Asset Pricing in China's Stock Market

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Abstract: This paper tests four main-stream asset pricing model with China's stock market information. We use stock return data from CSMAR and constructed China Stock Market Factor. The result suggests that the Fama and French (2014) five-five model is a better description of Chinese market than the Fama and French (1993) three-factor model.

Keywords: Asset pricing model, Fama and French five-factor model, Chinese stock market.

1 INTRODUCTION

With the development of society, people gradually realize the importance of data. Investors try to find factors related to stock return with several datasets. China has already been the second greatest stock market around the world. The passage attempts to figure out which asset model is the best description of Chinese market. We examine four main-stream asset pricing model. The CAMP asset pricing model, the Fama and French (1993) three-factor model, the Carhart (1997) four-factor model, and the Fama and French (2014) five-five model. These inclusive five factors are Market risk factor (RM-RF), size risk factor (SMB) and Book-to-Market ratio factor (HML) Profitability Factor (RMW), and Investment Pattern Factor (CMA). We use data from CSMAR and sub-database, and the other one is China Stock Market Factor Database. We have discovered that the Fama and French (2014) five-factor model provides a more accurate depiction of the Chinese market compared to the Fama and French (1993) three-factor model.

2 LITERATURE REVIEW

There has been extensive studies in the asset pricing literatures, for example the renowned Capital Asset Pricing Model, the CAMP asset pricing model, the Fama and French (1993) three-factor model, the Carhart (1993) four-factor model, and the Fama and French (2015) five-five model. Fama and French (2015) focus on a five-factor asset pricing model, capturing the size, value, profitability, and investment patterns in average stock returns. This five-factor model performs better than the traditional Fama-French three-factor model (Fama and French, 1993). However, the five-factor model fails to capture the low average returns on small stocks whose returns behave like those of firms that invest a lot despite low profitability. The authors suggest that HML is a redundant factor in the sense that its high average return is fully captured by its exposures to Rm-Rf, SMB, and especially RMW and CMA. Also, the tests indicate that a four-factor model dropping HML performs as well as the five-factor model. [7](Mosoeu and Kodongo,

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2020) focus on the Fama-French five-factor model and emerging market equity returns. They test the model on average stock returns for selected emerging and developed equity market. They find that the profitability factor is the most useful for explaining the cross-section emerging markets equity returns. Another important result is that the average returns of stocks of large-size firms appear to exceed those of stocks of small-size firms and that returns on stocks of growth firms exceed returns on stocks of value firms.

Nevertheless, researchers have been consistently exploring additional factors that would contribute to explain asset prices, and also across different locations. [4](Guo, Zhang, Zhang and Zhang, 2017) focus on the five-factor asset pricing model tests for the Chinese stock market. The test results suggest that strong size, value, and profitability patterns in average returns, but weak investment pattern. They find that the profitability factor significantly improves the description of average return. The test results are consistent with Chen et al. (2010), who show that many anomaly variables which are efficient in the U.S. market but do not affect the average returns of the Chinese market, except the obvious value effect. [6](Liu, Stambaugh and Yuan, 2019) focus on size and value factors in China. They find that the three-factor model based on Chinese stock market, CH-3, dominates the traditional FF-3 model, where in the latter is based on the BM value factor. The CH-3 model prices both the size and value factors in FF-3. The three-factor model strongly dominates a model formed by just replicating the Fama and French (1993) procedure in China and explains most reported anomalies in the Chinese stock market, including profitability and volatility. [5](Li and Rao, 2022) focus on a revised model, accounting for unique features of Chinese market, and evaluate the performance of competing asset price models. Li and Rao provide an effective benchmark model for empirical asset pricing in the Chinese stock market, which demonstrates that the propensity of firms to engage in reverse merges has sharply decreased in recent years. [1](Chen, Glabadanidis and Sun 2022) mainly focus on the five-factor asset pricing, short-term reversal, and ownership structure. They find that the five-factor asset pricing model proposed by [2](Fama and French 2015) is a better description of the Chinese stock market return than the three-factor asset pricing model. Moreover, they propose a short-term-reversal (STR) is highly significant, which substantially improves the pricing ability of three- and five- asset pricing models in explaining popular stock portfolio returns as well as Chinese mutual funds' returns. [3](Fama and French 2017) employee the international test of a five-factor asset pricing model. Average stock returns for North America, Europe, and Asia Pacific increase with the book-to-market ratio (B/M) and profitability and are negatively related to investment. In the case of Japan, there is a significant connection between average returns and book-to-market ratio (B/M), while average returns display minimal correlation with profitability or investment. By incorporating factors of profitability and investment into the Fama and French (1993) three-factor model, a five-factor model successfully encompasses the observed patterns in average returns.

