
Response of the Chinese Stock Market to the COVID-19 Outbreak: An Analysis Using the Fama-French Five-Factor Model

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Abstrat:

The Shanghai Stock Exchange 180 index (SSE 180) experienced a 17% decline from January 13 to March 23, 2020, due to the COVID-19 pandemic and the economic repercussions of measures implemented to curb the outbreak. However, from March 23 to August 13, the index rebounded significantly, achieving a 27% gain and ultimately ending 7% higher than its January 2020 level. This study investigates the response of the Chinese market to such unprecedented events, employing the Fama-French five-factor model as an analytical framework. The findings indicate that the Fama-French five-factor model remains robust in explaining the return rates of the Chinese stock market during the pandemic, consistent with prior research. Furthermore, the analysis suggests that COVID-19 had only a short-term impact on the Chinese stock market, attributable to the Chinese government's prompt and proactive measures to contain the virus's spread.

Keywords:

Asset pricing model; Fama-French fivefactor model; Chinese stock market; Impact of COVID-19 virus.

1. Introduction

The COVID-19 outbreak is a global pandemic caused by SARS-CoV-2. After being discovered in Wuhan in December 2019, the disease was quickly spread all over China and even the whole world in early 2020. It has gradually evolved into a global epidemic with 800,000 worldwide confirmed deaths to date.

The pandemic has had a huge impact on the Chinese economy. Compared with the SARS epidemic in 2003 [1], the outbreak of COVID-19 has negatively affected Chinese stock market significantly.

Starting on January 13, the Chinese government began to implement a series of measures, such as lockdown and isolation, to prevent the spread of this disease. These measures slowed economic activity.

China's financial regulator suspended trading on the Shanghai and Shenzhen stock exchanges on January 23. At this time, the SSE 180 fell by more than 3% [2,3]. The stock market resumed trading after the Chinese New Year on February 3[4]. Due to the rapid outbreak of COVID-19, the composite index plummeted by 7.72%. After the market depth adjustment on February 3, SSE 180 index hit 12-month lows. From January 13 to March 23, 2020, the Shanghai Stock Exchange 180 Index fell by 17% [5]. During this period, the average return on the stock market also fell by 10.1%. Until the end of March, the Shanghai Stock Exchange 180 index and stock yields began to gradually rise.

Eugene Fama and Kenneth French [6] put forward Fama-French five-factor model on basis of the three-factor model. It has strict constraints and theoretical assumptions. As the actual trading environment of different countries is different, the degree of constraint on the assumptions will also change. The efficacy of the Fama-French five-factor model has been test by many scholars in China's A-share market, like Zhao and Yan [7] and Qu [8] they believe that its explanatory power is better than other factor models. Whether the investment strategy can

obtain excess returns and predict the company's future profitability is tested applying the risks of market, market value, book-to-market value ratio, profit level risk and investment level as factors. But there is none of the research about the application of the Fama-French five-factor model in the Chinese stock market on pandemic or natural disaster period. In the work, Guided by the Fama-French five-factor [6] model, the article mainly studies the influence of COVID-19 on China stock markets by observing the Shanghai 180 index return rate and how does the Chinese stock market responding to the pandemic outbreak.

2. Literature review

The majority of Chinese stock studies focused on the efficiency or the analysis of the association between China stock market and foreign stock markets. Studies on the effect of the pandemic are rare, but there are researches on effects from natural disasters. Cao and Xiang [9] taking the 1998 floods and 2003 ice and snow disasters as sample points, empirically analyze the impact of climate emergencies on China's stock market and put forward relevant countermeasures and suggestions. Gen and Sun had a different view [10], they think the financial crisis and natural disasters have little impact on the whole Chinese stock market, they are limited to impacts on the insurance industries.

Back Wenshan Earthquake in 2008, Shan [11] concludes that after a severe natural disaster (such as the Wenchuan earthquake), negative investor sentiment will affect stock returns. Twelve months after the earthquake (2008.6-2009.5), the closer the company was to the epicenter, the lower the stock returns rate, and the inventory returns within 500 kilometers of the epicenter were significantly negative.

Three contributions in this aspect particularly relevant. According to the report of Chong et al [12], China's pharmaceutical stocks achieved significant positive abnormal returns, while the severe acute respiratory syndrome (SARS) significantly affected tourism stocks due to coronavirus. After examining 60 natural disaster announcements from 2003 to 2013, Li et al [13] observed that great negative stock returns are produced in China. Last, Sen and Puah analyzed [14] industries during the pandemic period, In this pandemic outbreak, the sectors of health care, information technology, and telecommunication services can relatively resist epidemic disease, but many sectors were hard hit by the outbreak of COVID-19.

