Comparison Between the Fama-French Three-Factor Model and the Fama-French Five-Factor Model: An Empirical Study on China's Stock Market

Kasoi Cheong(✉)

Washington University in St. Louis, St. Louis, MO 63130, USA
rickcheong@wustl.edu

Abstract. This paper compares the performance of the Fama-French three-factor model (FF3) and Fama-French five-factor model (FF5) in China's stock market. The empirical result of the regression and GRS test demonstrates a stable size effect in China, which can be captured by these two models. In addition, compared to the three-factor model, the five-factor model, to a certain degree, can better explain the stock return in China over the sample period 2000–2020.

Keywords: Fama-French three-factor model · Fama-French five-factor model · China stock market

1 Introduction

As the world's second largest economy, China has witnessed a remarkable growth in its stock market over the last few decades. Shanghai Stock Exchange (SHSE) and Shenzhen Stock Exchange (SZSE) are two major stock exchanges in mainland China. Two kinds of equities, A-share and B-share, are traded at corresponding exchanges. Before 2005, however, only approximately 30% of the stock shares are tradeable in China [1]. The major goal of the stock market at that time was to help state-owned enterprises to raise sufficient funds and help government retain control of these enterprises [2]. Nevertheless, after the Split-Share Structure Reform conducted by the Chinese government in 2005, the stock market grew further. As of August 2022, there are a total of 1,663 listed companies in the A-share market. As one of the most famous asset pricing models, many scholars have applied the Fama-French model to China's stock market. Xu and Zhang examine the effectiveness of the FF3 in China and identify several factors that may affect the application of the model in China [3]. Huang tests the robustness of the FF5 in China's stock market from1994 to 2016 [4] while Hu, Pan, and Wang discuss the role of the size factor and value factor in explaining the A-share stock return between 1990 and 2016 [5]. Lin shows the significance of the size factor and value factor in China [6]. Previous studies mainly concentrate on the application of the single Fama-French model to a specific region. However, few of them combine different model together to discuss their explanatory powers in China. This paper will compare the application of FF3 and FF5 to determine which one is better in explaining the excess stock return for China.

© The Author(s) 2023
Y. Jiang et al. (Eds.): ICFIED 2023, AEBMR 237, pp. 249–260, 2023.
https://doi.org/10.2991/978-94-6463-142-5_28

2 Literature Review

Under the theoretical framework of Markowitz's mean-variance portfolio theory, Sharpe [7], Mossin [8] and Lintner [9] introduced and developed the capital asset pricing model (CAPM). The basic idea for CAPM is that the asset's expected return depends on the risk-free rate return as well as the return compensation of bearing the systematic risk. In terms of the single factor model, CAPM highlights the importance of the market factor as the only source of the systematic risk and affects expected returns. However, it should be noted that the CAPM cannot fully explain the market anomalies. Also, some assumptions made by CAPM are unrealistic.

To improve the explanatory power and prediction accuracy of the CAPM, the asset pricing model is developing from the single factor model to the multiple factor model. In 1993, Fama and French identified three key factors that can further explain the existence of excess return [10]. They proposed the firm's size and book-to-market ratio (B/M) as two new factors and added them into the original CAPM. These two factors can not only explain the size effect and value effect, but also increase the explanatory power of the model to the expected stock return. However, Elton, Gruber [11] and Carhart [12] proposed that the previous FF3 failed to explain the momentum effect on the stock market. Carhart proposed that the momentum effect should be considered as the new factor for asset pricing [12].

To better explain the market anomalies, Fama and French continue to update their previous model and added profitability factor and investment factor, respectively to their work in 2015 [13]. To identify the robustness of this model, Fama and French conducted an empirical study in North America, Europe, Japan, and Asia Pacific markets in 2017 [14]. Their result shows that the performance of the FF5 is much better than the FF3.

