

Research on the Influence of the COVID-19 Pandemic on Pharmaceutical Stock Markets in China —Based on Granger Causality Test

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ABSTRACT

The World Health Organization (WHO) declared the coronavirus disease, which broke out in early 2020, a "public health emergency," triggering significant problems to the Chinese economy. The pandemic has had a massive effect on the majority of industries. This article will apply the Event Analysis Approach based on Granger Causality Test to examine the epidemic's influence on the stock returns of public companies in China's pharmaceutical industry by using the Shenwan Pharmaceutical Biological Index as an example. The Granger causality test is a statistical hypothesis test used to determine if one time series can be used to predict another. If the probability value is less than any α level, then the hypothesis would be rejected at that level. The research findings reveal that the COVID-19 pandemic has a substantial positive impact on the profitability of China's pharmaceutical sector, although the influence is only temporary. The importance of studying the impact of epidemics on capital markets is that the findings can provide a theoretical basis and practical recommendations for regulators and investors to make decisions during emergencies.

Keywords: COVID-19, pharmaceutical industry, stock market, positive impact

1. INTRODUCTION

With the acceleration of the globalization process and the evolution and development of society, the frequency of public emergencies has become higher and higher, which leads to a significant influence on individuals' lives and economic growth [1]. The COVID-19 pandemic breakout in 2020 was unquestionably a harsh winter for the Chinese market, profoundly influencing individual investment, family consumption, and business production. The stock market has long been seen as a barometer of the domestic economy. The impact of accidents and other emergencies is frequently reflected in the stock market over extremely short periods [2]. Therefore, the influence of the pandemic on the stock market deserves more investigation and analysis. Following the COVID-19 outbreak, the government has implemented multiple strong measures, such as "lock down the city," to halt the spread of contagious diseases effectively. Throughout the epidemic's expansion, the need for different kinds of medical products, like masks, clinical test reagents, and antiviral medications, grew dramatically. Due to this, concept stocks related to the

fight against the epidemic performed relatively strongly[3]. This article adopts the event analysis method and selects the HuShen 300 Index and the Shenwan Pharmaceutical Biotechnology Index as the objects of empirical study. Furthermore, this research will utilize the cumulative excess returns throughout the designated period (the event window) to determine if the coronavirus pandemic has a major influence on the Chinese pharmaceutical industry's stock price [4].

Discussing this issue can not only help visualize see the extent of the impact of the epidemic on the pharmaceutical industry but also help understand the resilience of the Chinese stock market when facing huge external shocks and the efficiency of absorbing and processing information. The research significance of this article is to assist researchers or investors in visualizing the influence of the epidemic on the pharmaceutical industry, understanding the adaptability of the Chinese financial market in the face of massive external fluctuation, and the performance of processing and absorbing information. To better improve the stock market supervision system and emergency mechanism

and provide reliable evidence support for the investment and financing decisions of stock market traders[5].

2. EMPIRICAL ANALYSIS

2.1. Event Window Definition and Sample Selection

In a CCTV interview on January 20, 2020, prominent Chinese pulmonologist Zhong Nanshan stated that there is a spread of the human-to-human phenomenon of coronavirus [6]. Therefore, the date of the occurrence, January 20, 2020, is marked in this research, recorded as time 0 ($T = 0$). The event window is defined as the 12 trading days preceding and following the event day, denoted as $T=-12,-11,\dots,-2,-1$, and $T=1,2,\dots,11, 12$. Additionally, the 103 business days preceding the event window are chosen as the estimate window for conducting event research and analysis.

This study implements the daily closing prices of the HuShen 300 Index and the Shenwan Pharmaceutical Biological Index as sample data from August 1, 2019, to February 13, 2020. With the exception of data that is not traded on holidays, a sum of 127 daily closing prices was acquired. The daily rate of return is measured based on the simple rate of return approach, applying historical data of the everyday closing prices of the sample stock indexes. Supposing that P indicates the daily closing price of stock index j , the daily return rate of the stock index is:

$$R_{jt} = \frac{P_{jt} - P_{jt-1}}{P_{jt-1}} \quad (1)$$

Table1. Expected Rate of Return and Excess Rate of Return

Date	AR_{jt}	R_{jt}	$E(R_{jt})$	R_{mt}
-12	-0.01071	0.00277	0.013484	0.013587
-11	-0.00233	-0.00339	-0.00106	-0.00175
-10	-0.00301	-0.006	-0.00299	-0.00378
-9	0.00801	0.015714	0.007704	0.007491
-8	-0.0014	-0.01172	-0.01032	-0.01152
-7	0.013929	0.026532	0.012603	0.012658
-6	0.003243	0.003573	0.00033	-0.00028
-5	-0.00234	0.007554	0.009894	0.009801
-4	-0.00285	-0.00543	-0.00258	-0.00335
-3	0.008176	0.003535	-0.00464	-0.00553
-2	0.004866	0.00144	-0.00343	-0.00425
-1	0.006577	0.008505	0.001928	0.0014
0	0.010846	0.018517	0.00767	0.007456
1	0.034292	0.018689	-0.0156	-0.01709
2	-0.01916	-0.0145	0.004662	0.004283
3	0.009954	-0.01883	-0.02878	-0.03099
4	0.038791	-0.03535	-0.07414	-0.07881
5	0.011504	0.037116	0.025612	0.026375
6	0.032016	0.043359	0.011344	0.01133
7	0.016347	0.034595	0.018248	0.01861
8	-0.01931	-0.01869	0.000623	2.42E-05
9	-0.01728	-0.01276	0.004524	0.004138

2.2. Calculate Excess Return

The event analysis method used in this article defines the excess return as the difference between the actual return of the index and the expected return, expressed as:

$$AR_{jt} = R_{jt} - E(R_{jt}) \quad (t = -12, -11, \dots, 0, \dots, 11, 12) \quad (2)$$

Choose the market model as the measurement model. The model is as follows: $R_{jt} = \alpha_j + \beta_j R_{mt} + \varepsilon_{jt}$. α_j , β_j are regression coefficients, and ε_{jt} as a random error term. Select the estimation window HuShen 300 Index daily return rate to regress the daily return rate of Shenwan Pharmaceutical Biological Index, and get the expected return rate:

$$(R_{jt}) = \hat{\alpha}_j + \hat{\beta}_j R_{mt} \quad (3)$$

Among this, $\hat{\alpha}_j$, $\hat{\beta}_j$ are the estimated values of ordinary least squares (OLS).

Regression based on relevant data to get the expected rate of return of Shenwan Pharmaceutical Biological Index is:

$$E(R_{jt}) = 0.000599 + 0.948317 R_{mt} \quad (4)$$

Then use the event window to calculate the actual rate of return R_{jt} of the Shenwan Pharmaceutical Biological Index to obtain the excess return AR_{jt} , as shown in Table 1. The cumulative excess return rate is:

$$CAR_j(t_1, t_2) = \sum_{t_1}^{t_2} AR_{jt} \quad (5)$$

10	-0.01201	-0.00258	0.009429	0.00931
11	0.001821	0.010091	0.00827	0.008088
12	-0.0091	-0.01434	-0.00523	-0.00615

2.3 Significance testing

In order to analyze whether the impact of the COVID-19 pandemic on the income of the pharmaceutical industry is significant, this paper conducts a significance test on the cumulative excess return CAR_j with the following assumptions: In order to investigate whether the Coronavirus pandemic has a significant influence on the revenue of the pharmaceutical industry in China, this study conveyed a significance test on the cumulative excess return CAR_j , with the following assumption:

H_0 : when the cumulative excess return rate CAR_j is zero, the Coronavirus pandemic has no influence on the revenue of the pharmaceutical industry.

H_1 : when the cumulative excess return rate CAR_j is not equal to 0, the Coronavirus pandemic has an influence on the revenue of the pharmaceutical industry.

According to Table 2, the cumulative excess return rate of Shenwan Pharmaceutical's biological index eventually reached 10.09 % during the event window, the standard deviation was 0.015, and the p-value was less than 0.01. The symbol *** denotes that the test result is significant at the 1% level of confidence.

Table 2. Significance test results of cumulative excess returns in the pharmaceutical industry

CAR_j	sd	n	t-value	P-value	star
0.1009	0.015454	25	32.631	0.000	***

3. RESULT ANALYSIS

Figure 1 depicts the variation curve of the excess return rate and the cumulative daily excess return rate. As shown in Figure 1, the excess return rate of the pharmaceutical business varied modestly about zero in the 12 trading days preceding the choosing event, and the excess return rate on the day of the occurrence was 1.08 %. The excess return rate varied significantly throughout the 12 trading days following the occurrence, exhibiting alternating positive and negative phenomena. The frequency of occurrence of positive values is greater than that of negative ones. The cumulative excess return rate

surged dramatically on the first trading day following the event, then declined the next day, connected to the spread of fear in the financial market. From the second trading day to the seventh trading day, the cumulative excess return rate rose rapidly, reaching a maximum of 15.67%. Afterward, the cumulative excess return rate has been declining and tending to flatten out. Overall, the cumulative excess return rate of the pharmaceutical industry was 10.09 % inside the [-12, 12] event window, which has been positive since the -7th day and is significant at the 1% level. According to the results, it can be assumed that the Coronavirus pandemic has had a significant positive influence on the market revenue of the pharmaceutical industry in China.

