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Pricing of Non-financial Assets Considering Bank Credit Risk

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Abstract: This paper selects the data of Shanghai and Shenzhen A-share listed companies and 12 commercial banks from January 2010 to December 2020, constructs A bank factor representing the level of bank credit risk and introduces it into the Fama-French three-factor model, and theoretically establishes a four-factor asset pricing model considering bank credit risk. The empirical test results show that: (1) In the non-financial market, the bank factor quantified by the level of bank credit risk plays a good role in explaining individual stocks, and can be used as the influence factor of asset pricing in the non-financial industry; (2) The addition of bank factor improves the comprehensive explanatory ability of market factor, size factor and book-to-market ratio factor, and reasonably expands and revises the Fama-French three-factor model theoretically. The results of this paper improve the pricing efficiency of the Fama-French three-factor model based on bank credit risk, and enrich and perfect the asset pricing theory to a certain extent.

Keywords: Bank credit risk, Fama-French three-factor model, Assets pricing.

1. Introduction

As for how to quantitatively describe the relationship between stock risk and return rate, foreign scholars first explored a set of theoretical system with capital asset pricing model as the core, and then carried out a series of researches on the multi-factor asset pricing model theory that affects the factors of stock excess return. It was not until sharpe revealed the relationship between stock risk and Asset return to the world clearly for the first time in 1970, and proposed Capital Asset Pricing Model (CAPM) [1] , that people gradually began to have a clearer understanding of the relationship between stock risk and asset return. This model holds that the stock return of an enterprise is only related to market risk. However, with the changes of the market and investors' investment behavior, people gradually found that the applicability of CAPM model is getting worse and worse. Scholars found that CAPM model has many theoretical and practical limitations. Faced with the complex and changeable capital market, scholars have launched a vigorous exploration of the multi-factor asset pricing model to further find more risk factors that can explain the excess return of stocks and improve the effectiveness of the asset pricing model.

In 1992, Fama and French [2] found that there was not a simple linear relationship between stock returns and market risk factors, and there were other premium factors in the market that affected the excess returns of stocks. Fama and French ranked the size of companies from small to large, and divided the market value index into small and large groups according to the middle point. Using the time series regression method, they found that the return rate of value stocks of small group and high BM ratio group was higher. The three-factor model has a profound impact on the asset pricing theory around the world. Many domestic and foreign scholars have conducted different studies based on the model, mainly focusing on two aspects: on the one hand, using relevant market data to test the effectiveness of the three-factor model in different industries and countries; On the other hand, other premium factors are introduced to explore the pricing efficiency difference between the new asset pricing model and the three-factor model.

In terms of verifying the validity of the three-factor model, domestic and foreign scholars mainly study the difference of the effect of the three-factor model on asset pricing in different industries and countries. Yang Xin and Chen Zhanhui [3] found that Chinese A-shares showed significant book-to-market ratio effect and scale effect. Robert Faff [4] empirically tested the Australian stock market with the three-factor model, and the results verified the applicability of this model to Australia. Jiang Jinxia [5] took the stock yield of GEM in 2017-2019 as the research object and found that the pricing efficiency of CAPM model was much higher than that of the three-factor model. For the assets of different countries and industries, the three-factor model also has different performance: Luo Xiaolei's [6] empirical test results prove that the three-factor model can play a good role in the explanation of the daily stock return rate of the main board and small and medium-sized board in China, but this explanation has not been reflected in the GEM. Cheng Shiyu [7] analyzed the monthly returns of automobile stocks from 2013 to 2018 as a sample, and believed that there was a significant scale effect and book-to-market effect in China's automobile industry. Zang Xueqing [8] takes home appliance industry as the research object and confirms that the effectiveness of the three-factor model is higher than that of the CAPM model.

Another aspect of the extended study of the three-factor model is to add other premium factors on the basis of the model to explore the pricing efficiency of the new model. The added premium factors include but are not limited to: management discussion and analysis factor, liquidity factor, corporate governance level, momentum factor, quality factor, growth factor and market sentiment factor. Jiang Yanhui and Ma Chaoqun [9] used text mining technology to extract DS factors to measure management discussion and analysis factors, and introduced them into the three-factor model. The empirical results showed that the newly added management discussion and analysis factors could effectively improve the pricing efficiency of the three-factor model. Liu Ruizhi [10] added liquidity factor into the three-factor model and found that the significance of liquidity factor was closely related to the reform of non-tradable shares, and the significance of liquidity factor after the reform was stronger than that before the reform. Qi Yue [11] found that the corporate governance level factor can significantly improve the pricing efficiency of the three-factor model. Liu Yuying [12] added the momentum factor, the quality factor and the growth factor into the three-factor model respectively, and found that the three premium factors all showed good premium explanation function, and the empirical test results showed that the momentum factor had the highest contribution to the model.

