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An Empirical Study of the Chinese A-share Market Based on the Fama-French Three-Factor Model

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Abstract: In recent years, the international situation has been unpredictable, changes in the economic environment have profoundly affected people's psychological expectations, and the securities market has experienced different volatility, which brings challenges to the validity of the Fama-French three-factor model. Based on this model, this paper selects 20 stocks in the Chinese A-share market, divides them into six portfolios according to their size and book-to-market ratio, conducts a regression analysis of monthly returns from August 2017 to July 2022, and then verifies the explanatory power of the market factor, size factor, and book-to-market ratio factor on the excess returns of the stocks. The results demonstrated that the three factors can partially account for the variation in returns, with SMB having a more significant impact on small-cap companies and HML on firms with a high book-to-market ratio.

Keywords: Fama-French three-factor model, regression, rate of return, Chinese A-share market

1. Introduction

China's capital market started late and still suffers from several problems, with stock market returns exhibiting more obvious uniqueness and complexity. Although some Chinese academics have studied the Fama-French three-factor model's potential application in China in earlier years, in recent years, with the outbreak of covid 19, including generally high global inflation and constant interest rate hikes by the Federal Reserve, all these factors have had varying degrees of impact on the Chinese A-share market. The shift in the situation puts the validity of the model to the test. This paper conducts regression analysis on the market risk premium factor, size factor, and book-to-market ratio factor based on the Fama-French three-factor model and using Stata software to investigate the practical value of the three factors on the portfolio returns of the Chinese A-share market during the period from August 2017 to July 2022. And according to the empirical results, some patterns are summarized to provide reference values for stock investors and further improvement of the model.

2. Literature Review

Asset pricing has always been a hot topic in the financial world, and the rationality of the related models is the focus of research. With the establishment of portfolio theory by Harry M. Markowitz in 1952, the pioneer of asset pricing was established. Immediately after, William Sharpe put forth the

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well-known Capital Asset Pricing Model (CAPM), which included the beta factor to explain why the projected return is only correlated with the security's systematic risk.

$$Rit-Rft=\alpha i+\beta i(Rmt-Rft)+\mathcal{E}it \quad (1)$$

He believed that the return is unpredictable, which is also the core idea of Fama EHM theory [1]. In 1976, Stephen Ross proposed the Arbitrage Pricing Theory (APT) to estimate the value of assets, which in a way became an alternative theory to CAPM. It was not until 1993 that Fama and French took the SMB (Small Minus Big) and HML(High Minus Low) factors into account and proposed the three-factor model, which was certainly a refinement of the CAPM [2]. The Fama-French five-factor model was proposed in 2015 based on empirical evidence, and scholars from all walks of life are still testing its validity, and there are many different opinions.

In this paper, the Fama-French three-factor (FF3) model is selected for empirical evidence, and some important domestic studies on the FF3 model are briefly reviewed:

Yi et al. show that the three-factor model cannot be used in China because the book-to-market ratio cannot be incorporated into the model as a good explanatory variable, and suggest that a two-factor model can predict stock returns in China well [3].

Yang & Teng demonstrate that the Fama-French three-factor model can explain the Chinese stock market up to a point. The Chinese stock market has a minor firm influence: between January 1995 and February 2001, the average monthly returns of small-cap value portfolios in Shanghai were significantly higher than those of large-cap value portfolios but mixed and growth stocks in Shanghai and growth stocks in Shenzhen did not have the small firm effect [4].

Liao & Shen use Fama-French three-factor model to describe cross-sectional stock return changes and find that there is indeed a significant market effect after the split-share structure reform and that the market effect is positively related to the share reform consideration and the check-and-balance of ownership, and negatively related to equity concentration [5].

By comparing and examining the contemporaneous returns of asset portfolios in the US and Chinese capital markets, Tian et al. find that, unlike the US, the book-to-market ratio effect is less pronounced in the domestic market, but the systematic risk is more prominent and the market capitalization effect is more significant [6].

Li & Li selected 85 listed companies related to the 5G industry chain in China as the research sample, and according to the empirical findings, the five-factor model has less predictive ability than the three-factor model, while the size factor has a stronger influence on small-scale high-tech enterprises [7].

Zang argues that MKT (Market Factor), SMB, and HML can account for the volatility of portfolio returns in the stock market, but other components require more empirical support, and the effects of these three factors are different in different portfolios [8].