3. Data

3.1. Data selection

The SSE daily returns and daily Fama-five factors used in this paper are from the CSMAR database. The SSE 180 includes 90% of companies in China's A-Share market. Data is gathered from Jan 2015 to July 2020, and it split into two groups, 2015 – 2019 and 2020.

3.2. Factor Construction:

Fama and French [1] put forward the following five-factor model:

$$R_{it} - R_{Ft} = a_i + b_i (R_{Mt} - R_{Ft}) + S_i \text{SMB}_i + h_i \text{HML} + r_i \text{RMW}_i + c_i \text{CMA}_i + e_{it}$$

Where

R_{it} is the SSE index return R_{Ft}

means the risk-free rate

R_{Mt} refers to the weighted average market portfolio return of market value $R_{Mt} -$

R_{Ft} stands for the market risk premium

SMB_t is the size factor, the variation between the return of a small market capitalization and a large market value capitalization portfolio

HML_t is the book-to-market value ratio factor, the variation between the return of high and low book-to-market ratio portfolios

RMW_t refers to the profitability factor, the variation between the return of a high operating profit rate and a low operating profit rate stock portfolio

CMA_t is the investment factor, the variation between the returns on conservative and aggressive investment stock portfolios

This article uses the 2x3 grouping method proposed by Fama and French [1] to construct risk factors. First, according to the median of the stock market value, all stocks are fallen into small and large market value (B); based on the book-to-market value of 30% and 70% quantile points, all stocks are divided into high (H) and medium (N) and low (L); secondly, two indicators of market value and book-to-market value ratio are crossed to divide all stocks into SH, SN, SL, BH, BN, and BL; again, operating profit separately rate and investment style instead of book-to- market value ratio, repeat the above steps to divide all stocks into SR, SN, SW, BR, BN, BW, SC, SN, SA, BC, BN, BA, among them, R represents profit Steady, W refers to weak profitability, C means conservative style of investment, A refers to aggressive style of investment, N refers to middle style of profitability or investment; Next, the weighted average rate of return on the market value of the above combinations is calculated; finally, use the difference in the portfolio yield constructs four factors.

The Figure below demonstrates the construction methods of each factor under 2×3 grouping:

$$\begin{aligned}
 &SMB_{B/M} = \frac{SH + SN + SL}{3} - \frac{BH + BN + BL}{3}, SMB_{OP} = \frac{SR + SN + SW}{3} - \frac{BR + BN + BW}{3} \\
 &SMB_{Inv} = \frac{SC + SN + SA}{3} - \frac{BC + BN + BA}{3} \\
 2 \times 3 &SMB = \frac{SMB_{B/M} + SMB_{OP} + SMB_{Inv}}{3}, HML = \frac{SH + BH}{2} - \frac{SL + BL}{2} \\
 &RMW = \frac{SR + BR}{2} - \frac{SW + BW}{2}, CMA = \frac{SC + BC}{2} - \frac{SA + BA}{2}
 \end{aligned}$$

Figure 1 Construction of the Fama-French Five factors

3.3. Descriptive statics and plot

Table 1: Fundamental statistical features of Fama-five factors and SSE Index before 2020

	Median	Mean	Max	Min	STD	SKEW
RiskPremium	0.00097	0.00038	0.07396	-0.09404	0.01668	-0.94795
SMB	0.00105	0.00035	0.05329	-0.07175	0.01007	-0.94161
HML	-0.00033	-0.00012	0.03698	-0.02993	0.00582	0.60330
RMW	-0.00032	0.00007	0.03918	-0.02495	0.00484	1.15563
CMA	-0.00006	-0.00010	0.01096	-0.01918	0.00321	-0.52766
Return rate of SSE index	0.00030	0.00020	0.06740	-0.09030	0.01522	-0.87645

Table 2: Fundamental statistical features of Fama-five factors and SSE Index in 2020

	Median	Mean	Max	Min	STD	SKEW
RiskPremium	0.00197	0.00121	0.05197	-0.08003	0.01615	-1.19341
SMB	0.00155	0.00064	0.01858	-0.02649	0.00643	-0.87936
HML	-0.00143	-0.00086	0.01537	-0.01305	0.00430	0.96216
RMW	0.00048	0.00014	0.01658	-0.00945	0.00433	0.35670
CMA	-0.00072	-0.00072	0.00707	-0.00923	0.00271	0.13263
Return rate of SSE index	0.00210	0.00070	0.06430	-0.07350	0.01626	-0.49458