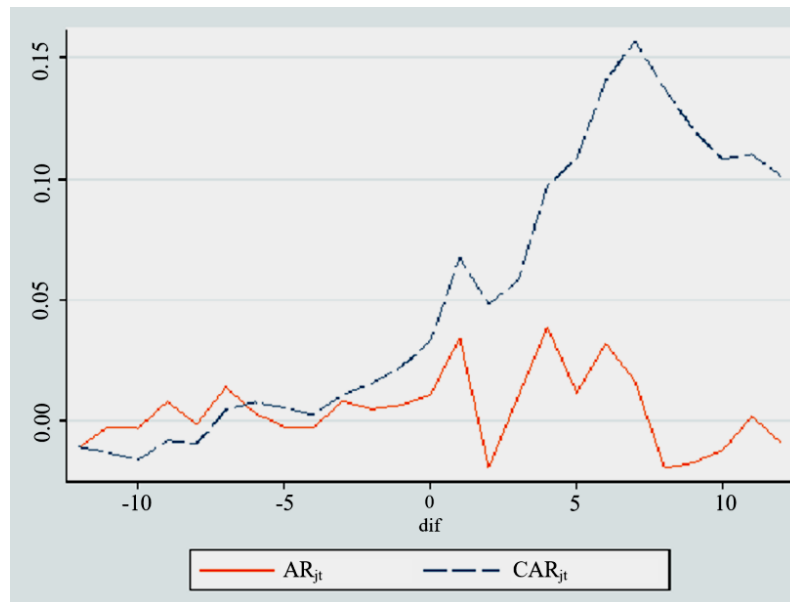


Figure 1. Changing Curve of AR_{jt} and CAR_{jt}

4. DISCUSSION

In the context of frequent accidents, to mitigate the influence of emergencies on the financial market in China and effectively safeguard investors' rights and interests, this article combines the research content and puts forward relevant suggestions for different disciplines. Firstly, supervisors must first release information related to emergencies in a timely and accurate manner to protect the public's right to know about emergencies. Online media can be used to disseminate authentic and accurate information in a timely approach, therefore stabilizing investor mood and ensuring the financial market's steady and effective functioning. Besides, the government must establish a prewarning security system and emergency management system to avoid significant emergencies from posing more severe threats to the financial market, identify problems ahead of time, and actively respond through various emergency plans after that. Avoid having a large influence on the stock market in the case of an emergency. Secondly, when faced with unanticipated events, investors must take precautions before they occur, such as establishing a robust and elastic investment portfolio to diversify risks. Nevertheless, they must also be prepared after the event to collect and comprehend market information thoroughly. Evaluate their risk preference and risk tolerance, and stick to a sensible set of investing strategies.

5. CONCLUSION

This article employs the event analysis approach to perform an empirical study of the Shenwan Pharmaceutical Sector Index to assess whether the

Coronavirus epidemic has contributed to public enterprises in China's pharmaceutical industry to generate excess returns. The research findings reveal that: Firstly, when the pharmaceutical industry is in the event window $[-12, 12]$, the internal cumulative excess return rate reaches a positive value of 10.09 %, indicating that it is significant at the 1% confidence level. According to the data obtained from the test results, investors' expectations for the pharmaceutical industry have risen as a result of the breakout of the pandemic. Also, the COVID-19 pandemic has substantially influenced pharmaceutical industry revenues, driving stock values to increase. Furthermore, the accumulated excess returns reached their peak on the 7th trading day following the occurrence and thereafter exhibited a downward trend and flattened out. In a nutshell, the coronavirus pandemic only has a short-term influence on the pharmaceutical industry's revenues, which caused the market to cool down solely after a short period of hype quickly. In summary, we believe that under the stimulus of the long-term epidemic and the support of national strategies and policies, the medical and health industry has an excellent long-term momentum of development. In addition, under the acceleration of rapid economic growth in recent years, and under the increasingly severe national conditions of China's huge population base and aging problems, the logic of the long-term improvement of the medical and health industry will not change. It is recommended to increase medium and long-term support for leading national and regional medical and health enterprises. At the same time, we must pay attention to the emerging Internet and technology-related companies entering the medical and health industry and actively deploy the Internet medical-related industry chain.

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