3 DATA AND VARIABLES

There are two main sources of data for this survey. One is CSMAR and sub-database, and the other one is China Stock Market Factor Database. We focus on the A-share broad market factors and select the 2*2 portfolio division method for market risk factor construction. Ultimately, the full data contains five-year sample from 12 October 2017 to 11 October 2022. It contains 1214-day observation and 5149 firms. The overall data set contains 4901762 firm-day observations.

In the later robustness examination, we also use the weekly observation. The week sample contains 253 weeks and 5145 firms, in total of 2878834 firm-week observations.

The market risk premium is that we compute the disparity between the daily market return and the daily risk-free rate, accounting for the reinvestment of cash dividends. Specifically, we evaluate market risk using two approaches: the trading value weighted average of shares listed in the market and the market capitalization value weighted average. We refer to the former risk premium measure as mk_rf1 and the latter as mk_rf2. The risk-free rate is based on the benchmark deposits published by the Central Bank of China in March.

The size factor, alternatively known as the market capitalization factor is calculated the difference between the return of a small-cap portfolio and a large-cap portfolio. Again, we denote the trading value-weighted size factor as SMB1, and the market capitalization weighting measure as SMB2. Similar fashion also applies to the following measures.

The book-to-market factor, which calculates the difference between the return on a portfolio with a high book-to-market ratio and a portfolio with a low book-to-market ratio. Particularly, we measure HML in two ways, one is the liquidity weighted and the other one is the total market value weighted. We name the former HML measure as HML1 and the latter one as HML2. Therefore, the portfolio investment return for the former one is using market capitalization weighting, and the portfolio investment return for the latter one is the total market value weighting.

The profitability factor is calculating the difference between the return on a high-profit portfolio of stocks and a low-profit portfolio. Specifically, there are two types of RMW. RMW1 represents the market capitalization weighted and RMW2 is total market capitalization weighted. Portfolio investment returns in the former one is calculated using market capitalization weighting., and for the latter one is using total market capitalization weighting.

The investment pattern factor is calculated as the difference between the return of a low and high investment ratio stock portfolio. Concretely, we measure the investment pattern factor in two ways, one is the market capitalization weighted average, and the other one is total market capitalization weighted average of shares listed in the market. We denote the former one as CMA1 and the latter one as CMA2.

Dretwd denotes the daily stock return with considering of reinvestment of cash dividends. It is measured as the stock offer price minus the previous closing price plus the reinvestment return from dividends by earning a market risk-free return. On the other hance, Dretnd captures the daily stock return without considering of reinvestment of cash dividends.

Wretwd represents the weekly individual stock return with considering of cash dividend reinvestment. It is measured as the stock offer price minus the previous closing price plus the reinvestment return from dividends by earning a market risk-free return. On the other hance, wretnd indicates weekly individual stock return without considering of cash dividend reinvestment.