3. Methodology

3.1. Source and Selection of Sample Data

CSMAR is World leading economic and financial database, with the most up-to-date data. It has a top-notch R&D team and an independent financial laboratory and has entered into long-term partnerships with several internationally renowned academic research institutes and financial institutions. With accurate information sources, keen financial insights, and powerful technology, it has provided innovative products and services to thousands of educational organizations, research institutions, and financial institution clients worldwide. The data in this paper was obtained from the CSMAR database, excluding companies that were suspended, with obvious errors and missing data,

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by randomly selecting 20 stocks covering different sectors and collecting their trading data from August 2017 to July 2022 as a sample.

Monthly Return on Individual Shares Rit. The monthly return of individual stocks in this article is calculated from the monthly closing price. The formula is:

$$Rit=(Pit-Pit-1)/Pit-1 \quad (2)$$

The monthly closing price in period t is denoted by Pit, while period t-1's monthly closing price is denoted by Pit-1.

Market Monthly Yield Rmt. The stocks selected for the article were listed on the A-share market before August 2017. To measure the monthly market return relatively accurately, the monthly return of the index CSI 300 is used to approximate instead of Rmt, calculated as above.

Monthly Risk-Free Rate Rft. The article pulls the values of the monthly risk-free rate for that period directly from the database, and the overall change is smooth over the five years, remaining at 0.1241%.

3.2. Model Building

To show the model's robustness in the Chinese A-share market, we evaluate the data in this study using the Fama-French three-factor model. Here's the concept:

$$Rit-Rft=ai+bi(Rmt-Rft)+siSMBt+hiHMLt+Ɛit \quad (3)$$

Rmt-Rft, one of them, exhibits market risk premium, which is consistent with that in CAPM. The book-to-market ratio factor is HMLt, while the market capitalization factor is SMBt. In general, a stock is referred to as a value stock if its book-to-market ratio is high, and a growth stock if it is low. The 20 stocks are divided into 6 portfolios in a 2x3 manner in the following form.

Table 1: Portfolio Grouping Method.

Portfolio				
		Book-to-market Ratio		
Market size		H (30%)	M (40%)	L (30%)
	S	S/H	S/M	S/L
	B	B/H	B/M	B/L

$$SMBt=(S/H+S/M+S/L)/3-(B/H+B/M+B/L)/3 \quad (4)$$

$$HMLt=(S/H+B/H)/2-(S/L+B/L)/2 \quad (5)$$

4. Empirical Results & Discussion

To ensure the accuracy of the study results, the data are first tested before regression. The following empirical procedures are completed using Stata.

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4.1. Descriptive Statistics

Table 2: Descriptive Statistics Results.

Portfolio	S/H	S/M	S/L	B/H	B/M	B/L
Mean	-0.00533	-0.00322	-0.00315	-0.00754	0.00383	0.0231
Sd	0.0800	0.0640	0.0740	0.0605	0.0712	0.0768
Min	-0.201	-0.124	-0.205	-0.131	-0.125	-0.151
Max	0.169	0.166	0.180	0.133	0.213	0.165

The dependent variables' descriptive statistics are shown in Table 2. It can be seen that only B/M and B/L have positive average excess returns, while the other groups are less favorable. The mean values of S/H and B/H are relatively smaller in negative returns, indicating that companies with high book-to-market ratios are less profitable. In addition, the standard deviation of S/H is the highest among the six groups, which shows that companies with high book-to-market ratios of small market capitalization have a higher risk. Although this is consistent with the theory, it is clear that size is not negatively related to returns by sample data alone.

4.2. DF Test

Table 3: DF Test Results.

Portfolio	S/H	S/M	S/L	B/H	B/M	B/L	Rmt
t value	-8.113	-7.656	-7.986	-6.925	-7.429	-6.931	-7.037
p-value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

As evidenced by the data in Table 3, the t-values for each portfolio as well as the monthly market returns are significantly greater than the critical value of 1% - 3.567, there is no unit root, the null hypothesis is rejected and the test of smoothness is passed. This is in line with the reality that the monthly returns are relatively stable and generally without significant trends.

4.3. Fama-French Three-Factor Model Regression Analysis

Table 4: Fama-French Three-Factor Model Regression Results.

Portfolio	Cons.	Coefficient			F test		Goodness of Fit	
		MKTt	SMBt	HMLt	F value	P	R2	Adj R2
S/H	0.0107757	0.969811	0.7240906	0.6343191	66.30	0.0000	0.7803	0.7685
	(t=2.06 p=0.044)	(t=9.70 p=0.000)	(t=7.88 p=0.000)	(t=6.34 p=0.000)				
S/M	-0.0010365	0.9077896	0.5290806	-0.0979925	30.30	0.0000	0.6188	0.5984
	(t=-0.19 p=0.851)	(t=8.62 p=0.000)	(t=5.47 p=0.000)	(t=-0.93 p=0.375)				

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Table 4:(continued).