The financial system has been formed in the early stage of reform and opening up, during which all kinds of professional financial institutions have been restored and financial supervision system has been rebuilt, and financial markets have been formed initially. After 2012, the financial reform was carried out in an all-round way. With the prosperity, recovery and development of the market economy, China's financial industry gradually reached a sustained and high level of development. Commercial banks provide services of fund preparation and distribution for enterprises and various sectors in the economic market, which is an important link for the smooth progress of the whole social economic activities. Therefore, commercial banks are an important economic lifeline in our country. Their development conditions not only affect the stability and ordinality of the whole financial market form, but also bring indirect and even direct influence on the development of the whole non-financial industry. Once commercial banks fall into operation and turnover difficulties, it will inevitably affect the healthy development of non-financial enterprises.

Allen [13] used the data of Asian and European banks to draw a mathematical measure that could represent the risk of the overall banking system. Harvey [14] focused on carrying some factors related to stock portfolio returns and argued that some exogenous factors of the stock market provided a more satisfactory description of the macroeconomic forces, with deeper macroeconomic motives, and should ultimately determine stock returns and asset prices. Vassalou M. and Xing Y.[15] used Merton option pricing model and KMV model for the first time to measure the credit risk level of a single company, defined credit risk as a default risk, and applied this risk factor to the study on the impact of equity excess return. The empirical study found that bank default risk, as a systemic risk, has a stable pricing effect in the cross section of stock return. Pereira and Rua [16], starting from the three aspects of credit, bankruptcy and relevant empirical studies, showed that the level of bank credit risk has deeper macroeconomic motives, which can represent the financial distress of the whole economy and thus affect the excess return of individual shares of non-financial companies. Moody's KMV model is selected to estimate the default risk of each bank, and the change of the average default distance (DD) of all banks is taken as the premium factor. In the American stock market, a bank factor representing the credit risk level of banks in the asset pricing model research of non-financial industry is proposed, which is a risk factor affecting the asset pricing of non-financial companies in the United States. A series of studies show that bank credit risk, as the most important object of prevention and supervision in bank risk management, has been paid attention to by many domestic scholars and has been applied to asset pricing in non-financial industries.

Based on the above background, this paper starts from the bank credit risk, establishes an index to measure the level of bank credit risk, and selects commercial banks listed in Shanghai and Shenzhen A-shares from 2011 to 2020 as research samples to study the influence of commercial banks' credit risk level on the stock volatility of non-financial capital market enterprises.

2. Bank Factor Construction

2.1. Calculation of bank default distance

Firstly, the Black-Schole-Merton option pricing formula is used to calculate the market value of a single commercial bank, according to the standard Black-Scholes formula:

$$E=VN(d_1)-De^{-rt}N(d_2) \tag{1}$$

$$d_1=\frac{\ln\frac{V}{D}+(r+\frac{\sigma_V^2}{2})T}{\sigma_V\sqrt{T}},\quad d_2=d_1-\sigma_V\sqrt{T} \tag{2}$$

Where, E is the equity value of the bank; V is the market value of the bank's assets; D is the carrying value of the bank's liabilities r stands for risk-free interest rate; σ_V volatility of the market value of the bank's assets; σ_E is the volatility of the value of the bank's equity market; T is when the bank's debt matures; $N(d_1)$, $N(d_2)$ represents the standard cumulative positive distribution function.