3 Methodology

3.1 Data Selection and Cleaning

The designed samples for mainland China are all A-share stocks including Shanghai and Shenzhen mainboard, Small and Medium Enterprise board, and growth enterprise market. The designed test period is from 2000 to 2020. Following Li, Yang, Feng, and Jing's approach [15], five kinds of stock and data are excluded from the sample: stocks carrying "ST" (special treatment) tags, which indicate the stock has suffered a consecutive loss for 2 years or more; stocks with "*ST" tags, which indicate that the stock has suffered a consecutive loss for 3 years or more and is entering delisting procedure; stocks with "PT" tags, which indicate that the stock has suffered a consecutive loss for 3 years or more and halt the listing procedures; stocks with the negative book value. Following Liu, Stambaugh, and Yuan's approach [16], the companies' stocks with the smallest 30% market value are deleted to reduce the shell-value contamination, which refers to the shells identified in the reverse merger process of avoiding IPO restrictions.

3.2 Fama-French Three-Factor Model

The generalized Eq. (1) for FF3 is given below:

$$R_{it} - R_{ft} = \alpha_{it} + \beta_i(R_{Mt} - r_{ft}) + s_i\ SMB_t + h_i\ HML_t + e_{it} \tag{1}$$

where R_{it} refers to the asset i's return at year t; $R_{Mt} - r_{ft}$ refers to the market risk factor (MKT) at year t; SMB_t refers to the average return spread of small-cap minus large-cap stocks (Size) at year t and HML_t refers to the average return spread of high book-to-market ratio minus low book-to-market stocks (B/M) at year t. The β_i, s_i, *and* h_i are the sensitivity coefficients for $(R_{Mt} - r_{ft})$, SMB_t, and HML_t respectively. Besides, e_{it} is the zero-mean residual for the year t.

3.3 Fama-French Five-Factor Model

The generalized Eq. (2) for FF5 is given below:

$$R_{it} - R_{ft} = \alpha_{it} + \beta_i(R_{Mt} - r_{ft}) + s_i\ SMB_t + h_i\ HML_t + r_i\ RMW_t + c_i\ CMA_t + e_{it} \quad (2)$$

where RMW_t refers to the average return spread of robust operating profitability and weak operating profitability stocks (OP) at year t and CMA_t refers to the average return spread of conservative investment and aggressive investment stocks (Inv) at year t. The r_i and c_i are the sensitivity coefficients for RMW_t and CMA_t respectively.

3.4 Fama French Factors Formation

To construct an efficient portfolio, the author follows the double-sorting approach of Fama and French [10, 13], Foye [17] and Leite et al. [18] to standardize the formulating process. The method proposed by Fama and French in 2015 is mainly being focused on:

The market factor $R_{Mt} - r_{ft}$or MKT. The market factor is defined as the return spread of the region's value-weighted market portfolio and the U.S one month Treasury bill rate. For mainland China, the market return, R_{Mt}, is calculated as the weighted average total market value. It considers the market return of the reinvestment of the cash dividend in China's stock market.

The size factor SMB_t and the value factor HML_t. The key idea is based on constructing six value-weight portfolios sorted by size and B/M, size and OP, as well as size and investment. First, for each year of t, all stocks in the sample are sorted independently by the market capitalization at the end of the year $t - 1$. The median market capitalization size is regarded as the breakpoint to classify the stocks into two groups, the big stock (B) above the median and the small stock (S) below the median. However, this is a little bit tricky for sorting stock in China. Liu, Stambaugh and Yuan point out that the listed companies with the smallest 30% market value in China's stock market will be seriously affected by what they called "shell value contamination" [16]. They consider that the unique IPO regulation in China will cause this problem. The mainstream factors will be contaminated in China if the Fama and French model is being copied directly. As a result, the asset pricing model cannot fully explain the difference of the stock expected return in China. Hence, the author follows Liu, Stambaugh and Yuan's approach [16] and deletes the companies with the smallest 30% market value and then sorts the remaining stocks as the big and small stocks respectively. Further, the stocks by the B/M ratio are sorted into 3 groups using the book value in July of the year $t-1$ and the market value in the December of the year $t-1$. The stocks with the lowest 30% B/M ratio are classified as the Low group (L), those with the highest 30% B/M ratio are classified as the High group (H), and the remaining middle 40% are classified as the Medium group (M). As a result, six groups sorted by the SMB factor and HML factor are obtained: SL, SM, SH, BL, BM and BH. All these groups will be held from July of the year t to June of the year $t+1$and the average return of value-weighted portfolio is calculated at the end of each month. The SMB factor for the B/M and HML factor are calculated as follows:

$$\mathrm{SMB_{B/M}} = \frac{1}{3}(\mathrm{SL} + \mathrm{SM} + \mathrm{SH}) - \frac{1}{3}(\mathrm{BL} + \mathrm{BM} + \mathrm{BH}) \tag{3}$$

$$\mathrm{HML} = \frac{1}{2}(\mathrm{SH} + \mathrm{BH}) - \frac{1}{2}(\mathrm{SL} + \mathrm{BL}) \tag{4}$$

