

Empirical Study and Reflection on the Impact of COVID-19 Pandemic on Chinese A-share Market

--Based on Fama French Five-factor Model

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Abstract: The COVID-19 pandemic has caused severe imbalances in the global economy and intensified stock market turmoil worldwide. Based on Fama-French five-factor model, this paper studies China's A-share market changes before and after the epidemic. The stocks treated by ST (special treatment) and * ST (delisting warning) are screened, excluding companies and banking stocks with shortlisting time. The equities are finally divided into groups using the two-by-three grouping approach. According to the median of the total market value of stocks, the entire sample is separated into two categories: modest market value (S) and large market value (B). The samples are classified into three categories based on the book-to-market ratio's 30% and 70% quantiles: high (H), medium (N), and low (L). Comparing the different times of the impact of the five factors on stock earnings is conducive to explaining the changes in the factors affecting the stock price of listed companies before and after the epidemic. It is possible to analyze which factors have declined and fluctuated after the epidemic, resulting in a decline in stock prices, a slowdown in the growth of listed companies, or even a recession. The analysis of the five-factor model can clarify which factors have led to the decline in stock prices after the beginning of the epidemic, which is conducive to the formulation of related policies and plans by listed companies and makes up for the decline in stock prices and the slowdown in company growth caused by the corresponding decline, which has apparent practical value.

Keywords: COVID-19 pandemic, Chinese A-share market, Fama-French five-factor model

1. Introduction

"What factors determine the return rate of stock portfolio" has always been a topic of discussion in financial circles. After continuous improvement, the model has developed from single factor to multi-factor, which significantly enriches the understanding of asset pricing by scholars in the industry. At first, Treynor, Sharpe, and others put forward the CAPM model. Its purpose is to study the equilibrium relationship between risk and required return under an entire portfolio, which can objectively explain the relationship between risk and return. However, the CAPM model has been challenged in many

aspects as a single-factor model. For example, in the actual situation, the foundation of model building is difficult to exist, and the model assumptions are too harsh. Fama and French proposed a three-factor model to describe the return rate of stocks to increase the ability to explain and predict the rate of return. Market value factor (SMB) and book-to-market ratio factor (HML), based on the CAPM model, were added in 1992 after research on the factors affecting the differences in return rates of various stocks on the American stock market revealed that the beta value of the stock market was unable to adequately explain these differences. According to the Fama-French model, exposure to three components, including market value factor (SMB), book-to-market ratio factor (HML), and market portfolio ($R_m - R_f$), may account for the excess returns of a portfolio, which includes (a single company). The selection of components is easily impacted by subjective opinion, and the study results are vulnerable to the selection of factors, even if the Fama-French model accounts for the size effect and value effect that CAPM cannot explain. Some stocks' intercept A in empirical study considerably differs from zero. To more accurately assess the capacity to achieve excess returns through active investment management, profit factor (RMW) and investment factor (CMA) is added based on the three-factor model, which takes into account the influence of system risk, book-to-market ratio, market value scale factor, and profit factor. Since 2020, Novel Coronavirus has spread all over the world. Facing the sudden outbreak has seriously affected the economic development of many countries, including China. The epidemic impacted China's A-share market before the Spring Festival; from January 21 to 23, the Shanghai Composite Index fell by nearly 4% and fell below the integer level of 3,000 points. The Shanghai Composite Index dropped by more than 10% in one trading day before and after the Spring Festival in 2020, and 3,209 stocks fell on February 3, 2020, creating a real stampede of systemic risk. This decline was caused by the rise in the number of confirmed cases and suspected cases as well as the influence of people's pessimism. As of February 4, 2020, the decline of the Shanghai Composite Index in the recent three trading days narrowed to about 9%, and the Shanghai Composite Index dropped from about 3,100 points to the lowest of 2,746.61 points, a decrease of about 11%. It can be seen that China's A-share market has been dramatically impacted by the epidemic. In light of the COVID-19 epidemic, this study examines the effect on the Chinese A-share market based on the Fama-French theory.