4 METHODOLOGY

In this paper, we examine four main-stream asset pricing model. The CAMP asset pricing model,

the Fama and French (1993) three-factor model, the Carhart (1997) four-factor model, and the Fama and French (2014) five-five model. These inclusive five factors are Market risk factor (RM-RF), size risk factor (SMB) and Book-to-Market ratio factor (HML) Profitability Factor (RMW), and Investment Pattern Factor (CMA). Furthermore, equations (1) to (4) list the standard asset pricing regression models.

$$R_{it}-R_{ft}=\alpha_i+\beta_1(R_{mt}-R_{ft})+e_{it} \quad (1)$$

$$R_{it}-R_{ft}=\alpha_i+\beta_1(R_{mt}-R_{ft})+\beta_2 SMB_t+\beta_3 HML_t+e_{it} \quad (2)$$

$$R_{it}-R_{ft}=\alpha_i+\beta_1(R_{mt}-R_{ft})+\beta_2 SMB_t+\beta_3 HML_t+\beta_4 RMW_t+e_{it} \quad (3)$$

$$R_{it}-R_{ft}=\alpha_i+\beta_1(R_{mt}-R_{ft})+\beta_2 SMB_t+\beta_3 HML_t+\beta_4 RMW_t+\beta_5 CMA_t+e_{it} \quad (4)$$

R_{it} captures the total return of a stock i at time t, and R_{ft} is risk free rate of return at time t. Moreover, R_{mt} represents total market portfolio return at time t. R_{it}-R_{ft} means the firm's expected excess return. Additionally, $R_{mt}-R_{ft}$is excess return on the market portfolio (index); SMBt stands for size premium (small minus big); HML_t is the representation of value premium (high minus low). In addition, RMW captures the returns on diversified portfolios of stock with robust (high and steady) minus weak (low) profitability, hence represents the momentum factor. Finally, CMA captures returns on diversified portfolios of the stocks of low reinvestment ratio and high reinvestment ratio investment firms, which represents conservative and aggressive dividend-payout ratios of the companies. β_1 to β_5 are the factor coefficients that we want to estimate based on the Chinese market data.

5 EMPIRICAL RESULTS

Table 1 presents the summary statistics of variables that used in the study, including the number pf observation (N), sample average (Mean), standard deviation (SD), minimum (Min), median (p50), and maximum (max) values of variables. As shown in the table, the total number of daily stock return, dretwd, is 4901762, with the mean of .0004402, standard deviation of .0434482, min of -0.895775, median of 0 and max of 19.42581. The standard deviation is much higher than the mean, which is more than ten times of the mean. In other words, the portfolio fluctuates a lot. For the dretnd, the total number is the same as dretwd, which is 4901762. The mean is 0.000396 and the standard deviation is 0.0434689. Both min, p50 and max are the same as the former variable. When it comes to mk_rf1, the total number of observations is 4901762 and the mean is 0.0001183. The standard deviation is 0.117876 and the min is -0.079134. P50 is 0.000586, which is slightly higher than the former one, but max is 0.056292 that is much smaller. Also, the portfolio fluctuates a lot because the standard deviation is higher than the mean. In terms of hml1, the mean is -8.23e-06 and the standard deviation is .0052621, both of which are relatively lower than the previous variables. Min is -0.19516 and p50 is -0.000317. Max is 0.17008. The portfolio shares similar moves with all the previous variables. For cma1,

the mean is -.0000315 and the standard deviation is .0033758. The min, p50 and max are -.012392, -.000084, and .013065.

Table 1. Summary Statistics: Daily Returns

Variable	N	Mean	SD	Min	p50	Max
dretwd	4901762	.0004402	.0434482	-.895775	0	19.42581
dretnd	4901762	.000396	.0434689	-.895775	0	19.42581
mk_rf1	4901762	.0001183	.0117876	-.079134	.000586	.056292
smb1	4901762	.0000583	.0081276	-.035087	.000573	.027585
hml1	4901762	-8.23e-06	.0052621	-.019516	-.000317	.017008
rmw1	4901762	.0001432	.0038559	-.016499	.000173	.016747
cma1	4901762	-.0000315	.0033758	-.012392	-.000084	.013065
mk_rf2	4901762	.0002838	.01214	-.08082	.00088	.056508
smb2	4901762	.0000197	.0076889	-.033052	.000519	.025245
hml2	4901762	-.000077	.0049466	-.018893	-.000376	.016418
rmw2	4901762	.0001298	.0040289	-.017676	.000176	.017886
cma2	4901762	-.0000158	.0034831	-.01306	-.000091	.013941

This table presents the summary statistics of variables that used in the study. It includes the number pf observation (N), sample average (Mean), standard deviation (SD), minimum (Min), median (p50), and maximum (max) values of variables.