The operating profitability factor $\mathbf{RMW_t}$ and the investment factor $\mathbf{CMA_t}$. Similarly, the author constructs six stock portfolios sorted by these factors respectively. First, the stocks are divided into big and small categories. However, the operating profitability is used instead of B/M to sort the stocks into 3 categories in July of the year $t-1$. The stocks with the lowest 30% OP are divided as the Weak group (W), those with the highest 30% OP are classified as the Robust group (R), and the remaining middle 40% are classified as the Neutral group (N). As a result, six portfolios sorted by the OP factor are generated: SW, SN, SR, BW, BN and BR independently. The above procedures can be repeated on the investment factor and six portfolios sorted by investment factor are generated: SC, SN, SA, BC, BN and BA independently. Overall, a total of three sets of six portfolios are constructed. The RMW factor is calculated as the average return spread of two robust and two weak operating profitability portfolios:

$$\mathrm{RMW} = \frac{1}{2}(\mathrm{SR} + \mathrm{BR}) - \frac{1}{2}(\mathrm{SW} + \mathrm{BW}) \tag{5}$$

The CMA factor is calculated as the average return spread of two conservative portfolios and two aggressive portfolios:

$$\mathrm{CMA} = \frac{1}{2}(\mathrm{SC} + \mathrm{BC}) - \frac{1}{2}(\mathrm{SA} + \mathrm{BA}) \tag{6}$$

Two new-size factors, $\mathrm{SMB_{OP}}$ and $\mathrm{SMB_{INV}}$ will be added and calculated during the process of constructing the RMW factor and CMA factor. Then, the average size factors are calculated as the average return of these sets of six portfolios:

$$\mathrm{SMB_{B/M}} = \frac{1}{3}(\mathrm{SL} + \mathrm{SM} + \mathrm{SH}) - \frac{1}{3}(\mathrm{BL} + \mathrm{BM} + \mathrm{BH}) \tag{7}$$

$$\mathrm{SMB_{OP}} = \frac{1}{3}(\mathrm{SW} + \mathrm{SN} + \mathrm{SR}) - \frac{1}{3}(\mathrm{BW} + \mathrm{BN} + \mathrm{BR}) \tag{8}$$

$$\mathrm{SMB_{INV}} = \frac{1}{3}(\mathrm{SC} + \mathrm{SN} + \mathrm{SA}) - \frac{1}{3}(\mathrm{BC} + \mathrm{BN} + \mathrm{BA}) \tag{9}$$

$$\mathrm{SMB} = \frac{1}{3}\left(\mathrm{SMB_{B/M}} + \mathrm{SMB_{OP}} + \mathrm{SMB_{INV}}\right) \tag{10}$$

3.5 Portfolio Formation

The Fama and French double-sorting approach [13] is followed to construct five sets of sorted test portfolios (5 × 5). Similar to the factor formation, the test portfolios are constructed at the end of June for each year t. For mainland China, however, the companies' annual report in year t are generally disclosed in April of the next year t + 1 but before the disclosure of the first quarter financial reports under the relevant financial regulation. Therefore, the author selects the period from May of the year t to April of the year t + 1 as the portfolio formation period for mainland China. The test portfolios will hold for 12 months from May of the year t to April of the year t + 1 and then be repeated during the test period.

3.6 GRS-F Test

The GRS-F test proposed by Gibbons, Ross, and Shanken is regarded as the mainstream regression tool to test the performance of the asset pricing model [19]. It can be used to test whether all intercepts of the portfolios, α, should jointly equal zero. For the Fama-French model, if all factors can fully explain the portfolio's excess return, then the joint hypothesis test should not reject the null hypothesis. As a result, the model is effective. Hence, the null hypothesis and alternative hypothesis for the model can be made as follows:

$$H_0 : \alpha_i = 0 \text{ for all } i \text{ obtained from the model}$$
$$H_1 : \text{Not all } \alpha_i \text{ equal zero for all } i \text{ obtained from the model}$$

3.7 Regression

The regression analysis on the monthly average excess return of 5 × 5 portfolios is applied, mainly focusing on testing the performance of FF3 and FF5: MKT, SMB, HML, RMW and CMA.