Table 1 and Table 2 show the descriptive statistics of two groups in different period, table 1 represents the data before 2020, and table 2 represents the data after 2020. From the tables we can observe that median of return rate of SSE180 Index before 2020 is 0.09% higher than the median in 2020, and maximum of return rate drops from 6.7% to 6.4%, but the mean value of return rate in 2020 is 0.5% higher than before 2020, the return rate actually higher during the pandemic. This can be explained by Puah and Sen’s study result [14], When the Shanghai Composite Index fell to its lowest point in 12 months on February 3, the indices of all industries began to rebound. Among them, industry indicators related to pandemic control such as health care and technology [15,16] service increased rapidly. this is a good explanation for the mean value of 2020 is larger than before 2020 but the median is smaller. Also, we can see the mean of SSE index return changed among with the Fama-French factors mean value when the mean value of five factors increased, the return rate increased as well, therefore the return rate of SSE index has a positive linear relationship with the Fama-French factors, and illustrate the applicability of the Fama-French factors to explain the return on China's stock market portfolio.



Figure 2: SSE Index Return rate in 2020

From figure 2 we observe that start in the middle of January when the new coronavirus was discovered in Wuhan and began to spread to the whole of China, the SSE return rate started to fall and reached the minimum return rate of the year [17,18]. After the Chinese New Year in Feb 3th, the Chinese government began to stop the epidemic spread by implementing lockdown, isolation [19] and other policies, the return rate started to climb, at the mid-February, the return rate back to before the outbreak and even higher. Afterward, with China’s active fight against the pandemic, the SSE index return rate fluctuates sharply, until the pandemic was effectively controlled in April.

4. Regression Analysis

Table 3: Regression result before 2020

2015/01/01-2019/12/31 R ² =0.968	MKT	SMB	HML	RMW	CMA	Alpha
Coefficient	-0.0006	-0.0005	-0.0005	0.0009	0.0014	-0.0004
T-Stat	-0.715	-0.703	-0.658	0.960	1.551	-186.262

Table 4: Regression result in 2020

2020/1/1-2020/7/31 R ² =0.971	MKT	SMB	HML	RMW	CMA	Alpha
Coefficient	5.621x10 [^] (-16)	-2.498x10 [^] (-16)	4.857x10 [^] (-16)	7.563x10 [^] (-16)	-5.274x10 [^] (-16)	-0.0041
T-Stat	0.233	-0.145	0.225	0.338	-0.175	-6.37x10 [^] (14)

From table 3 and table 4 we can see both R² are very close to 1, which means the Fama-French factors model fits the Chinese stock market very well. Secondly before 2020, from the t-value, we can see RMW and CMA factors are more significant than the other three factors in the Chinese stock market. Alpha value has a strong negative correlation and least significant to the SSE Index return rate. In 2020, all five factors coefficient fall to an extremely small value, and the t-value of RMW and CMA decreased in varying degrees. On the contrary, the t-value of the other three factors rises, especially the t-value of Alpha increases the most, from -186.262 to -6.37 x 10[^] (-14). So, during the coronavirus pandemic, the effect of SMB increase, while MKT, HML, RMW are more significant, these three factors can better explain the return rate in the Chinese stock market.

5. Conclusion

This paper compares the Chinese stock market data in 2020 and before, using the Fama-French factor as a guide. In conclusion, the Fama-French factor model could still apply in the Chinese stock market during the pandemic period, it explains well the Chinese stock market return rate as many previous studies did. Before 2020, the profitability and investment style factor has more influential on the stock market's return rate, in the pandemic period, the significance of five-factors are changed, market risk premium, book-to-market value ratio, and profitability greatly affect the market return rate. Also, through the previous research on the influence of natural disasters on China stock market, serious disasters such as the SARAS, Wenchuan earthquake, these events cause the long-term stock market crash in different degrees. It can be seen from the data in this article, the return rate only rapidly declines in the first month of the outbreak of a pandemic. Compare to the US stock market in the same period, there is only a short-term effect on the Chinese stock market during this pandemic, this due to the timely and proactive response of the Chinese government to prevent the spread of the coronavirus. So, it could be concluded that there is a certainly rapidly decline of return rate in China stock markets at beginning of natural disasters, as long as the government takes action against the disaster, the disaster will not have a long-term impact on China stock markets, and during the disaster, the value of the stocks of companies in industries that are helpful for disaster relief will increase in the short term. This article provides references for stock investors and Chinese stock market regulators to respond to the Chinese stock market with natural disasters.

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