In the process of research, we first calculated the five factors of A shares per day before and after the epidemic, then conducted a significance test on the factors before and after the epidemic, and then regressed the return of stocks and the panel data of five factors to obtain a regression model, which showed the changes in the interpretation ability of each factor before and after the epidemic to the stock earnings.

Comparing the results of panel data regression before and after the outbreak, the following conclusions can be drawn:

The five risk factors all have a considerable positive impact on the listed company's stock price yield after the outbreak. Until the outbreak, the SMB factor and the RMW factor had a significantly negative impact on the listed company's stock price yield.

Before the epidemic, the RM factor was the risk factor that had the biggest effect on the stock price income of listed firms. Following the outbreak, the CMA factor was the one with the main consequences on the stock price yield of listed companies.

Before and after the epidemic outbreak, there are apparent differences in the interpretation of the yield of listed companies by the five risk factors.

The structure of this paper is as follows: The first part summarizes the theories of the CAPM model, Fama-French three-factor model, and five-factor model and introduces the impact of the epidemic on China's A-share market; The second part uses Fama-French five-factor model to analyze the changes of China's A-share market before and after the epidemic; In the third part, the daily values of 16 months before and after the epidemic are selected as reference data in Wind database; In the fourth

part, the selected A shares are grouped by using Fama-French five-factor model; Finally, the conclusion summarizes the research results of the article, explores the shortcomings of the research and makes future research plans.

2. Research Problem

2.1. The Impact of the Epidemic on the Stock Market

From the industry point of view, the epidemic's impact on different industries is different. Zhang Zhiping, Zhu Siying, and Lu Fengguang pointed out that the short-term impact of the COVID-19 pandemic on the capital market is severe, and has prominent industry heterogeneity characteristics. Industries greatly affected by the epidemic highlight stronger impact effects, and investor sentiment is a vital transmission path for the impact effects of the capital market in the COVID-19 pandemic [1].

Investor sentiment fluctuations caused by the epidemic will also significantly impact stock prices. When researching the SARS outbreak, Qin Qiwen and Zhou Yongkang discovered that a disproportionate market reaction can occur if the bulk of stock market investors had an unfavorable outlook on purchasing [2]. The broad scope and long time of this COVID-19 pandemic make the fluctuation of the stock market more obvious, and at the same time, it also causes significant damage to the real economy. Investors' negative emotions and stock price differences between industries are changing with the development of the epidemic. On the premise of predecessors' rich research results on the influencing factors of the epidemic situation, If we can explore the laws and changes of China's stock market in the face of major public health events through particular theoretical research, on the one hand, we can deepen the cognition of the epidemic on the economic impact, on the other hand, we can also provide preventive measures for future emergencies so that the stock market can be effectively controlled. The normal operation of the capital market can be ensured.

Wang Qing, Wang Zhongli, Li Shixue, and Xue Fuzhong noted that the impact mechanism of the "novel coronavirus pneumonia" epidemic on short-term stock price fluctuations is primarily caused by short-term emotional changes, which exacerbate investors' fear and anxiety, and the stock price is adjusted downward due to investors' emotional fluctuations and conservative risk appetite. The majority of stock market investors have a negative outlook, making them less likely to make investments, which will harm the market and even cause an exaggerated market reaction [3].

2.2. The Epidemic Hurts the Return Rate of the Stock Market

Chenfeng Gong examined how the new coronavirus pneumonia epidemic affected the Chinese stock market. It has been discovered that the outbreak has a deleterious effect on the stock market's return rate and a positive effect on its volatility. The stock market's return rate dramatically fell throughout the pandemic period, while its volatility significantly rose. The performance of several firms under the impact of the epidemic was empirically examined using financial indicators, type indicators, and regional indicators [4].

3. Research Data

The data in this paper comes from Joinquant data, and A shares are selected as stock samples. Because the COVID-19 pandemic began to spread in China in December 2019, the daily values from December 2017 to November 2019 and from December 2019 to November 2022 were selected as the comparative data before and after the outbreak.

To screen the stock samples, the first screen out the stocks treated by ST (special treatment) and *

ST (delisting warning) to avoid the impact of listed companies with delisting risk on the overall research. Second, removing companies with a quick time to market will change the research sample data if those companies are included.