4 Empirical Result and Analysis

4.1 Summary Descriptive Statistics for Portfolio Returns

Following Fama and French [13], two and three dimensions are applied to report the average monthly excess returns of portfolios. For mainland China, the stocks are classified to 5 Size groups based on their different market capitalization. Similarly, the stocks are classified to 5 B/M groups according to their different B/M ratio. As a result, two sorts will create a total of 25 Size-B/M portfolios. Table 1 and 2 summarized descriptive statistics of 3 & 5 factors in China's stock market between 2000 and 2020.

Table 1. Factor Statistics Summary for the FF3 [Original].

Panel A: Descriptive statistics for 3 factors based on sorted portfolio							
	Mean	SD	Min	Max	Median	Skewness	Kurtosis
MKT	0.784	7.751	-26.835	29.604	0.959	-0.073	4.539
SMB	0.416	4.246	-20.760	22.548	0.403	-0.023	7.306
HML	0.169	3.511	-14.383	16.835	0.163	0.014	5.809
Panel B: Cross-correlation analysis among 3 factors							
	MKT	SMB	HML				
MKT	1.000						
SMB	0.224	1.000					
HML	-0.080	-0.468	1.000				

Table 2. Factor Statistics Summary for the FF5 [Original].

Panel A: Descriptive statistics for 5 factors based on sorted portfolio							
	Mean	SD	Min	Max	Median	Skewness	Kurtosis
MKT	0.790	7.970	-26.835	29.604	1.001	-0.075	4.369
SMB	0.359	4.065	-20.479	19.928	0.451	-0.117	6.922
HML	0.204	3.864	-19.292	19.958	0.128	-0.155	7.632
RMW	0.219	3.362	-13.840	15.881	0.100	-0.065	6.310
CMA	-0.082	2.194	-6.517	9.228	-0.209	0.267	4.085
Panel B: Cross-correlation analysis among 5 factors							
	MKT	SMB	HML	RMW	CMA		
MKT	1.000						
SMB	0.194	1.000					
HML	-0.088	-0.476	1.000				
RMW	-0.414	-0.510	0.081	1.000			
CMA	0.068	0.190	0.418	-0.493	1.000		

Panel A of Table 2 indicates the average value-weighted excess returns of the monthly portfolio for MKT, SMB, HML, RMW and CMA. The return with descending order is given by as follows: MKT(0.790%) $>$ SMB(0.359%) $>$ RMW(0.219%) $>$ HML(0.204%) $>$ CMA($-$0.082%). Panel A of Table 1 illustrates the similar pattern on the three-factor model: MKT(0.784%) $>$ SMB(0.416%) $>$ HML(0.169%). Both results indicate that Chinese stock investors can obtain the maximum excess return premium from the market portfolio.

Panel B of Table 1 and 2 demonstrates the relationship between FF3 and FF5. Overall, different Fama French factors are observed to be correlated with other factors. The size factor shows a higher positive correlation with the market factor in the FF3 (0.224) compared to the FF5 (0.194). The value factor shows a significant negative correlation with the size factor in both FF3 and FF5 (-0.468 and -0.476 respectively). However, the value factor in both FF3 and FF5 only shows a minimal correlation with the market factor (-0.080 and -0.088 respectively). Overall, the empirical result of this paper seems to be a little bit different compared to other previous studies. Huang [4] and Jiao and Lilti [20] suggest that the selection of different sample periods will generate different correlations among factors, which implies that the factor correlation is highly sensitive to the sample selection.

4.2 Regression Analysis for FF3 and FF5 on 25 Size-B/M Portfolios

With the limitation in space and time, only the 2×3 factors are used to run the regression on 25 Size-B/M portfolios in this paper, so as to simplify and evaluate the explanatory power of both two models together during the research period.

