The Impact of COVID-19 on the Medical Industry Based on the OLS Model

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Abstract—The large-scale outbreak of the new crown in 2020 has led to a great blow to China's economy. In order to investigate the impact of COVID-19's on China's stock market, the daily return data of stock index, bank and medical sector were collected for ordinary least square linear regression analysis, and the results were tested for significance. Based on the analysis, it is concluded that the COVID-19 basically had a negative impact on the domestic stock market, especially in the banking industry, while the medical industry had the opposite impact. However, over time, these effects have also stabilized with the Chinese government's policy instruments to control the COVID-19. Overall, these results shed light on the impact of COVID-19 on Chinese stock market.

Keywords-COVID-19; OLS; Medical industry.

1 INTRODUCTION

Since the reform and opening up, China's economy has entered a stage of rapid development. However, in 2019, an unexplained new crown case was discovered in Wuhan, Hubei, China. In 2020, the outbreak of the new crown virus has become the main uncertainty factor for China's economic development. On January 30, the World Health Organization declared the "COVID-19" outbreak a public health emergency of international concern. On March 12, 2020, there have been a total of 233,672 cases nationwide and a total of 8,933 deaths, which has a considerable impact on China's economy. Even though China has adopted strict prevention and control measures, such as city closures, traffic restrictions, and border closures, it is still difficult to resist the adverse impact of the epidemic on the economy, raising China's unemployment rate and seriously affecting imports and exports [1]

The stock market serves as a barometer of the economy. The stock price will not only change with the economic cycle, but also change according to the form of economic development expressed by Wen [2]. From the performance of the A-share market during the SARS period from 2002 to 2003, from the outbreak of the epidemic in Guangdong in November 2002, the market seems to be no apparent reaction to this. Until the outbreak worsened in April, under a series of measures such as the central government's personnel appointment and removal measures on April 17 and the premier's clear warning on April 19 that the actual epidemic situation should not be concealed or underreported, the market turned into a rapid decline. From April 17 to 25, the Shanghai Stock Exchange index fell from 1613.60 points to 1487.15 points in 8 days, a decrease of 7.84%. Although the Chinese stock market is closed during the Spring Festival.

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Before the holiday, the Shanghai Composite Index and Shenzhen Component Index fell 2.75% and 3.52% after the market respectively, which also worried that the further deterioration of the epidemic would affect the Chinese economy. On this occasion, one should pay close attention to the fundamentals and not panic too much. Guosheng Securities claimed that the current outbreak of the new coronavirus in Wuhan has become a new factor of uncertainty. If the epidemic cannot be effectively contained and becomes a repeat of the historical "SARS" epidemic, it will have an impact on the stock market. Although it will not directly affect the securities trading, it will cause the expected decline of residents' consumption and attack the trend of economic recovery, which will indirectly have a negative impact on the stock market. Therefore, it is a sudden factor that must be paid attention to.

Regarding the impact of the new crown pneumonia epidemic on China's financial market, this article first selects the daily returns of the Shanghai Composite Index and Shenzhen Component Index to analyze the overall changes during the epidemic. The second is to take the banking sector and medical sector of A-shares as examples, and choose to compare the returns before and after the outbreak of the epidemic based on March 1, 2020, to analyze whether there is an overreaction. Referring to the research methods of Lin and Chen, we decided to use the Fama-French five-factor model and the OLS model for research analysis [3, 4]. According to the results, the epidemic had a huge impact on the Chinese stock market in the early stage, but as the epidemic was properly controlled, the impact gradually diminished. For the medical industry, the empirical analysis of the medical industry obtained by Duan is consistent with our analysis results, which has a positive impact on the medical industry [5]. For the banking industry, according to Wang, the analysis of the impact of the COVID-19 on the banking industry is consistent with the obtained results, and there is a long-term negative impact on the banking industry [6].