By partial differentiation of equation (1), we can obtain the market value volatility of bank assets, σ_V, as shown in Equation (3) :

$$\begin{cases} \partial E=N(d_1)\partial V \\ \partial \ln E=\frac{V}{E}N(d_1)\partial \ln V \\ \sigma(\partial \ln E)=\frac{V}{E}N(d_1)\sigma(\partial \ln V) \\ \sigma_E=\frac{V}{E}\sigma_V N(d_1) \end{cases} \tag{3}$$

By combining (1) and (3), the asset value V and the volatility of the market value of bank assets σ_V can be obtained. Therefore, the default distance DD of a single bank can be calculated:

$$DD=\frac{V-DP}{V\sigma_V} \tag{4}$$

Where, DP (Default Point) represents the default point, which is located between current liabilities and total liabilities.

In order to accurately calculate the default distance DD in the Chinese market, parameters involved in the KMV model need to be modified and set.

(1) Correction and setting of equity value E

In KMV model, the equity market value E is the product of stock price and total number of stocks. Considering the special situation of our market, combined with predecessors' studies, the equity market value of our country is:

Equity market value E = number of tradable shares × stock price + number of non-tradable shares × net asset value per share (5)

(2) Correction and setting of stock value volatility σ_E

The historical volatility method is used to estimate the volatility of stock value. According to the KMV model, the stock prices of listed enterprises obey the lognormal distribution, then the formula of stock value volatility σ_E is as follows:

$$\begin{cases} \mu_i=\frac{\ln S_i}{\ln S_{i-1}} \\ \bar{\mu}=\frac{1}{n}\sum_{i=1}^{n}\mu_i \\ \sigma=\sqrt{\frac{1}{n-1}\left(\sum_{i=1}^{n}(\mu_i-\bar{\mu})^2\right.} \\ \sigma_E=\sqrt{N}\times\sigma \end{cases} \quad (6)$$

Where, μ_i represents the daily stock return, i =1,2... ,n; S_i and S_{i-1} represent the daily closing price of the stock on the i day and the i-1 day; $\bar{\mu}$ is average monthly stock returns; σ is the daily volatility of stock returns; N indicates the actual number of trading days included in each month; This article uses monthly data, so, σ_E represents the monthly volatility of stock values.

(3) Correction and setting of default point DP

According to the KMV model, the calculation formula of enterprise default point DP is as follows:

$$\text{Default point DP} = \text{short-term liabilities} + \frac{1}{2}\ \text{long-term liabilities} \quad (7)$$

The default points defined in KMV model are based on complete default data from abroad. As our country does not have enough default data, the above points of default are not applicable to Chinese listed companies. Zhang Wenfang and Wu Limei [17] argued that KMV model has the best measurement effect when the weight coefficients of medium, long and short term liabilities are both 1. Therefore:

$$DP=STD+LTD \quad (8)$$

Where, STD stands for short-term liabilities; LTD stands for long-term liabilities.

(4) Setting of risk-free interest rate r and calculation period T

The risk-free interest rate is an ideal investment return influenced by the benchmark interest rate. Considering the reality of the domestic national debt market with few types and poor liquidity, this paper takes the monthly interest rate converted by the 3-month fixed deposit interest rate as the risk-free interest rate r of the KMV model, and the debt cycle T is set as one month.

Through the above calculation, the monthly default distance DD of the 12 commercial banks listed on Shanghai and Shenzhen A-shares from January 2011 to December 2020 can be obtained, thus providing the basis for the construction of the bank factor below.

2.2. Construction of bank factor

In this paper, the KMV model will be used to measure the default distance and the default distance index will be added into the bank credit risk assessment, providing a core index for the construction of bank factors in this paper. According to the definition of bank factor by Pereira and Rua, the weight of the market value of a single bank in the total market value of all the banks under study and the default distance of these two variables can construct a bank factor representing the level of bank credit risk. Therefore, the mathematical expression of bank factor is:

$$BANK_t=\sum_{i=1}^{I}(DD_{i,t}\omega_{i,t}-DD_{i,t-1}\omega_{i,t-1}) \quad (9)$$

Where, $DD_{i,t}$ is the default distance of bank i at time t; $\omega_{i,t}$ is the weight of bank i's market value at time t (that is, the weight of bank i's market value at time t in the total market value of all banks).

3. Research design

3.1. Sample selection and data description

The commercial banks and non-financial industries selected in this paper are all from the domestic Shanghai and Shenzhen A-share markets, mainly from Wind database, public annual reports of listed commercial banks and daily trading price information of Shanghai and Shenzhen Stock exchanges.