Figure 1: The trend of the CSI 300 Index in recent years.

Based on figure 1, the CSI 300 Index was stable before the epidemic. Within one year after the outbreak, the CSI 300 Index was in an upward stage. One year later, influenced by geopolitics and the global economic environment and policies, it entered a downward stage and returned to the scope before the epidemic.



Figure 2: The trend of the medical manufacturing industry in recent years.

Based on figure 2, the medical manufacturing industry as a whole is also significantly affected by the epidemic. The epidemic has made the market realize the great value of medical companies. The epidemic outbreak has made companies such as masks, ventilators, vaccine research and development, and virus prevention and control perform well, so they are popular. With the growth over time, due to policies, epidemic situations, and other reasons, the medical service industry has been affected to some extent, which is not as favored by the market as within six months after the outbreak of the epidemic, and the market heat tends to slow down.



Figure 3: The trend of the food industry in recent years.

Based on figure 3, this is the rose trending of the A-share food industry, which changed before and after the epidemic, especially in the year after the outbreak, indicating that after the outbreak, the food and beverage sector was favored by the market and welcomed by investors, but then it trended to go down.

4. Research Method

To more accurately characterize the excess return rate of a portfolio, this study opts for the Fama-French five-factor model and supplements it with profitability and investing style fact-based on the three-factor model. The profitability factor among them represents the variation in return rates between stock portfolios with strong profitability and those with weak profitability. The return rate of a stock portfolio with a conservative versus aggressive investment strategy can be seen by looking at investment style characteristics. R_{it} represents the return rate of the stock portfolio i at time t in the Fama-French five-factor model, while R_{ft} stands in for the risk-free interest rate at that same moment. The market portfolio factor ($R_{Mt} - R_{ft}$), which often denotes the difference between the return rate of the market portfolio weighted by market value and the risk-free interest rate, is represented by the α_i on the right side of the equal sign. The dimension SMB_t stands for the variance in returns between portfolios of small- and large-cap stocks; The difference in the return rate of stock portfolios with high and low book-to-market ratios is the book-to-market ratio factor HML_t ; A residual term called ϵ_{it} has a mean value of 0. By using the weighted average method of market value in the database, the market portfolio factor $R_{Mt} - R_{ft}$ is derived, taking into account the difference between the total

monthly market return rate of cash dividend reinvestment and the risk-free interest rate; The total market value of each stock during the t-1 year is used to calculate the size of listed firms (Size); The book-to-market ratio (BM) is calculated by dividing the overall market value at the end of time 1 by the book owner equity of the company. Profit factor RMWt represents the difference between the return on the stock portfolio of profitable and unprofitable enterprises; The element of investment The difference between a company's stock portfolio's return rate with low investment and high investment is represented by CMAT. Because Chinese and American accounting rules differ, profitability (OP) is determined by "operating profit/total owner's equity = operational profit rate"; investment (Inv) relies on the ratio of the increase in total assets from the end of t-1 to the end of t-2. In this study, equities are grouped using the 2 3 grouping approach. According to the median of the total market value of stocks, all samples are first separated into small market value (S) and large market value (B). According to the 30% and 70% quantiles of the book-to-market ratio, samples are split into three groups: high (H), medium (N), and low (L). Second, the samples are split into six combinations: SH, SN, SL, BH, BN, and BL, and the market value to book market value ratio is cross-constructed; Thirdly, the entire sample can be divided into 12 combinations using the operational profit rate and investment in place of the book-to-market ratio: SR, SN, SW, BR, BN, BW, SC, SN, SA, BC, BN, and BA. Then, determine the market worth of various combinations for each period's weighted average return rate; Finally, the difference between the average values of various combinations is used to calculate the value of each factor in each period.

The research in this paper mainly verifies the difference between the impact of the five factors on equity earnings before and after the epidemic from the perspective of empirical analysis. This paper used data from Joinquant's study on 2018-2022. The entire study interval was divided into two parts, the time range before the outbreak was November 28, 2017, to November 28, 2019, and the time range after the epidemic was December 12, 2019, to December 12, 2021.

