. The model of the three factors is developed in American mature capital market to build the relationship between risk factors and capital market returns. In the emerging marketplaces, Yu, Morck & Yeung [1] contended that the market risk should be more eminent. Currently, China and other emerging stock markets are not mature; additionally, the system risk leads the marketplace, which is known as the "policy market" by the public. In emerging markets, can Fama French three factor model accurately predict these stocks?

The risk of stock investment has always been the focus of the academic and business circles, and people hope to avoid investment risk as much as possible while obtaining income. Markowitz's portfolio theory points out that systematic risk and unsystematic risk constitute the total risk of stocks. System risk is related to the market as a whole. Stock returns will change with the overall trend of the market, which will inevitably cause fluctuations to each stock in the market, that is, market systematic risk; from the initial single factor pattern to this five factor pattern mentioned in this article, from the single marketplace risk factor to these factors such as firm dimension, market book rate, profitability, invest capacity, along with marketplace premium, the asset pricing model has went through a long-standing advancement in the theory. On the foundation of the portfolio theory by Markowitz's, Sharpe (1964) proposed CAPM (Capital Asset Pricing Model) [2], which establishes the thought that the asset income originates in risks taken by assets, has become the foundation of the theory concerning the financial marketplace pricing. The CAPM aims to price securities in a balanced marketplace, since in a balanced capital marketplace, competition is adequate, demand is equivalent to supply.

Most investors are just in the optimal portfolio and the best consumption; moreover, and the securities price is determined on the basis of this. Roll [3] queried the CAPM's test consequences and raised the APT (arbitrage pricing theory); Stattman [4] discovered that if the book value rate is higher, the stock yield of the firm will be higher, too; Banz [5] discovered that the explanatory force of the

stock yield rate is that the company's marketplace value is stronger than the premium for the marketplace risk. By means of previous achievements for reference, French and Fama made an elaborate dissection of factors that impact the stock yield rate in America. They recognized that the company's whole marketplace value, book to market rate, etc. could greatly interpret the gaps in the stock return rate concerning the cross section. By comparison, they recognized that the existing three-factor model is much more explanatory than CAPM. Of course, it is not ideal. Mark Carhart [6], on this basis, supplemented the factor of income momentum and set up one four-factor pattern, in order that the income variability could be interpreted. French and Fama [7] enhanced the early three-factor pattern, added two elements of profitability and investment mode, and built the five-factors Prime model, in order that the distinction in cross sectional stock returns can be better explained.

2. Data and method

This paper tests whether the three factor model is valuable through academic and empirical studies.

Academic research on the explanation of the theory concerning the capital asset pricing and the combination of different research results. Compare the similarities and differences between the Fama French three-factor and capital asset pricing models, explore the improved part of the Fama French three-factor pattern in the capital asset pricing model and its impact on the forecast, and verify it in the empirical analysis. The empirical research part focuses on the emerging market stock marketplace; also, it compares the three-factor model applicability in emerging countries. In this paper, research samples are selected for the purpose of studying rationality and realistic possibility. These final samples include the stock data from July 1992 to August 2022, and have constructed a portfolio for experienced researches. Carry out the regression analysis and stability examination, analyze the impact of scale elements and book price earnings rate elements on emerging market stock yields, and whether capital asset pricing model (CAPM) can explain emerging markets

3. Theoretical model

3.1 Single factor model

The premise of CAPM is that the capital market is free from any defects, investors can borrow at risk-free interest rates when they are risk averse, and can not affect the stock price through trading. The proposed model originates in portfolio theory by Markowitz, William F. Sharpe's (1964) paper and Lintner (1965) and Mossin (1966)'s paper with the identical conclusion, which brought forward one single factor model for the CAPM asset pricing together. The specific settings are:

$$R_i - R_f = \alpha_i + \beta_i (R_M - R_f) + \varepsilon_i \quad (1)$$

In which, R_i means the return ratio of the i th stock; R_f indicates the risk-free return ratio; R_M denotes the return ratio of the marketplace portfolio, β_i represents the marketplace risk, β_i The greater the i , the greater the expected return on the asset. On the contrary, if β_i If i is below 1, it means a more marginal yield. On condition that this model is established, α_i needs to be near 0, β_i I ought to be positive, when the market of the stock rises, β_i The greater the value, the greater the return. Because this model shows the correlation between the an anticipated returns and the marketplace risk, it is also called the single element generation pattern. Scholes, Jensen and Black [8], Blume and Friend [9], Fama and MacBeth [10], along with other researches back up the conclusion from CAPM[11].