For bank data, this paper selects 12 commercial banks listed on Shanghai and Shenzhen A-share exchanges (including China Construction Bank, Agricultural Bank of China, Bank of China, Industrial and Commercial Bank of China, Bank of Communications, China Merchants Bank, Minsheng Bank, Huaxia Bank, Citic Bank, Shanghai Pudong Development Bank, Guangfa Securities and Industrial Bank) as research objects. For the non-financial industry, A total of 2,800 enterprises from all non-financial industries listed on Shanghai and Shenzhen A-shares are selected (1,700 in Shanghai Stock Exchange and 1,100 in Shenzhen Stock Exchange). The book-to-market ratio of financial industry stocks is higher than that of non-financial industry stocks, which will have a greater impact on the investment group. Therefore, financial stocks are excluded and only 2,800 enterprises in non-financial industry are studied in this paper.

3.2. Model Setup

In this paper, bank factor is introduced into the three-factor model to construct the four-factor asset pricing model of non-financial industry. By referring to the research ideas of scholar Zhao Shengmin [18], the pricing effect of bank factor on assets of non-financial industry is tested. Therefore, the mathematical expression of the four-factor asset pricing model of non-financial industry constructed in this paper considering bank factor is as follows:

$$R_{it}-R_{ft}=\alpha_i+\beta_{it}(R_{mt}-R_{ft})+s_iSMB_t+h_iHML_t+b_{it}BANK_t+\varepsilon_{it} \quad (10)$$

Type, $(R_{mt}-R_{ft})$ is to reflect the market risk premium of the market factor; SMB_t represents the Size factor of time t, representing the size factor expressed by the company's market value (Size); HML_t represents the book-to-market ratio (B/M) factor of time t, which represents the value factor expressed by the ratio of book value to market value; β_{it}, s_i and h_i are the risk measures of each factor respectively; α_i represents the part not explained by the model; ε_{it} represents the residual term.

3.3. Variable construction and data grouping

A 2×3 grouping method was adopted to construct the impact factors and portfolios: Firstly, all stocks were divided into small group (S) and large group (B) according to 50% sub-loci. Secondly, the book-to-market ratio of all stocks was arranged from small to large and divided into three groups according to 30% and 70% subpoints: the first 30% was recorded as low-value group (L), the last 30% as high-value group (H), and the rest as medium-value group (M). Finally, the two classification indexes of market value and book-to-market ratio are intercrossed to form six size-value (Size-B/M) stock portfolios including SL, SM, SH, BL, BM and BH.

The construction method and calculation formula of the four explanatory variables are as follows:

(1) Market factor MKT

The 3-month fixed deposit interest rate of the Central bank is converted into the monthly interest rate as the risk-free interest rate R_f, and the return rate of Shanghai Composite Index (namely Shanghai and Shenzhen A-share Index) is used to calculate the market factor in this paper. The mathematical formula is as follows:

$$\text{Market factor MKT= Shanghai and Shenzhen A-Share Index - risk-free interest rate "}R_f\text{"} \quad (11)$$

(2) Scale factor SMB

According to the investment portfolios after the above groups, the weighted average rate of return of (SL+SM+SH)/3 of the small group is calculated first by using the idea of weighted average rate of return, and then the weighted average rate of return of the large group is calculated by (BL+BM+BH)/3 . Finally, the difference between the two is calculated and recorded as the size factor SMB. Therefore, the formula for calculating the scale factor SMB is:

$$SMB=(SL+SM+SH)/3-(BL+BM+BH)/3 \quad (12)$$

(3) book-to-market factor HML

According to the portfolios after the above groups, the weighted average rate of return (SH+BH)/2 of the group with high book value is first calculated, and then the weighted average rate of return (SL+BL)/2 of the group with low book value is calculated. Finally, the difference between the two is calculated and recorded as the value of the book-to-market factor HML. Therefore, the calculation formula of book-to-market ratio factor HML is as follows:

$$HML=(SH+BH)/2-(SL+BL)/2 \quad (13)$$

(4) BANK factor

The bank factor is defined in Equation (9), which needs to select the financial and market data of 12 listed commercial banks. Taking monthly as the calculation cycle, DD of default distance of each bank is calculated first through the book value of bank liabilities, asset value and their volatility according to the KMV model with modified parameters, and the volatility of default distance is generated by weighted market value index.