This table presents the summary statistics of variables that used in the study. It includes the number pf observation (N), sample average (Mean), standard deviation (SD), minimum (Min), median (p50), and maximum (max) values of variables. The total number of observations is 1002357. For the wretwd, the mean is 0.000116. moreover, the standard deviation is 0.0679955. Min, p50m, and max are -.895775, -.002967, and 3.872825. The standard of deviation is much higher than the mean, so the portfolio fluctuates a lot. When it comes to wretnd, the mean is .0001423 and the standard deviation is .0680482. It is obvious that the standard deviation is still higher than the mean, so the moves of the portfolio of wretnd is similar with wretwd. In terms of mk_rf1, The mean is .0001177 and the standard deviation is .0244852. The standard deviation is still higher than the mean, so the portfolio of mk_rf1 fluctuates a lot. The min, p50, and max are -.099403, .000602, and .082596. Concerning to hml1, the mean and standard deviation are -.000103 and .0113316. Apparently, the portfolio of hml1 fluctuates a lot. The min, p50, and max are -.028418, -.001279, and .037644.

Table 2. Summary Statistics: Weekly Returns

Variable	N	Mean	SD	Min	p50	Max
wretwd	1002357	.000116	.0679955	-.895775	-.002967	3.872825
wretnd	1002357	.0001423	.0680482	-.895775	-.002964	3.872825
mk_rf1	1003792	.0001177	.0244852	-.099403	.000602	.082596
smb1	1003792	.0007365	.0180571	-.067276	.000904	.054241

hml1	1003792	-.000103	.0113316	-.028418	-.001279	.037644
rmw1	1003792	.0004411	.0091104	-.033482	.000708	.032173
cma1	1003792	-.000097	.0073286	-.023371	-.000723	.022254
mk_rf2	1003792	-.0000388	.0250088	-.096956	.000764	.087175
smb2	1003792	.000514	.0170897	-.064713	-.000614	.051245
hml2	1003792	-.0004493	.0108418	-.028598	-.001666	.040238
rmw2	1003792	.0003338	.0094793	-.034569	.000976	.031089
cma2	1003792	-8.83e-06	.0075386	-.022417	-.000567	.023441

This table presents the summary statistics of variables that used in the study. It includes the number pf observation (N), sample average (Mean), standard deviation (SD), minimum (Min), median (p50), and maximum (max) values of variables.

Table 3. Regression Results: Trading-Valued Weighted Return with Dividends

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	dretwd	dretwd	dretwd	dretwd	wretwd	wretwd	wretwd	wretwd
mk_rf1	1.098***	1.032***	1.028***	1.028***	0.565***	0.516***	0.514***	0.516***
	(1027.68)	(912.86)	(907.07)	(906.00)	(224.11)	(194.81)	(190.28)	(190.95)
smb1		0.836***	0.759***	0.757***		0.517***	0.504***	0.496***
		(564.09)	(342.99)	(340.77)		(151.95)	(97.85)	(96.24)
hml1		-0.0706***	-0.125***	-0.131***		-0.119***	-0.126***	-0.210***
		(-28.76)	(-45.95)	(-44.57)		(-20.92)	(-20.70)	(-30.70)
rmw1			-0.222***	-0.211***			-0.0337***	0.0879***
			(-47.02)	(-41.29)			(-3.32)	(7.92)
cma1				0.0270***				0.305***
				(5.57)				(26.84)
Constant	-0.0000781	-0.000165***	-0.000132**	-0.000133**	-0.000922***	-0.00136***	-0.00133***	-0.00137***
	(-1.34)	(-2.95)	(-2.36)	(-2.41)	(-7.69)	(-11.43)	(-11.26)	(-11.62)
N	4901762	4901762	4901762	4901762	1002357	1002357	1002357	1002357
R2	0.177	0.229	0.230	0.230	0.0477	0.0718	0.0718	0.0724

t statistics in parentheses

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

In Table 3, the trading-weighted returns including dividends are presented. The left panel consists of four columns reporting results based on daily returns, while the right panel consists of four columns reporting results based on weekly returns. From column 1 to column 4 in the left panel (corresponding to columns 5 to 8 in the right panel), a gradual regression analysis is conducted, where stock returns are regressed on the market-risk premium, size factor, book-to-market factor, profitability factor, and investment pattern factor.