Table 3 and 4 describe the regression results of 25 Size-B/M portfolios on two models. The corresponding t-statistics indicate that 5 out of 25 intercepts shown in Table 3 and 4 out of 25 intercepts shown in Table 4 are statistically significantly distinguishable from zero. This indicates that they reject the null hypothesis in which alpha in portfolios is jointly zero. The regression coefficients of the size factor are all statistically significant at the given confidence level, which shows a stable size effect in China's stock market can be captured by both FF3 and FF5.

In addition, Table 4 shows that the presence of profitability factor and investment factor, to a certain degree, can help capture the variation of monthly average excess return for 25 Size-B/M portfolios. Regarding to the adjusted R-square, the FF5 explains average excess returns of 25 Size-B/M portfolios better than the FF3 in general. 20 out of 25 values of adjusted R-squares for the FF5 are higher than that of the FF3. In conclusion, the empirical results of the FF5 do improve and better explain the variation of the excess return in 25 Size-B/M portfolios.

4.3 GRS Test Analysis

Table 5 applies the GRS-F statistic to illustrate the ability of the different factor models on explaining the monthly average excess return for 25 Size-B/M portfolios, 25 Size-OP portfolios, and 25 Size-Inv portfolios respectively. The results evaluate if all intercepts of regression of 5 factors are jointly zero.

The first column of Table 5 shows the average absolute value of the intercept $A|a_i|$ among three different sorted portfolios. Compared to the empirical result on the US market [13], it can be seen that China's stock market has a higher $A|a_i|$, especially for the FF3 and FF5. The result is reasonable since the original model is tested by the US stock market. Besides, the $A|a_i|$ decreases as the number of factors increases on 25 Size-B/M portfolios, 25 Size-OP portfolios, and 25 Size-Inv portfolios, respectively. The FF5

Table 3. Regression for 25 Size-B/M portfolios on the FF3 [Original].

Size	B/M ratio									
	Low	2	3	4	High	Low	2	3	4	High
	a (Alpha)					t(a)				
Low	0.299**	0.159	0.313***	0.171	0.028	2.117	1.650	3.088	1.479	0.000
2	-0.054	0.055	0.068	0.023	0.145	-0.413	0.574	0.602	0.222	1.010
3	-0.248*	-0.081	0.209*	-0.017	0.125	-1.664	-0.701	1.690	-0.151	0.940
4	-0.047	-0.040	-0.025	0.005	0.001	-0.273	-0.315	-0.191	0.038	0.007
High	-0.210	0.295*	0.105	-0.075	0.036	-1.021	1.953	0.568	-0.464	0.289
	b (MKT)					t(b)				
Low	1.037***	0.995***	0.942***	0.997***	1.021***	40.605	49.838	55.520	55.099	42.150
2	1.030***	0.988***	0.971***	0.990***	1.051***	47.370	60.641	53.721	56.289	50.415
3	1.018***	0.996***	0.975***	0.980***	1.089***	41.037	54.032	37.781	42.704	61.279
4	1.083***	0.959***	0.932***	1.047***	1.112***	45.309	33.327	33.918	42.255	59.492
High	1.060***	0.974***	0.910***	1.004***	1.043***	43.471	32.292	28.283	32.321	42.492
	s (SMB)					t(s)				
Low	0.929***	0.925***	1.015***	0.969***	1.030***	17.255	18.802	23.494	20.239	15.792
2	0.794***	0.911***	0.986***	0.928***	0.885***	10.345	28.394	20.012	21.137	17.265
3	0.685***	0.663***	0.814***	0.797***	0.667***	11.749	14.652	8.181	18.847	10.490
4	0.405***	0.483***	0.477***	0.505***	0.447***	3.390	8.967	7.066	7.692	8.172
High	-0.279***	-0.357***	-0.385***	-0.230***	-0.264***	-2.609	-5.136	-3.963	-3.575	-4.155
	h (HML)					t(h)				
Low	-0.579***	-0.372***	-0.280***	0.012	0.241***	-8.114	-6.083	-6.445	0.247	3.989
2	-0.463***	-0.381***	-0.199***	0.010	0.321***	-7.680	-9.269	-3.925	0.176	5.098
3	-0.548***	-0.441***	-0.354***	0.039	0.314***	-8.044	-9.284	-6.092	0.697	4.626
4	-0.664***	-0.460***	-0.339***	0.012	0.289***	-7.208	-6.363	-5.336	0.183	4.590
High	-0.767***	-0.665***	-0.302***	0.219***	0.597***	-8.799	-7.289	-4.280	3.081	9.080
	Adj- R2					s(e)				
Low	0.958	0.973	0.961	0.962	0.925	2.209	1.624	1.884	1.804	2.571
2	0.955	0.973	0.966	0.962	0.932	2.159	1.600	1.743	1.793	2.385
3	0.950	0.964	0.943	0.951	0.938	2.250	1.806	2.285	1.962	2.261
4	0.933	0.938	0.931	0.944	0.950	2.694	2.269	2.279	2.107	1.997
High	0.902	0.907	0.888	0.913	0.940	3.037	2.659	2.588	2.340	1.964