The explained variable is the monthly excess rate of return of the portfolio. The common rate of return is used to calculate the market rate of return R_{it} of asset i at time t. Then, the mathematical expression is:

$$R_{it}=\frac{S_{i,t}-S_{i,t-1}+D_{i,t}}{S_{i,t-1}} \quad (14)$$

Where, $S_{i,t}$ is the daily closing price of asset i at time t; In our country's stock market, the market yield of this paper does not consider the stock dividend $D_{i,t}$ from the hour T-1 to the hour t because the rights issue leads to fewer issues. The 5×5 grouping method proposed by scholars Fama and French was adopted to construct 25 benchmark portfolios, and the market value (Size) and book-to-market ratio (B/M) were sorted from small to large and divided into five groups. In this way, 25 portfolios under the Size-B/M grouping were divided into five groups. Finally, the average monthly rate of return of each group of stocks is taken as the rate of return of this group, and the excess rate of return can be obtained by differentiating with the risk-free rate. The above process is repeated to solve all the explained variables.

4. Empirical Analysis

4.1. Factor correlation analysis

The Pearson correlation test results of each factor are shown in Table 1:

Table 1. Four-factor Pearson correlation test results

	excess return	MKT	SMB	HML	BANK
excess return	1.00				
MKT	0.43	1.00			
SMB	0.54	0.21	1.00		
HML	0.50	0.20	0.39	1.00	
BANK	0.49	0.28	0.33	0.41	1.00

4.2. Multicollinearity test

Stata15.0 was used to complete the multicollinearity test, and the results are shown in Table 2:

Table 2. Multicollinearity test for four factors

variable	VIF	1/VIF
MKT	1.45	0.6897
SMB	1.67	0.5988
HML	2.24	0.4464
BANK	1.89	0.5291
Mean VIF	1.81	-

In Table 2, the VIF value of each factor is between 1.45 and 2.24, and the average VIF value is 1.81. Therefore, the degree of multicollinearity among the four factors is low, which can theoretically avoid the result of pseudo-regression.

4.3. Regression test and analysis

Regression analysis was carried out on the 5×5 portfolio under the Size-B/M grouping, and the test results were shown in Table 3:

Table 3. Four-factor regression test results

	book-to-marke (B/M)				
Size	Low 1	2	3	4	High 5
			α（intercept）		
Small 1	1.1051*	1.1689**	1.2194**	1.3181**	1.0102*
2	0.2901	0.6681	0.7110	0.6926	0.6709
3	0.0866	0.3721	0.3441	0.3070	0.2553
4	-0.3832	0.3480	0.1444	0.0177	-0.2554
Big 5	-0.4159*	0.0534	0.1701	-0.0471	-0.0447
			β（MKT coefficient）		
Small 1	1.2791***	1.2433***	1.1840***	1.2093***	1.2065***
2	1.2201***	1.2019***	1.2124***	1.1884***	1.2491***
3	1.2174***	1.1923***	1.1657***	1.1906***	1.2238***
4	1.1632***	1.1504***	1.1291***	1.1600***	1.2619***
Big 5	0.9310***	0.8831***	1.0584***	0.9457***	1.1459***
			s（SMB coefficient）		
Small 1	1.3287***	1.3164***	1.3407***	1.2986***	1.0475***
2	1.0052***	0.9014***	1.0821***	1.0715***	1.0224***
3	0.7431***	0.7939***	0.8963***	0.9336***	0.6866***
4	0.4940***	0.5758***	0.6030***	0.5863***	0.4829***
Big 5	-0.3535***	-0.2591***	-0.1109	0.2224	-0.0981
			h（HML coefficient）		
Small 1	-0.6679***	-0.4361***	-0.3485***	0.3203	-0.0540
2	-0.7244***	-0.5790**	-0.3734***	0.3641***	0.0018
3	-0.9643**	-0.5818**	-0.4652	0.2815***	-0.2523
4	-0.7350***	-0.6627**	-0.5016***	0.4181***	-0.2047
Big 5	-0.7248***	-0.6055**	-0.4354**	0.3331	0.1330***
			b（BANK coefficient）		
Small 1	0.6402**	0.6613**	0.4794*	0.5565**	0.7905***
2	0.4975**	0.5697**	0.4230*	0.3927	0.5613**
3	0.5761**	0.4074*	0.2289	0.3702*	0.4051**
4	0.3587*	0.2983*	0.2521	0.1925	0.4180**
Big 5	0.1780	-0.0089	0.0177	0.0254	0.1146

According to the above table, three coefficient items of the four-factor model are significantly different from zero respectively at the significance level of 10% and 5%. In general, the four-factor model can explain the excess return under the Size-B/M group.