First, all factors illustrate significant explanatory power in explaining stock returns, with the significance level of 1 %. Second, for each of the series of the mk_rf1, smb1, and hml1, for example, the trading-valued weighted return with dividends of mkt_rf1 decreases from 1.098 to 0.516. The smb1 decreases from 0.836 to 0.496. The hml1 decreases from -0.0706 to -0. 210.The sign in front of mkt_rf1, smb1, cma1 are all positive, which means with these market factors increase, stock returns also increase. In addition, it represents the smaller the company is, the higher the return is. The investment pattern factor gets growing, the return will get higher. However, for each of the series of the cma1 and rmw1, the effect on trading-valued weighted return with dividends from cma1 increases from0.0270 to 0.305. Similarly, the effect of rmw1 increases from -0.222 to 0.0879. The sign in front of hml1 and rmw1 are negative. In other words, as book-to-market factor be higher, the lower returns it is. Also, the high of profitability factor, the lower return it is.

These overall findings are consistent with the five-factor asset pricing model, short-term reversal, and ownership structure – the case of China (Chen, Glabadanidis and Sun, 2022). In other words, the five-factor asset pricing model can be explained by Chinese asset returns.

Table 4. Regression Results: Trading-Valued Return without Dividend

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	dretnd	dretnd	dretnd	dretnd	wretnd	wretnd	wretnd	wretnd
mk_rf1	1.098***	1.032***	1.028***	1.028***	0.565***	0.516***	0.514***	0.516***
	(1026.19)	(911.64)	(905.86)	(904.77)	(223.98)	(194.68)	(190.16)	(190.83)
smb1		0.836***	0.759***	0.758***		0.517***	0.504***	0.497***
		(563.57)	(342.68)	(340.49)		(151.88)	(97.82)	(96.21)
hml1		-0.0695***	-0.123***	-0.129***		-0.119***	-0.126***	-0.210***
		(-28.24)	(-45.46)	(-44.02)		(-20.93)	(-20.71)	(-30.70)
rmw1			-0.222***	-0.211***			-0.0335***	0.0881***
			(-46.96)	(-41.33)			(-3.31)	(7.93)
cma1				0.0258***				0.305***
				(5.31)				(26.83)
_cons	-0.000123**	-0.000210***	-0.000177***	-0.000178***	-0.000900***	-0.00133***	-0.00131***	-0.00135***
	(-2.10)	(-3.75)	(-3.16)	(-3.23)	(-7.51)	(-11.25)	(-11.08)	(-11.44)
N	4901762	4901762	4901762	4901762	1002357	1002357	1002357	1002357
r2_o	0.177	0.229	0.229	0.229	0.0476	0.0717	0.0717	0.0724

In Table 4, the trading-weighted returns excluding dividends are presented for the market-risk premium, size factor, book-to-market factor, profitability factor, and investment pattern factor. Firstly, it is noteworthy that all factors exhibit significant explanatory power for returns at a 1% significance level, thus confirming the robustness of the five-factor pricing model. Secondly, when analyzing mk_rf1, smb1, and hml1, a declining return pattern is observed from (1) to (8). Conversely, for cma1 and rmw1, an increasing trend in returns is observed from (1) to (8).