3.2 Three factor model

With the continuous improvement of China's capital market, CAPM based asset pricing theory has been widely used in both investment practice and financial theory research in the 81 era. However, in practice, CAPM has also met the drawbacks which are hard to demonstrate through its verification.

Accordingly, a multitude of the financial experts make an effort to relax the hypothesis of CAPM for the purpose of seeking one theory concerning the practical asset pricing. Fama French (1992, 1993, 1996) showed that the overall marketplace value, book value rate and marketplace excess return rate β_i Value is more convenient to interpret the distinction in stock yields, and they look on the added return as one CAPM model β_i Value does not to show the partial compensation; additionally, the model is named three-factor model that is also the most broadly employed model in the asset pricing and an extension of the arbitrage pricing pattern. Could be defined as:

$$R_i - R_f = \alpha_i + \beta_i * (R_M - R_f) + s_i SMB_t + h_i HML_t + \varepsilon_i \quad (2)$$

Among them, R_i represents the anticipated yield (investment portfolio or individual stocks; R_m refers to the portfolio yield of the marketplace (marketplace value weighted); HML means the book to marketplace rate; SMB means the overall marketplace value. There are the three factors to interpret the return of the portfolio, that is to say, R_M , R_f , HML and SMB; meanwhile, the coefficient β_i . If h_i and s_i are just true values but not the estimated values, they both need show the total variations in the anticipated returns. For portfolios or individual stocks, α_i should equal zero. The relationship between stock returns is also shown by one or more elements.

3.3 Five factor model

During the last two decades years, this three-factor model has already been checked by armies of scholars and discovered that the overall excess returns couldn't be interpreted by the whole three factors. Fama and French, in 2014, regulated the pattern once again, supplemented the two factors of operating profit margin and investment; they built one five-factor model and its expression is as below:

$$R_i - R_f = \alpha_i + \beta_i * (R_M - R_f) + s_i SMB + h_i HML_t + r_i RMW + c_i CMA + \varepsilon_i \quad (3)$$

In which, the RMW means the operating profit margin; furthermore, the CMA means the variable for the investment. Since the other factors are convenient to manage except for momentum factors, and the interaction between the factors are also able to be separated, so the momentum factors are not supplemented[12].

Because of its birth, CAPM has been broadly employed in the capital marketplace and has underwent numerous effectiveness tests in practice, however, a few scholars have raised many doubts about the test results of the CAPM, including β_i . The coefficient has an insufficient explanatory force so as to interpret the earnings price rate influence, book value ratio influence and other anomalies, resulting in many new interesting thoughts. Simultaneously, the hypothesis for the model are relatively harsh, which is not possible to occur in practice; β_i It is hard to assess the coefficient correctly; additionally, it is inevitable to affect the estimation effect when estimating the future with past data. On account of the shortcomings of CAPM, the scholars they turned to multifactor model study. As for the three-factor model, there exist three dominant elements which decide the variance from the stock yield ratio, that is to say, the total marketplace element, the element of the corporation value, along with the scale element. The research shows that three factors in America stock marketplace own an increased explanatory force to changes in stock returns, and the three factor model also has an increased explanatory force to other developed nations and novel marketplace nations, including China. Though the three-factor model is broadly realized by the financial practice community, it is an empirical model. Although value effect and scale effect are found in the marketplace, there exists no related theory for interpreting the reason for the impact. In the model, the risk factors are summed up on the foundation of the previous literature and empirical consequences, particularly the market to net worth rate and corporation dimension. The factors are lack of the powerful academic support[13]. The behavioral school believes that, Market to net worth ratio and company size factors don't denote the risk, however, they mean the bias of the investor behavior. From one single factor model to the five-factor model, from one single factor marketplace

risk to covering corporation dimension, the capacity of the investment, the premium of the market, the marketplace book rate, the profitability, etc