The regression coefficients of market factor MKT are positively correlated with market excess returns, and all the excess returns of 5×5 portfolios are significant at 1% confidence level. Compared with other factors, the regression coefficients of market factor MKT are all higher, which proves that market factor has a higher explanatory power for the excess return of non-financial industry stocks.

The regression coefficients of the first four scale groups are all positive, and in the same value group, the smaller the scale, the larger the regression coefficient of the factor. Among the regression coefficients of the scale factor, 22 were significantly different from 0 at the significance level of 1%, among which, the regression coefficients of the first four scale groups were all significantly different from 0 at the significance level of 1%. As a whole, the size factor has a more obvious explanatory effect on the excess return of non-financial industry, especially on the return of small-market stocks.

Among the regression coefficients of book-to-market ratio factor HML, 7 regression coefficients are positive, and the rest are negative, and the absolute value of regression coefficients increases with the decrease of book-to-market ratio, indicating that book-to-market ratio factor has a better explanatory effect on the excess return of stocks in the small book-to-market ratio group. Among 25 regression coefficients, 12 regression coefficients were significant at the 1% significance level. As a whole, the book-to-market ratio factor plays a certain role in explaining the excess return of non-financial industries, especially in explaining the excess return of stocks in the small book-to-market ratio group.

The regression coefficient of the BANK factor bank changes roughly in the same direction as the market excess return, among which 24 are positive and 1 is negative, which is basically the same as the conclusion of Pereira, namely: the bank factor is positively correlated with the volatility of individual stocks in the non-financial market. It can be seen from the significance level that most of these significance are concentrated in the small group, and the banking factor has a more significant impact on the excess return of stocks in the small group as a whole.

4.4. Pricing efficiency test

Table 4 lists the GRS test results:

Table 4. Four-factor GRS test results

factor of influence	GRS statistics	$\lvert\alpha\rvert$	R^2
Market	21.0519	0.0029	0.7634
Market、SMB	19.7821	0.0015	0.7986
Market、SMB、HML	16.1249	0.0010	0.8104
Market、SMB、HML、BANK	10.9614	0.0009	0.8619

As can be seen from the table above, after the addition of the single traditional market factor to the scale factor, the GRS statistic decreases from 21.0519 to 19.7821, and the goodness of fit also increases from 0.7634 to 0.7986. After adding the book-to-market ratio factor, the GRS statistic of Fama-French three-factor model is 16.1249, which is 0.3572 lower than the statistic with only market factor and size factor, and the goodness of fit also increases. The last row in the table shows the GRS statistics and goodness of fit of the four-factor asset pricing model we constructed considering bank factors. Compared with the Fama-French three-factor model, the GRS statistics of the new four-factor model decreased from 16.1249 to 10.9614 after the addition of bank silver, with the largest decline. Moreover, the goodness of fit increased from 0.8104 to 0.8619, indicating that the four-factor asset pricing model considering the bank factor is effective, and the bank factor plays a good role in explaining the excess return of non-financial industry.

5. Conclusion and prospect

5.1. Conclusion

First, in the non-financial market, the bank factor, which represents the level of bank credit risk, shows good premium and can be used as the factor of asset pricing in the non-financial industry.

Secondly, there exist obvious scale effect, book-to-market effect and market effect in our non-financial markets, especially the small group and the low book-to-value (B/M) group have shown more obvious explanatory role. The coefficient of bank factor is mostly positive when it regress with the excess return of non-financial stocks, showing the same direction as the return.

Third, the addition of bank factor improves the explanatory ability of market factor, size factor and book-to-market ratio factor.

5.2. Prospect

This paper only selects the market data of recent ten years for empirical analysis. The time span is short, and the Chinese stock market in the future will have more complete data information. Under the condition of a long time span, the empirical test results will be more robust and reliable.