2 LITERATURE REVIEW

There have been many emergencies in history, e.g., the plague that swept across Europe in the 14th century, killing 25 million Europeans, accounting for about 1/3 of the population at that time. The SARS incident in 2002, the SARS virus in Guangdong in 2002 It appeared and spread to Southeast Asia and the world, resulting in the death of many medical staff and infected people. As well as the new crown epidemic this year, it has also been listed as a public health emergency of international concern by the World Health Organization. The above three have similarities (e.g., suddenness, high contagion and danger of taking lives), which will cause social panic and have a big blow to the national economy by Jin [7].

There are a lot of literatures about the impact of emergencies on the stock market. Xu took Brexit as an example and found that the five days before and after Brexit had a greater impact on the stock market through the event research method, and explained that the emergencies occurred on the day of voting. It had a negative impact on the world stock market [8]. Liu pointed out that the 9/11 incident had a huge impact on the U.S. economy by affecting trade, exchange rates, financial market channels, etc., causing the U.S. economy to decline. Due to economic globalization, the impact also spread to the world, including China [9]. The above is the impact of emergencies on the stock market. Relatively speaking, emergencies cover a wider range, i.e., there are relatively few empirical studies on the impact of health emergencies such as the new crown on the stock market.

Zhang analyzed the stock market under the influence of the new crown for companies of different industries and sizes by analogy to SARS [10]. It is believed that even if the SARS virus and the new coronavirus are similar in nature, the impact on companies of the same size in the same industry is different. Chen proposed that when the number of cases in a region increases and the epidemic becomes more severe, the stock price of listed companies in the region will fall more significantly [11]. In view of the lack of research on the empirical analysis of stocks under the impact of the new crown epidemic, inspired by the above two reports, this paper aims to study the impact of the epidemic on stocks before and after the epidemic and the increase in the number of infected people. Based on the conjecture that the medical industry and the epidemic should be positively correlated, select the bank and the pharmaceutical industry are used for specific examples to verify.

Research on this issue can help us understand the efficiency of our country's handling of incidents when it is hit by emergencies, and provide substantive cases for preventing and defusing the impact in the future, helping investors learn lessons and understand how the market responds.

3 METHODOLOGY

3.1 Framework

In this paper, the research period is from December 6, 2017 to March 11, 2022, then the December 6, 2017 to March 10, 2020 is the date before the outbreak, and January 19, 2020 to March 11, 2022 is the date after outbreak The data of Shanghai Composite Index, Shenzhen Component Index and A-share banking sector and medical sector are selected as the initial samples. Average all the data and analyzed. A total of 8949 effective samples are accumulated. The stock data are from CSMAR and the epidemic data is from WeChat official account man-yi-666. Growth rate of epidemic population in this paper comes from the real-time big data report of the epidemic, which is updated once a day.