$^{*}\ p < 0.1,^{**}\ p < 0.05,^{***}\ p < 0.01$

shows a lower $A|a_i|$ (0.151 for 25 Size-B/M portfolios, 0.150 for 25 Size-OP portfolios, and 0.126 for 25 Size-Inv portfolios) than the FF3 (0.160 for 25 Size-B/M portfolios, 0.277 for 25 Size-OP portfolios, and 0.147 for 25 Size-Inv portfolios).

This result implies that the explanatory power for the variation of the excess return in China also increases as the number of factors increases. This result is consistent with the previous regression analysis on 25 Size-B/M portfolios. Similar patterns are observed by conducting the regression analysis on 25 Size-OP portfolios and 25 Size-Inv portfolios.

Table 4. Regression for 25 Size-B/M portfolios on the FF5 [Original].

Size	B/M ratio									
	Low	2	3	4	High	Low	2	3	4	High
	a (Alpha)					t(a)				
Low	-0.033	0.345**	0.342***	0.270**	0.147	-0.213	2.541	3.471	2.321	1.355
2	-0.094	-0.106	0.042	0.149	-0.018	-0.683	-0.957	0.356	1.301	-0.201
3	-0.347**	-0.199	-0.080	0.054	-0.085	-2.418	-1.480	-0.623	0.422	-0.710
4	-0.142	-0.116	-0.178	0.126	-0.038	-0.977	-0.876	-1.126	0.870	-0.300
High	0.267	0.112	0.023	-0.054	-0.016	1.956	0.693	0.143	-0.384	-0.168
	b (MKT)					t(b)				
Low	1.009***	1.024***	1.022***	1.012***	1.031***	28.435	60.711	59.182	90.420	76.298
2	1.040***	0.993***	0.979***	1.043***	1.051***	39.348	52.750	63.018	66.995	72.225
3	1.007***	1.018***	1.008***	1.087***	1.052***	49.866	60.294	59.017	64.903	63.470
4	0.954***	1.046***	1.034***	1.102***	1.039***	41.194	47.064	35.012	52.314	63.372
High	0.994***	1.058***	1.017***	1.029***	0.931***	56.246	37.438	39.547	40.472	43.034
	s (SMB)					t(s)				
Low	0.943***	0.975***	0.994***	1.056***	0.989***	14.400	16.117	24.664	24.197	23.721
2	0.850***	0.950***	0.90***	0.918***	0.762***	12.979	22.900	17.466	20.644	23.085
3	0.638***	0.742***	0.843***	0.678***	0.617***	14.808	15.967	15.955	11.796	14.856
4	0.427***	0.494***	0.551***	0.480***	0.317***	10.741	10.070	9.486	8.215	5.726
High	-0.318***	-0.255***	-0.299***	-0.249***	-0.281***	-6.204	-3.685	-5.357	-3.884	-6.139
	h (HML)					t(h)				
Low	-0.381***	-0.308***	-0.128**	0.136***	0.288***	-5.800	-4.430	-2.311	3.037	7.790
2	-0.416***	-0.195***	-0.098	0.148***	0.381***	-6.067	-4.339	-1.438	2.869	9.388
3	-0.566***	-0.341***	-0.055	0.115*	0.481***	-9.760	-5.694	-0.943	1.789	8.472
4	-0.642***	-0.351***	-0.058	0.166**	0.454***	-13.438	-5.675	-0.891	2.415	7.586
High	-0.912***	-0.277***	-0.065	0.383***	0.634***	-14.574	-4.009	-0.915	6.841	12.351
	r (RMW)					t(r)				
Low	0.075	0.025	-0.065	-0.092	-0.148**	0.630	0.258	-1.092	-0.989	-2.193
2	-0.044	-0.062	0.059	-0.158**	-0.294***	-0.443	-0.737	0.762	-2.217	-4.275
3	0.048	-0.025	-0.224**	-0.215**	-0.187***	0.468	-0.348	-2.578	-2.453	-2.745
4	0.050	-0.141	-0.217***	-0.338***	-0.166**	0.641	-1.554	-2.611	-3.138	-2.288
High	-0.145	-0.021	-0.088	0.084	0.137	-1.507	-0.174	-0.869	0.848	1.648
	c(CMA)					t(c)				
Low	0.218	0.352***	0.192**	0.094	0.189***	1.385	4.293	2.375	1.566	3.092
2	0.128	0.123	0.113	0.173**	0.162**	1.447	1.579	1.541	2.275	2.354
3	0.139*	0.141*	0.224**	0.005	0.036	1.712	1.935	2.391	0.078	0.463
4	0.041	0.193*	0.098	0.224**	0.209**	0.384	1.671	0.750	2.322	2.376
High	-0.058	-0.10	-0.056	-0.242***	-0.150**	-0.694	-1.049	-0.561	-2.622	-2.061
	Adj-R2					s(e)				