In the future, if some scholars are interested in related research, they may consider expanding the following research directions based on this paper: On the one hand, due to space constraints, this paper only uses 2×3 grouping to construct the portfolio. Future research can be extended to the influence of different grouping on the effectiveness of asset pricing model. For example, 2×2 grouping and 2×2×2×2 grouping can be used to construct the portfolio and compare when other conditions are the same. Whether and how different grouping methods affect the pricing efficiency of the model. On the other hand, based on Merton's Merton model, this paper uses KMV model to calculate the default distance so as to construct a bank factor to measure the level of bank credit risk. However, Merton model also requires many strong assumptions, such as: corporate value completely follows normal distribution, asset value follows geometric Brownian motion, etc. Therefore, in the future, bank credit risk and other methods to calculate default distance can be further explored, in order to optimize the construction of bank factors.

References

[1] SHARPE W F. Capital asset prices: a theory of market equilibrium under conditions of risk. Journal of Finance. Vol. 19 (1970) No. 3, p. 425-442.

[2] FAMA E.F, FRENCH K.R. Common risk factors in the returns on stocks and bonds. Journal of Financial Economics. Vol. 33 (1993) No. 1, p. 3-56.

[3] Yang Xin, Chen Zhanhui. An empirical study on the three-factor asset pricing model of Chinese stock market. Journal of Quantitative and Technical Economics. Vol. 12 (2003) No. 6, p. 137-141.

[4] ROBERT FAFF. A better three-factor model that explains more anomalies. Journal of Finance. Vol. 65 (2013) No. 2, p. 563-595.

[5] Jiang Jinxia. Validity analysis of Fama-French three-factor model on GEM market. Time Finance. Vol. 12 (2022) No. 1, p. 70-71.

[6] Luo Xiaolei. Empirical study on stock returns in China's A-share Market -- Based on Fama-French three-factor model. China Prices. Vol. 12 (2016) No. 9, p. 34-37.

[7] Cheng Shiyu, Fang Hua. Empirical Research on Stock Return Rate of Chinese Automobile Sector Based on Fama-French Three-factor Model. China Prices. Vol. 3 (2019) No. 1, p. 71-73.

[8] Zang Xueqing. Empirical Study on Application of Fama-French Three-factor Model in Domestic Household Appliances Industry. Investment and Entrepreneurship, 2021, 32(08): 25-27.

[9] Jiang Yanhui, Ma Chaoqun, Xiong Xixi. Text inertia Disclosure, Information Similarity and Asset Pricing of GEM Listed Companies: An Empirical analysis based on Fama-French improved Model. Chinese Journal of Management Science. Vol. 8 (2014) No. 4, p. 56-64.

[10] Liu Ruizhi. Empirical Test of Market Liquidity Pricing Based on Improved Fama-French Model [J]. Statistics and Decision, 2015, 11: 152-155.

[11] Qi Yue, Zhou Yidan, Zhang Yu. Research on the influence of corporate governance level on stock asset pricing -- Based on extended Empirical analysis of Fama-French three-factor model [J]. Journal of Industrial Technical Economics, 2020, 39(04): 113-122.

[12] Liu Y Y. Demonstration and extension of Fama-French three-factor model [D]. Guangdong University of Foreign Studies, 2019:22-35.

[13] ALLEN, LINDA, TURAN G. BALI, and YI TANG. Does Systemic Risk in the Financial Sector Predict Future Economic Downturns?[J]. Review of Financial Studies,2012, 25(10): 3000–3036.

[14] HARVEY, CAMPBELL, YAN LI, and HEQING ZHE. The Cross-Section of Expected Returns[J]. Journal of Financial Econometrics, 2013, 22(4):13-15.

[15] VASSALOU M, XING Y. Default risk in equity returns[J]. Journal of Finance, 2004, 59(2): 831-868.

[16] PEREIRA, JOÃO, PEDRO et al. Asset pricing with a bank risk factor[J]. Journal of Money Credit & Banking, 2018. 51(8): 108-162.

[17] Zhang Wenfang, Wu Limei, Cui Xiaoyan. Determination of default points of listed companies based on KMV model [J]. Statistics and Decision, 2016(14): 169-171.

[18] Zhao Shengmin, Yan Honglei, Zhang Kai. Is the Fama-French five-factor model better than the three-factor model -- Empirical Evidence from China's A-share Market [J]. Nankai Economic Research, 2016, 188(02): 41-59.