The five risk categories in this study are estimated before and after the epidemic: market risk, market capitalization risk, book market value ratio risk, profitability level risk, and investment level risk. Additionally, there was a substantial difference between the five risk factors before and after the outbreak.

The study used a panel data regression model to verify the similarities and differences between the impact of five risk factors on the yield of listed companies in the A-share market before and after the epidemic. In this section, the same calculation period as before is used, the risk factor results calculated above are used, and the daily rate of return data of the stock prices of non-suspended and non-ST stocks of Shanghai and Shenzhen listed companies are selected for panel data regression analysis. The relationship between the five risk factors and the stock price yield of the listed company is analyzed.

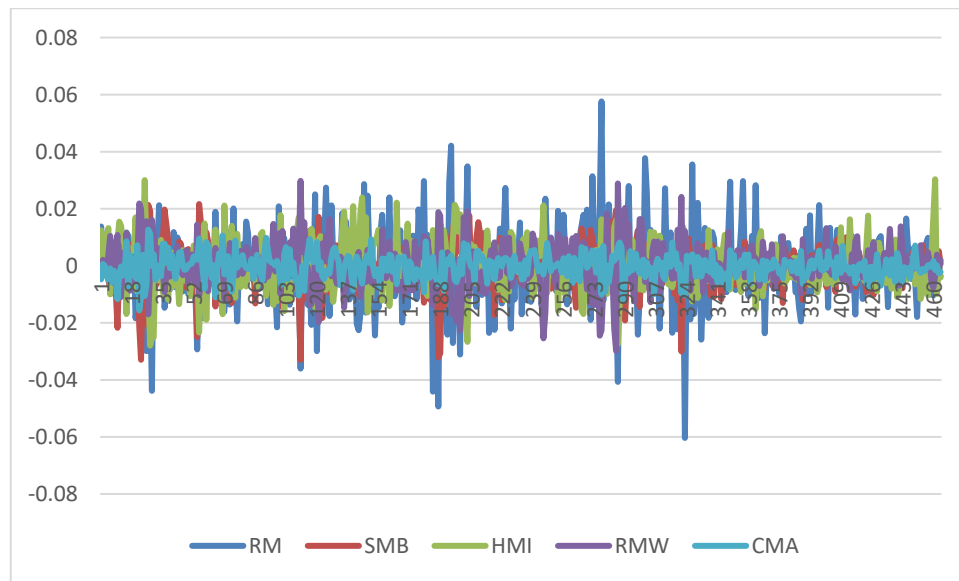


Figure 4: The five-factor time series trend plot.

Figure 4 shows the calculation of the five risk factors before the outbreak. As can be seen from the figure, the five risk factors are all smooth time series, the CMA factor fluctuates the least, the RM factor fluctuates the most, and the mean of the five risk factors is similar.

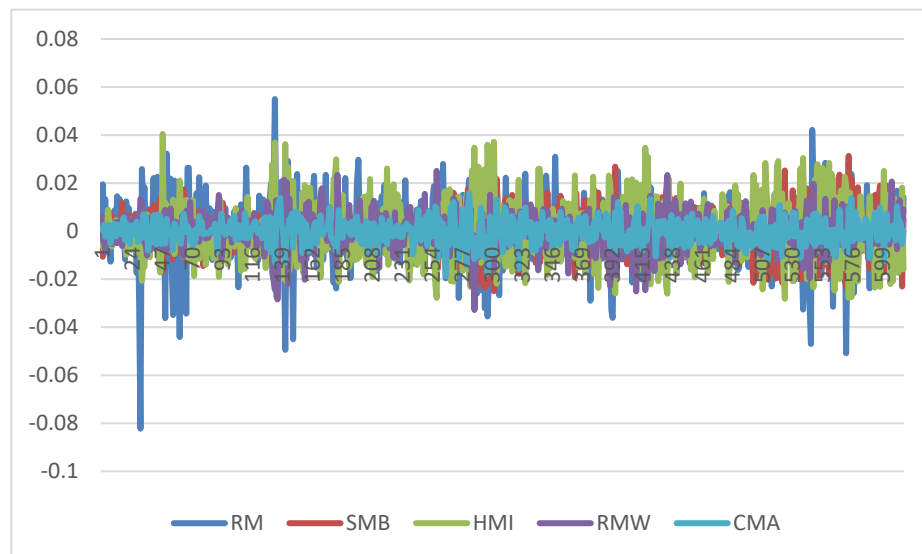


Figure 5: The time series plot of five factors after the outbreak.