(*continued*)

Table 4. (*continued*)

Size	B/M ratio									
	Low	2	3	4	High	Low	2	3	4	High
Low	0.933	0.974	0.967	0.972	0.968	2.696	2.053	1.833	1.649	1.755
2	0.949	0.966	0.969	0.970	0.973	2.339	1.825	1.677	1.715	1.568
3	0.951	0.968	0.954	0.958	0.962	2.183	1.929	2.084	1.987	1.793
4	0.948	0.952	0.937	0.946	0.944	2.081	2.083	2.349	2.235	2.107
High	0.943	0.919	0.906	0.918	0.947	2.105	2.491	2.567	2.423	

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 5. Summary GRS-F statistics for the different model based on 5 × 5 portfolios [Original].

Panel A: GRS test for 25 Size-B/M Portfolios					
25 Size-B/M Portfolio	GRS	$A\|a_i\|$	P-value	Adj. R-square	SR
SMB HML	1.591**	0.654	0.041	0.220	0.425
RMW CMA	2.909***	1.337	0.000	0.365	0.570
MKT SMB HML	1.897**	0.160	0.047	0.950	0.420
MKT SMB HML RMW CMA	1.845***	0.151	0.004	0.951	0.501
Panel B: GRS test for 25 Size-OP Portfolios					
25 Size-OP Portfolio	GRS	$A\|a_i\|$	P-value	Adj. R-square	SR
SMB HML	2.657***	0.632	0.000	0.202	0.549
RMW CMA	2.361***	1.339	0.000	0.372	0.513
MKT SMB HML	2.716***	0.277	0.000	0.943	0.558
MKT SMB HML RMW CMA	1.811***	0.150	0.013	0.951	0.476
Panel C: GRS test for 25 Size-Inv Portfolios					
25 Size-Inv Portfolio	GRS	$A\|a_i\|$	P-value	Adj. R-square	SR
SMB HML	2.209***	0.648	0.001	0.204	0.500
RMW CMA	2.508***	1.334	0.000	0.367	0.529
MKT SMB HML	2.195***	0.147	0.001	0.949	0.501
MKT SMB HML RMW CMA	1.825***	0.126	0.012	0.954	0.478

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Besides, for three different sorted portfolios, the FF3 and FF5 always show the highest adjust R square, over 90% compared to the two-factor model. This result shows that both the FF3 and FF5 can capture and explain more than 90% of the variation of excess return on China's stock market.

In conclusion, the FF5, compared to other factor models, is the best one to explain the monthly average excess return in China's stock market.