3.4 Model evaluation

The model of the asset pricing has underwent a long-standing advancement theoretically and empirically. Domestic scholars have also done a lot of research on indicator replacement on the foundation of the Fama French three-factor pattern in combination with the practical situation of Chinese stock marketplace. As an illustration, they have adopted the three-factor pattern with a view to researching the value premium of Chinese stock marketplace, and discovered that China own a similar value premium as well as the scale premium to the developed nations. While employing three factor model with the aim of researching the asset pricing problem, scholars found that they could not interpret the origin of the stock returns. The test consequences of this five-factor model on the basis of China's A-share samples indicate that, in comparison to the three-factor pattern, the five-factor pattern owns a powerful explanatory force. After adding investment mode and profitability factors, the five-factor model shortens the explanatory force of the marketplace book rate factor on the stock yield rate; Particularly for the model of the novel factor investment, the regression consequences indicate that the model of the radical investment is going to fulfill the higher stock yields compared to the backward-looking investment model that is contrary to the research results of Fama and French in respect of the American stock marketplace, namely, the effect of investment model is adverse in China's stock marketplace, otherwise investors have obvious investment opportunities, and they are more willing to buy the stocks of companies with radical investment models. For the sake of the novel element profitability, the consequences of the regression indicate that the coefficient of its sensitivity is statistically obviously positive, showing that the profitability impact emerges in the China's stock marketplace, which corresponds to the studies consequences by Fama and French in relation to the U.S. stock marketplace, namely, highly profitability consist with the highly stock returns. In view of the existence of value premium, scale impact, investment mode impact, together with profitability impact in China's stock marketplace, the Fama French five-factor pattern is more integrated for China's stock market. Synchronously, while the trade volume premium couldn't be interpreted by CAPM and three factor models, nor by the short-run reversal impact of stock yields, the extended pricing model is effective

Explained, which indicates that the five-factor pattern is primarily applicable in the China's marketplace.

4. Data selection and Source

All the data used in this article comes from emerging markets from 1992 to 2022. By selecting the specific factors, namely SMB, HML, RMW, CMA and MKT, the database is constructed.

Besides, two regressions are constructed for the sake of CAPM, the three-factor and the five-factor models. The dependent variable is portfolio excess return, Port -RF. The three-factor pattern tested the significance of HML and SMB. The five-factor pattern tested the significance of the two additional coefficients, RMW and CMA.

5. Results

According to table 1, the results are as follows: (1) Market Excess Return and SMB are positively related to returns, however, the rest of the factors, namely HML, RMW and CMA are passively associated to returns. (2) As to the three-factor pattern, the β of HML is significant at 1% significance level, however, after adding two extra elements; as to the five-factor pattern, it is not significant at any significance level. (3) As for the five-factor pattern, the β of RMW is not important at any level. however, the β of CMA is important at the level of 1% significance. (4) The adjusted R square in the

five-factor pattern is bigger than that of the three-factor pattern, which means the five-factor pattern explains returns more accurately.

Table 1. Results of Regressions with Different Candidate Factors on the Portfolio Returns

| | Dependent variable: Portfolio 1 Excess Return | | |
|-------------------------|---|----------------------------|-----------------------------|
| | CAPM | Three Factor | Five Factor |
| Market Excess Return | 0.936*** (0.020) | 1.010*** (0.010) | 0.995*** (0.012) |
| SMB | | 0.994*** (0.030) | 0.984*** (0.030) |
| HML | | -0.059** (0.027) | -0.035 (0.032) |
| RMW | | | -0.038 (0.046) |
| CMA | | | -0.109*** (0.036) |
| Constant | -0.107 (0.124) | -0.225*** (0.063) | -0.190*** (0.066) |
| Observations | 362 | 362 | 362 |
| R ² | 0.854 | 0.965 | 0.966 |
| Adjusted R ² | 0.854 | 0.964 | 0.965 |
| Residual Std. Error | 2.332 (df = 360) | 1.151 (df = 358) | 1.139 (df = 356) |
| F Statistic | 2,110.144*** (df = 1; 360) | 3,256.810*** (df = 3; 358) | 1,997.297*** (df = 5; 356) |
| Note: | | | *p<0.1; **p<0.05; ***p<0.01 |

6. Conclusion

First of all, this paper gives a detailed description of the CAPM and Fama French three-factor model; next, several researchers have studied the model with three factors by Fama French. These results show that that model is mainly used to predict mature capital markets, and the prediction ability of emerging markets still needs to be improved.. On this basis, the necessity of model applicability test on the emerging market is proposed. As the emerging market can offer greater returns to investors due to their rapid growth, this paper selects this as the research object. Next, it is empirically studied in this article that the applicability of CAPM and Fama French three-factor pattern in the emerging marketplace based on the stock trading data and financial annual report data of listed companies related to the emerging market from 1992 to 2022, and draws the conclusions through the analysis of regression results.