S/L	**-0.0009867**	**0.8368575**	**0.9855339**	**-0.395249**	**54.07**	**0.0000**	**0.7434**	**0.7269**
	(t=-0.19 p=0.851)	(t=8.37 p=0.000)	(t=10.73 p=0.000)	(t=-3.95 p=0.000)				
B/H	-0.0018476	0.8429266	-0.116448	0.516353	33.42	0.0000	0.6416	0.6224
	(t=-0.37 p=0.716)	(t=8.72 p=0.000)	(t=-1.31 p=0.195)	(t=5.34 p=0.000)				
B/M	0.0006854	0.8956515	-0.2669555	0.0788036	19.11	0.0000	0.5059	0.4794
	(t=0.10 p=0.922)	(t=6.71 p=0.000)	(t=-2.18 p=0.034)	(t=0.59 p=0.558)				
B/L	0.0099148	0.9758801	-0.3778913	-0.4540789	69.91	0.0000	0.7893	0.7780
	(t=2.02 p=0.048)	(t=10.37 p=0.000)	(t=-4.37 p=0.000)	(t=-4.82 p=0.000)				

Overall, all six sets of regressions pass the F-test, which indicates that the model is significant and the three Fama-French components can properly account for the excess return of the A-share market stock portfolio in the last five years. For the goodness of fit, the Adj R2 is greater than 0.5 except for B/M, which shows that the model fits well. Relative to H and M, S/L and B/L have better performance in the fit, suggesting that the three variables have more influence on stock returns when the book-to-market ratio is smaller.

For the constant term, except for S/H and B/L, all other groups failed the t-test at a 5% confidence level, indicating that there are other factors besides MKTt, SMBt, and HMLt that have a higher impact on the portfolio's excess return.

For the MKTt factor, it can be seen that the p-values are all equal to 0.000 and the regression results are significant. The regression coefficients for all six groups are greater than 0 and close to 1, indicating that the excess returns of the selected stocks are similar to the movements in the excess returns of the market and further demonstrating the reasonableness of the sample selection, which is representative of the market as a whole to a certain extent.

For the SMBt factor, B/H does not pass the t-test, while all small-cap groups pass the test, and the size factor has a more significant effect on the excess return of stocks in the small-cap group than in the large-cap group. In addition, regarding the correlation coefficients of the size factor SMBt, all small-cap groups are greater than 0 and all large-cap groups are less than 0. Thus, it can be seen that the excess return of small-cap stock portfolios has a positive relationship with the size factor and has better growth.

For the HMLt factor, only S/M and B/M do not pass the t-test, for which they can be neglected. The coefficients of the S/H and B/H groups are greater than 0, and the coefficients of the S/L and B/L groups are less than 0. The correlation coefficients do, to some extent, rise as the book-to-market ratio rises, which also suggests, obliquely, that portfolios of companies with high book-to-market ratios make higher returns.

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5. Conclusion

This study chooses monthly data of 20 listed businesses in the A-share market from August 2017 to July 2022 focusing on the Fama-French three-factor model, builds six portfolios for SH, SM, SL, BH, BM, and BL, respectively, and tests the explanatory power of MKT, SMB, and HML factors on their excess returns. The following conclusions are obtained: First, the Fama-French three-factor model has some applicability to China's A-share market. In the regression analysis, MKT passes the test perfectly and the return fluctuation is close to the market return change. Second, the SMB factor has better performance on small-cap stocks, and the excess return is positively related to company size. Investors should pay more attention to the small-cap effect in the Chinese stock market because the smaller the market capitalization of an individual stock, the easier it is to be manipulated by the market and the less money is available to drive the stock price up. Third, stocks with high book-to-market ratios tend to be accompanied by high returns. Although the above findings are basically consistent with the model, it cannot be denied that there are still portfolios that fail the t-test and there are additional elements that affect the excess return. This is also the shortcoming of this paper. In the subsequent research, further empirical evidence can be tried to introduce other factors, such as liquidity factors, according to the specific market environment. Meanwhile, the capacity of the sample data should be expanded. In the future, scholars may focus on a certain market segment or a specific industry to conduct relevant research and provide more specialized advice to investors.

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