Table 5. Regression Results: Capitalization Weighted Return with Dividend

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	dretwd	dretwd	dretwd	dretwd	wretwd	wretwd	wretwd	wretwd
mk_rf2	1.085***	1.019***	1.014***	1.015***	0.577***	0.526***	0.522***	0.526***
	(1057.48)	(915.11)	(908.51)	(907.88)	(233.52)	(197.93)	(192.50)	(193.82)
smb2		0.829***	0.732***	0.730***		0.509***	0.481***	0.475***
		(522.35)	(330.13)	(327.46)		(139.82)	(94.66)	(93.44)
hml2		0.0759***	-0.00362	-0.0171***		-0.0332***	-0.0526***	-0.142***
		(28.09)	(-1.21)	(-5.33)		(-5.40)	(-7.93)	(-19.15)
rmw2			-0.264***	-0.240***			-0.0707***	0.0716***
			(-62.69)	(-50.34)			(-7.83)	(6.86)
cma2				0.0553***				0.317***
				(11.35)				(27.03)
Constant	-0.000240***	-0.000273***	-0.000249***	-0.000253***	-0.000807***	-0.00114***	-0.00111***	-0.00120***
	(-4.10)	(-4.86)	(-4.44)	(-4.62)	(-6.73)	(-9.59)	(-9.40)	(-10.16)
N	4901762	4901762	4901762	4901762	1002357	1002357	1002357	1002357
R2	0.186	0.229	0.230	0.230	0.0515	0.0713	0.0713	0.0720

In Table 5, the capitalization-weighted returns including dividends are presented for the market-risk premium, size factor, book-to-market factor, profitability factor, and investment pattern factor. Once again, all factors demonstrate significant explanatory power for returns at a 1% significance level. Additionally, when examining mk_rf1, smb1, and hml1, the table reveals a declining return pattern from (1) to (8). However, for cma1 and rmw1, the table indicates an increasing trend in returns from (1) to (8).

Table 6. Regression Results: Capitalization Weighted Return without Dividend

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	dretnd	dretnd	dretnd	dretnd	wretnd	wretnd	wretnd	wretnd
mk_rf2	1.085***	1.019***	1.014***	1.015***	0.577***	0.526***	0.522***	0.526***
	(1055.89)	(913.82)	(907.22)	(906.58)	(233.38)	(197.80)	(192.38)	(193.70)
smb2		0.829***	0.732***	0.730***		0.509***	0.481***	0.475***
		(521.83)	(329.73)	(327.08)		(139.76)	(94.64)	(93.42)
hml2		0.0769***	-0.00274	-0.0160***		-0.0334***	-0.0527***	-0.142***
		(28.44)	(-0.92)	(-4.99)		(-5.42)	(-7.94)	(-19.15)

rmw2			-0.265***	-0.240***			-0.0705***	0.0718***
			(-62.73)	(-50.46)			(-7.81)	(6.87)
cma2				0.0545***				0.317***
				(11.16)				(27.02)
Constant	-0.000285***	-0.000318***	-0.000294***	-0.000298***	-0.000785***	-0.00112***	-0.00109***	-0.00118***
	(-4.86)	(-5.65)	(-5.23)	(-5.43)	(-6.55)	(-9.41)	(-9.22)	(-9.97)
N	4901762	4901762	4901762	4901762	1002357	1002357	1002357	1002357
R2	0.185	0.229	0.230	0.230	0.0515	0.0712	0.0713	0.0719

In Table 6, the capitalization-weighted returns excluding dividends are presented for the market-risk premium, size factor, book-to-market factor, profitability factor, and investment pattern factor. Firstly, the table reveals that all factors show significant explanatory power for returns at a 1% significance level. It is worth noting that despite the absence of dividends in the table, the results remain consistent with those including dividends. Consequently, the regression results exhibit robustness across the various terms.

6 CONCLUSION

We examine four widely-used asset pricing models, including the Capital Asset Pricing Model (CAMP), the Fama and French (1993) three-factor model, the Carhart (1997) four-factor model, and the Fama and French (2014) five-factor model. These inclusive five factors are Market risk factor (RM-RF), size risk factor (SMB) and Book-to-Market ratio factor (HML) Profitability Factor (RMW), and Investment Pattern Factor (CMA). We use data from CSMAR and sub-database, and the other one is China Stock Market Factor Database. By employing the data from CSMAR and sub-database, and the other one is China Stock Market Factor Database. The findings imply that the Fama and French (2014) five-factor model provides a more accurate depiction of the Chinese market compared to the Fama and French (1993) three-factor model.

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