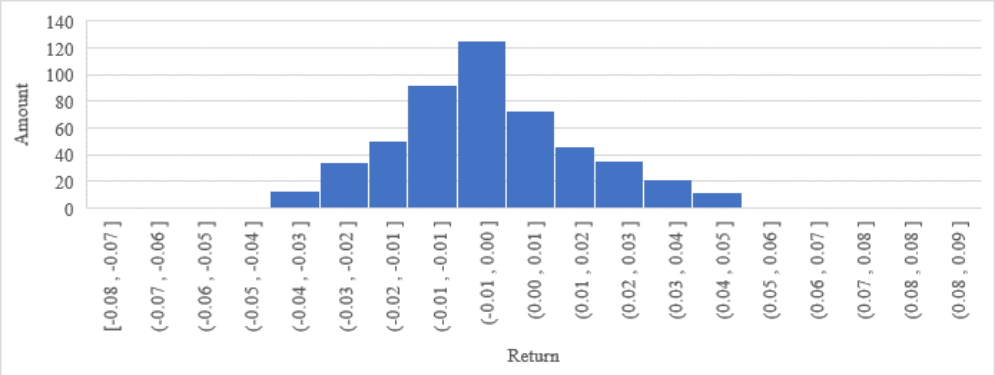

Figure 1. Bank return before COVID-19

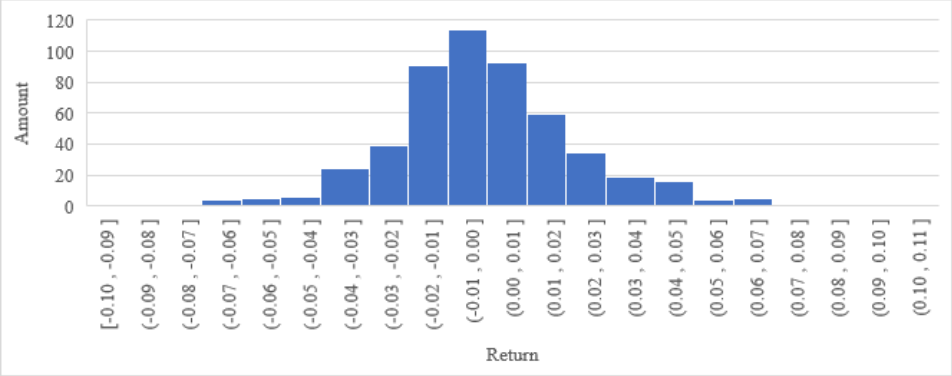

Figure 2. Bank return after COVID-19

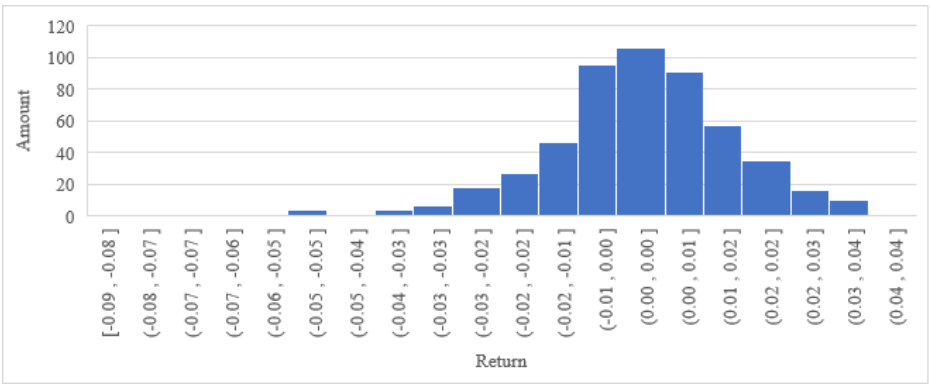

Figure 3. Shenzhen index before COVID-19

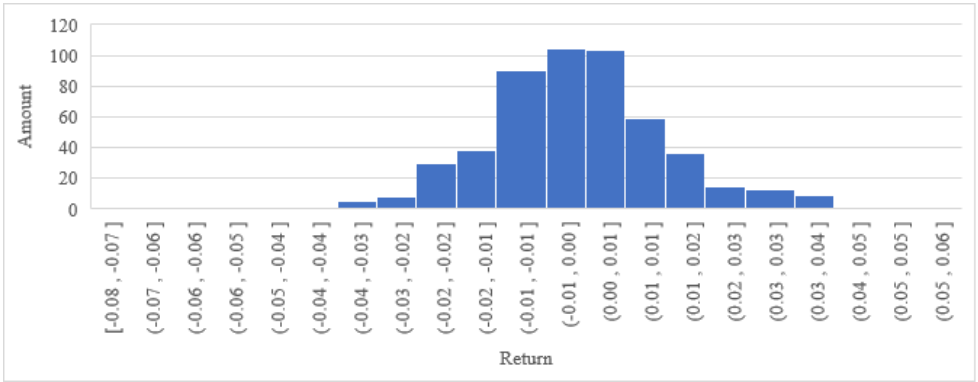

Figure 4. Shenzhen index after COVID-19

Figure 5. Shanghai index before COVID-19

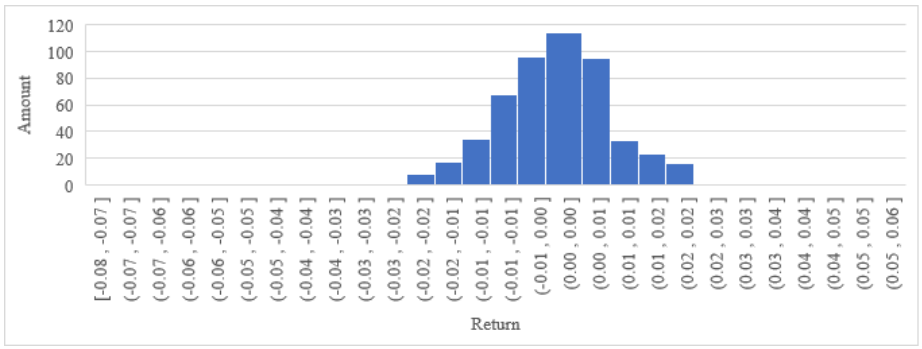

Figure 6. Shanghai index before COVID-19

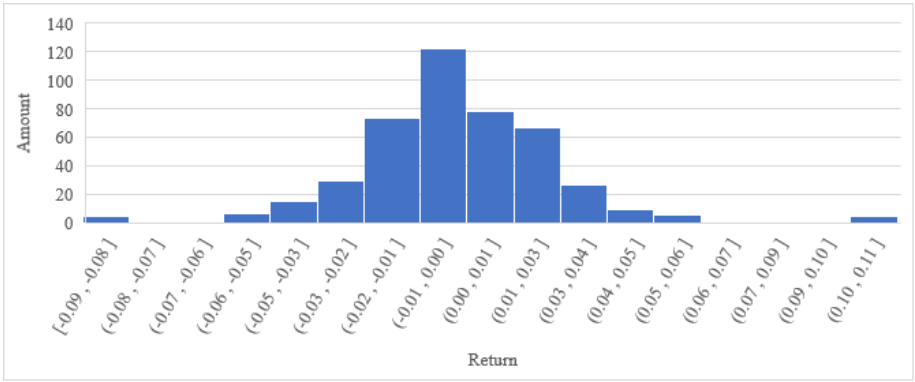

Figure 7. Medical return before COVID-19

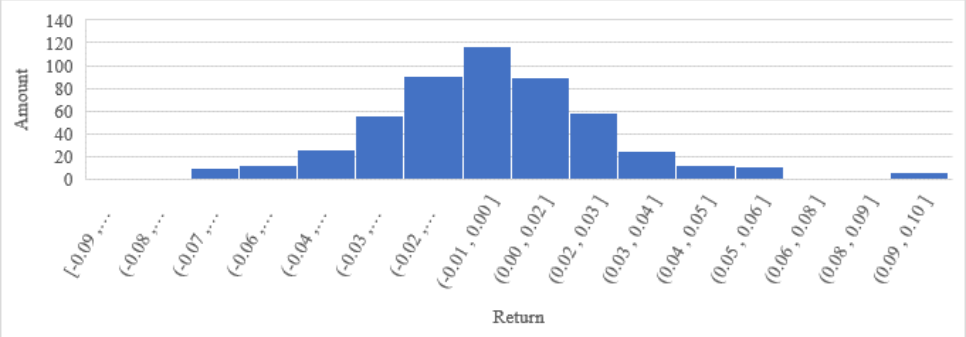

Figure 8. Medical return after COVID-19

3.2 Data

According to the Table. 1, China's stock market had a great negative impact, and the average yield of the Shanghai stock Index and the Shenzhen component index decreased after the outbreak of COVID-19. Meanwhile, it also had a great negative impact on the banking industry. After the outbreak, most people were isolated at home and had no source of income. The credit demand of the banking industry decreased and the risk of bad debt exposure increase in some regions and related industries, and the performance of banks in the first quarter was under pressure. In the medical industry, due to the increase in the number of inpatients and the large demand for medical equipment, it has a positive impact on the medical industry after the outbreak. Figs. 1-8 show the distribution of return after and before COVID-19 for each industry.