Overall, this paper conducts regression analysis on emerging markets by using three-factor and five-factor models, separately; and through the results of the comparative analysis, this paper believes that the five-factor pattern is more explanatory compared to the three-factor model. The general financial asset pricing theory is very helpful for analyzing the real world. Its value lies in providing a benchmark for understanding the reality, as a benchmark for analyzing asset pricing, and providing one foundation for the study about the theory of the behavioral financial asset pricing. As an illustration, the BAPM model is developed from the CAPM. On condition that there exists no ordinary theory of the financial asset pricing, the study about the behavioral financial asset pricing could not be implemented. Because the early model couldn't interpret the price determination of all assets, in the subsequent advancement of the ordinary theory concerning the financial asset pricing, we need lay stresses on how to improve the capability of interpreting the determination in relation to the asset price. The research shows that the asset pricing is affected not merely by micro elements, including the corporate governance and the determination about the firm boundaries, but by a few macro

elements. Recently, a few scholars have researched the correlation between the financial crisis and asset pricing, the volatility of the asset price, together with the monetary policy. Though macro elements are supplemented, they are not profound. Accordingly, in the follow-up advancement of the theory, many more micro and macro elements which impact the asset prices could be considered to improve the explanatory force of the pattern on the asset price determinations.

Reference

- [1] Morck, R., Yeung, B. & Yu, W. (2000) The information content of stock markets: why do emerging markets have synchronous stock price movements? *Journal of financial economics*. 58 (1), 215–260. doi:10.1016/S0304-405X(00)00071-4.
- [2] Sharpe (1964) Capital asset prices: A theory of market equilibrium under conditions of risk. *Journal of Finance*, 19, 425-442.
- [3] Roll, R.A. (1977) A critique of the Asset Pricing Theory's Tests. *Journal of Financial Economics*, 4, 129-176.
- [4] Stattman, D. (1980) Book Values and Stock Returns. *The Chicago MBA: A Journal of Selected Papers*, 4, 25-45.
- [5] Fama, E. F., and French, K. R. (1993). French, 1993, Common risk factors in the returns on stocks and bonds. *Journal of Financial Economics*, 33(1), 3-56.
- [6] On Persistence in Mutual Fund Performance, Mark M. Carhart, *The Journal of Finance*, Vol. 52, No. 1. (Mar., 1997), pp. 57-82., *The Journal of Finance* is currently published by American Finance Association.
- [7] Fama, E. F., and French, K. R. (2016). Dissecting anomalies with a five-factor model. *The Review of Financial Studies*, 29(1), 69-103.
- [8] Black, F., Jensen, M. and Scholes, M. (1972) The capital asset pricing model: Some empirical tests. In: Jensen, M.C., Ed., *Studies in the Theory of Capital Markets*, Praeger, New York, 79-124.
- [9] Friend, I. and Blume, M.E. (1975) The Demand for Risky Assets. *The American Economic Review*, 65, 900-922.
- [10] Fama, E.F. and Macbeth, J. (1973) Risk return and equilibrium: Empirical tests. *Journal of Political Economy*, 71, 607-654.
- [11] Cui Jin, Yin Xia, Huo Qiuju Research on the Improvement of CAPM Model in China's Capital Market *China Assets Appraisal*, 2020, (05): 60-66
- [12] Fama, E. F. and French, K. R. (2015a), A Five-factor Asset Pricing Model, *Journal of Financial Economics*, 116 (1), pp. 1~22
- [13] Aharoni, Grundy and Zeng, 2013, Stock returns and the Miller Modigliani Valuation Formula: revisiting the Fama French Analysis, *Journal of Financial Economics*, 110(2), pp. 347 ~ 357