5 Conclusion

Overall, the author investigates and evaluates the explanatory power of the Fama-French three- and five-factor model in China's stock market. First, the descriptive statistics as well as the cross-correlation analysis shows that factors in both two models are correlated with each other. Investors can obtain the maximum return premium from the market portfolio. Second, the regression analysis on 25 Size-B/M portfolios is conducted as an example to test the performance of two models in China, both of which can capture the size effect in China's stock market. Besides, empirical results show that the Fama-French five-factor model, to a certain degree, can better explain the variation of excess return in China's stock market. Last, the GRS-F test is applied to verify the regression. Both GRS-F statistics and adjusted R square are consistent with the previous regression result. However, a limitation of the Fama-French model discussed in this paper is that it still ignores the possible momentum effect. The momentum effect has been widely accepted in the financial market. To better explain the application of the model in China, the intersection of different factors with the momentum factor should be considered in the future work.

References

1. Carpenter, J. N., Whitelaw, R. F.: The Development of China's Stock Market and Stakes for the Global Economy. Annual Review of Financial Economics (9), 233-257 (2017).
2. Lee, S. L. J.: From non-tradable to tradable shares: Split share structure reform of China's listed companies. Journal of Corporate Law Studies8(1), 57-22 (2008).
3. Xu, J., Zhang, S. J.: The Fama-French Three Factors in the Chinese Stock Market. China Accounting and Finance Review 16(2), 210-227 (2014).
4. Huang, T. L.: Is the Fama and French five-factor model robust in the Chinese stock market? Asia Pacific Management Review 24(3), 278-289 (2018).
5. Hu, G. X., Pan, J., Wang, J.: Chinese Capital Market: An Empirical Overview. Emerging Markets: Finance eJournal (2020).
6. Lin, Q.: Noisy prices and the Fama–French five-factor asset pricing model in China. Emerging Markets Review 31, 141-163 (2017).
7. Shape, W. F.: Capital Asset Prices: A Theory of Market Equilibrium Under Conditions of Risk. The Journal of Finance 19(3), 425-442 (1964).
8. Mossin, J.: Equilibrium in a Capital Asset Market. Economitrica 34(4), 768-783 (1966).
9. Lintner, J.: The Valuation of Risk Assets and the Selection of Risky Investments in Stock Portfolios and Capital Budgets. The Review of Economics and Statistics 47(1), 13-37 (1965).
10. Fama, E. F., French, K.R.: Common risk factors in the returns on stocks and bonds. Journal of Financial Economics 33, 3-56 (1993).
11. Elton, E. J., Gruber, M. J., Blake, C. R.: Survivorship Bias and Mutual Fund Performance. The Review of Financial Studies 9(4), 1097-1120 (1995).
12. Carhart, M. M.: On Persistence in Mutual Fund Performance. The Journal of Finance LII(1), 57-82 (1997).
13. Fama, E. F., French, K.R.: A five-factor asset pricing model. Journal of Financial Economics 116, 1-22 (2015).
14. Fama, E. F., French, K.R.: International tests of a five-factor asset pricing model. Journal of Financial Economics 123(3), 441-463 (2017).

15. Li, Z. B., Yang, G. Y., Feng, Y. C., Jing, L.: Fama-French Five Factor Model in China Stock Market. Journal of Financial Research 444(6), 191-206 (2017).
16. Liu, J. N., Stambaugh, R. F., Yuan, Y.: Size and value in China. Journal of Financial Economics 134(1), 48-69 (2018).
17. Foye, J.: A comprehensive test of the Fama-French five-factor model in emerging markets. Emerging Markets Review 37, 199-222 (2018).
18. Leite, A. L., et al.: Size, value, profitability, and investment: Evidence from emerging markets. Emerging Markets Review 36, 45-59 (2018).
19. Gibbons, M. R., Ross, S. A., Shanken, J.: A Test of the Efficiency of a Given Portfolio. Econometrica 57(5), 1121–1152 (1989).
20. Jiao, W. T., Lilti, J. J.: Whether profitability and investment factors have additional explanatory power comparing with Fama-French Three-Factor Model: empirical evidence on Chinese A-share stock market. China Finance and Economic Review, Springer, 5(1), 1-19 (2017).

Open Access This chapter is licensed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (http://creativecommons.org/licenses/by-nc/4.0/), which permits any noncommercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.