Table 1 Stock returns before and after the COVID-19

	Mean		Std	
	Before COVID-19	After COVID-19	Before COVID -19	After COVID -19
Shanghai index	0.002	-7.28E-0.5	0.001	0.015
Shenzhen component index	0.0003	0.0001	0.01	0.023
Bank index	0.0006	-2.75E-0.5	0.015	0.005
Medical index	-0.002	0.001	0.018	0.023

3.3 Model

We carry out the regression models to quantitively investigate the effects of each factor, which can be described as:

$$Y = \alpha + \beta_1 Rmt + \beta_2 SMB + \beta_3 HML + \beta_4 RMW + \beta_5 CMA + u \quad (1)$$

Here, RMT is the market excess return rate, SMB is the simulated portfolio return rate of scale factor, HML is the simulated portfolio return rate of book to market ratio factor, RMW is the simulated portfolio return rate of investment factor, α, β_1~β_5 are the fitted regression coefficients,

and u is residual term. We collect the data of individual stocks and stock indexes, and use the least square method (OLS) and five factor model for regression analysis to obtain their coefficient values and beta values. Based on the relationship between significance test and correlation coefficient, one obtains the impact of the change of the number of confirmed cases on the stock market.

4 EMPIRICAL ANALYSIS

4.1 Results

Based on the linear regression, we obtain four models for different indexes and formulae for different cases as given below:

$$Shenzhen\ component\ index = -0.046 - 0.002Rni + u \tag{2}$$

$$Shanghai\ index = -3.96E - 0.5 - 0.003Rni + u \tag{3}$$

$$Bank\ index = 0.0005 - 0.026Rni + u \tag{4}$$

$$Medica\ index = 0.0007 + 0.003Rni + u \tag{5}$$

In terms of Eq. (1), the results of the five factor models are derived as following for before COVID-19

$$Stock\ Returns = 0.00060 + 148RMT - 0.868SMB + 0.878HML - 0.52RMW - 0.93CMA \tag{6}$$

and after COVID-19

$$Stock\ Returns = 0.00003 + 0.959MT - 0.575SMB + 0.86HML - 0.246RMW - 0.615CMA \tag{7}$$

Table 2 Shenzhen Compent Index

	Coefficient	Std	t-Statistic	Prob
C	-0.046	0.001	0.860	0.390
Number of confirmed cases	-0.002	0.01	-1.847	0.652

Table 3 Shangzheng Index

	Coefficient	Std	t-Statistic	Prob
C	0.0005	0.001	0.480	0.631
Number of confirmed cases	-0.026	0.015	-1.745	0.082

Table 4 Shangzheng Index

	Coefficient	Std	t-Statistic	Prob
C	-3.96E-0.5	0.001	0.076	0.939

Number of confirmed cases	-0.003	0.0000429	0.748	0.455

Table 5 Medical Industry

	Coefficient	Std	t-Statistic	Prob
C	0.001	0.001	0.557	0.577
Number of confirmed cases	0.003	0.018	0.143	0.886

Table 6 Fama-french model Before COVID-19

	Coefficient	Std	t-Statistic	Prob
C	0.0006	0.000578	1.038	0.577
RMT1-RF1	0.148	0.358770	0.4131399	0.886
SMB1	-0.868	0.171	-5.05	0.0000
HML1	0.878	0.172	5.11	0.00000
RMW1	-0.527	0.198	-2.66	0.008
CMA1	-0.935	0.239	-3.90	0.0001

Table 7 Fama-french model AFTOR COVID-19

	Coefficient	Std	t-Statistic	Prob
C	0.00003	0.0008	0.397	0.691
RMT1-RF1	0.959	0.431	2.23	0.026
SMB1	-0.575	0.161	-3.55	0.0004
HML1	0.862	0.187	4.59	0.00000
RMW1	-0.246	0.254	-0.97	0.332
CMA1	-0.615	0.304	-2.02	0.044