Figure 5 is a time-series chart of the five risk factors after the outbreak. Looking at the time frame after the epidemic alone, the RM factor remains the greater fluctuation, and the CMA factor is the less volatile. Comparing the two time periods, it can be found that the fluctuation amplitude of various factors after the epidemic has increased. The mean is still within a similar interval.

The significance t-test will then be used in this research to determine whether there is a significant difference between the means of each risk factor prior to and following the epidemic.

Table 1: Significance test results.

Time \ Factor	RM	SMB	HMI	RMW	CMA
Before the pandemic	-0.384553	0.243875	0.389250	0.706772	-0.568339
After the pandemic	0.700644	0.807374	0.697168	0.479861	0.569923

According to the results shown in table 1, there is no discernible variation between the five risk factors' averages before and after the epidemic, which suggests there is also no substantial difference between the five factors themselves.

The five-factor model's similarities and differences in understanding the return on stock prices of listed companies are then confirmed using a panel data regression model.

The time range is the same. The same is true of the filtering of listed companies. The results of panel data regression before the outbreak are as follows:

$$return_{it} = -0.001036 + 1.135936RM_{it} - 0.256631SMB_{it} + 0.037079HMI_{it} - 0.813302RMW_{it} + 0.824123CMA_{it} \quad (1)$$

The regression results of the panel data model after the outbreak are as follows:

$$return_{it} = 0.002636 + 0.666458RM_{it} + 0.684374SMB_{it} + 0.456273HMI_{it} + 0.783217RMW_{it} + 1.474436CMA_{it} \quad (2)$$

Comparing the results of panel data regression before and after the outbreak, the following conclusions can be drawn [5-7]:

The five risk factors all have a large beneficial impact on the listed company's stock price yield after the outbreak. Prior to the outbreak, the SMB factor and the RMW factor had a minimally negative impact on the listed company's stock price yield [8-10].

Prior to the epidemic, the RM factor was the risk factor that had the biggest effect on the stock price income of listed firms. Following the outbreak, the CMA factor was the one with the biggest effects on the stock price yield of listed companies [11].

There are obvious discrepancies between how the five risk criteria are used to analyze the yield of listed companies before and after the epidemic outbreak.

5. Conclusion

The spread of the disease has had a significant impact on China's economic growth. The majority of domestic businesses have stopped producing as a result of the widespread isolation measures taken during the early stages of the epidemic, which has increased the pressure on businesses in the short term. On the demand side, the short-term decline in consumption, investment, and export has all exceeded 20%. China's stock market crashed on February 3, 2020, and all major indices experienced a significant decline. More than 3,000 equities decreased on that day. As the epidemic spreads, there will be a great deal of uncertainty, increased risk, and shifting investor attitudes. Investors will abandon risky stocks and other assets in favor of the safer bond market. Additionally, a herd effect emerges as this market mentality spreads quickly and easily. Additionally, it has been discovered that the outbreak has a negative effect on the stock market's return rate and a positive effect on its volatility. The stock market's return rate dramatically fell throughout the pandemic period, while its volatility significantly rose. Based on this context, this article uses the Fama-French five-factor model to assess

the changes in China's A-share market before and after the outbreak.

This study samples data from the A-share market in China analyzes market trends before and after the outbreak using the Fama-French five-factor model and conducts an empirical test.

However, due to the lack of time data available for research, many complex reasons behind the research results are not further discussed. For example, the negative impact of the epidemic on investors is expanded based on previous studies, but the factors of other models are not explored. In the study of the applicability of each factor model, the reasons for analyzing the effects of China's stock market are not obvious. In the future, research will be based on the above research deficiencies for appropriate adjustments to explain the excess returns of each factor above will be an in-depth study.

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