4.2 Discussion

As listed in Table. 3, in the banking industry, the correlation coefficient of the increase rate of the number of diagnosed patients is -0.026. At the 5 percent level, it is significantly positive, indicating that the rate of return of banks is negatively correlated with the growth rate of the number of diagnosed patients. Under the circumstances of the epidemic this year, enterprises are facing a crisis in operation, it is more difficult to organize funds and the cost of capital tends to rise. In order to support the development of enterprises, bank lending rates will enter the channel of decline. Interest rate differences in the banking sector have narrowed further. In addition, the epidemic itself will increase bank costs and affect the normal business activities of banks. The overall profitability of banks will decline significantly, making the banking industry will have a greater impact.

As shown in Table. 5, the correlation coefficient of the number of confirmed diagnoses is 0.003, which is significantly positive at the level of 5%, indicating that the return rate of the medical industry is positively correlated with the growth rate of the number of confirmed cases. At the beginning of the epidemic, the medical industry benefited because hospitals needed a large number of medical instruments and drugs, which made the stock market increase greatly in the early stage. However, when the COVID-19 gradually stabilized in the later stage, the growth rate declined and leveled off.

As shown in Tables. 2 and 4, the correlation coefficient of the increase in the number of confirmed diagnoses was -0.003. At the 10 percent level, it's significantly negative. On this basis, there is a negative correlation between the return rate of Shanghai Composite Index and the growth rate of the number of confirmed cases. For the Shenzhen component index, the correlation coefficient of the increase rate of confirmed cases was -0.002. At the 10 percent level, it's significantly negative, which indicates that the return rate of SHENZHEN component index is negatively correlated with the growth rate of confirmed cases. Although the market index has been negatively affected by the epidemic, it has little impact due to insignificant conditions, indicating that the impact of the epidemic on the stock market has gradually weakened after a period of time. Generally speaking, the stock market will be greatly negatively affected at the beginning of the COVID-19, but the market will gradually stabilize with the government's epidemic prevention measures and the stability of the market itself, i.e., the impact of the epidemic on the market is short-term.

As summarized in Table. 6 and 7, we see that SMB factor before COVID-19 is larger than the SMB factor after COVID-19, providing that the portfolio return rate has become worse after COVID-19. For HML, it is positive both before and after the COVID-19, but the smaller HML after the COVID-19 means that the stock return is smaller after the COVID-19. For RMW, the stock profitability after the COVID-19 is worse than the before COVID-19 stock profitability comparison. For CMA, from the perspective of investment, the return rate of diversified investment in stocks after the COVID-19 is also reduced. The overall performance of the after COVID-19 market is significantly worse than the before COVID-19 stock market

4.3 Limitation

Nevertheless, this paper has some drawbacks and defects. The limitation of this paper is that we select a small number of industries, and the data is not large enough to fully represent the impact of the whole epidemic on China's stock market. Secondly, the growth rate of the number of epidemic cases can not affect the stock market in some cases. Therefore, this paper adds a five-factor model to prove it, so as to make the article more convincing.

5 CONCLUSION

In summary, this paper investigates the impact of the growth rate of COVID-19's diagnosis on stock and stock index returns based on the OLS regression model and the five-factor model. The correlation coefficients between the increase rate of the number of confirmed patients and the SSE Composite Index, the Shenzhen Component index, the stocks of the banking sector, and the stocks of the medical sector were -0.00321, -0.00197, -0.02626, and 0.002555, respectively. Therefore, the increase of the number of confirmed patients was negatively correlated with the above four modules, and positively correlated with the medical industry. In addition, a centralized comparative analysis of five factors indicates that the epidemic has a positive impact on the medical industry. Moreover, a negative impact on most other industries, and the stock market after the epidemic is generally worse than that before the epidemic. In the future, methods and technologies involved in the design and implementation to investigate the impact of the COVID-19 on China's stock market need to be continuously improved and developed. Overall, these

results offer a guideline for preventing the economic impact of major health events and pave a path for corresponding financial measures.

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