

# A Research on Stock Market Changes in China Caused by Covid-19 -- An Event Study Based Statistical Approach

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## Abstract

Event study based statistical approach is applied within the paper to facilitate a macro analysis against the overall changes of China's stock market. Sample statistics chosen to launch such empirical study are data from China's Growth Enterprise Market (GME) and Small and Medium Enterprises Board (SMEs) as well as those collected from the Shenzhen Stock Exchange Component Index and Shanghai Securities Composite Index. The paper analyzed the applicability of Event Study within this research, chose the market mean constant model for calculating Chinese stock market returns, and analyzed the macro tendency for CAR variation. It then took construction, finance, cultural tourism, and catering and hotel as examples to analyze the magnitude of impact Covid-19 had on major industries in the stock market. It is concluded that the change of stock market return caused by the epidemic varies among different industries.

**Keywords:** Event Study, change, rate of return model, Chinese stock market, CAR, Covid-19 epidemic

## 1. Introduction

Ever since its outbreak in late 2019, Covid-19 swept the entire world and posed huge threats to the sustained development of mankind. The epidemic, as is suggested by in-depth researches, has had a significant impact on world economy. Making precise prediction to Covid-19's impact on domestic economy has since become the focus of the market and scientific field. As the "barometer" of the economy, changes in stock market tells directly the relation between industrial economy and social public health events such as the epidemic, and in order to carry out researches of such kind in a full-scale manner, scholars and institutions had already explored in multiple perspectives the impact on market economy brought by Covid-19 since its very outbreak in China. A huge majority of them pointed to the epidemic's short-term shock and negative impact on China's stock market, yet the long-term growth of the country's market economy, considering its resilience, would neither be much too affected nor intervened by the epidemic after a certain period of adjustment and reform (Li & Zhang, 2022, pp. 73-79). Moreover, it is suggested that as long as the government counteracts with appropriate policies and measures, the country could still accumulate economic potentials while securing effective control of the epidemic. Nevertheless, much of the current researches in relevant fields remain theoretical, and that despite the existing assumptions and results may be true and reliable, the jury is still out. The paper, in light of such concerns, carries out the modeling analysis on changes and development of China's stock market after the Covid-19 epidemic by making use of both the sample numbers collected from stock market of a certain region and the statistical approach of Event Study, and thus contributes to the stable and sustained development of the market economy with references for direction.

### 1.1 Introduce the Problem

This outbreak was sudden, fast spreading speed and fast mutation, which caused a high degree of panic in society and produced dramatic impacts on the economy in China in a short period of time. The three distinctive features can be summarized as comprehensive, unpredictable, and double inhibitive on both social supply and demand in the epidemic (Feng & Liu, 2020, pp. 53-63). First of all, the epidemic has had an all-round impact on all domestic economic agents, regions and industries in China. Covid-19 is extremely contagious and far-reaching as every individual is susceptible to the virus. Meanwhile, the comprehensiveness of the epidemic is also manifested in the overall impact on the national economy and foreign trade of countries around the world.

Unpredictability, the second feature, is firstly reflected in that the time of the outbreak is totally unforeseeable. Covid-19's outbreak is completely random, following no fixed pattern. Moreover, the unpredictability is also seen in the countermeasures since information about the virus's host, transmission route, and specific drugs requires long-term research, and it is not possible to take proper and timely measures to curb the epidemic at the very beginning of its outbreak. Humans, therefore, are confronted with the serious problem of information asymmetry in face of the virus, which will lead to social panic.

Third, the double shrinking effect on both supply and demand is evidenced by the fact that the epidemic restricts people's economic activities in all aspects in the current period which, in turn, causes the overall demands for trade, tourism, and investment to fall off a cliff. The shrinking effect of covid-19 on supply is accompanied by the decrease in demand. This is mainly caused by restrictions on the free travelling of the people which brings huge obstacles to the global industrial chain. Business operations are also suspended and this further suppresses the market supply during the epidemic.

### *1.2 Literature Review*

Some scholars argue that the Covid-19 pandemic mainly brings short-term effects, with a precipitous drop in total consumption and a dampening of investment in the short term. Based on the high potential and resilience of China's economic development, continued technological progress, massive market demand, and improving human capital, in the long run, China's economy will return to a stable growth path (Ma, 2020, pp. 22-29). The sudden outbreak of public health events not only deals a blow to the economy but the stock market, as a barometer of the national economy, the impact of public health events on the economy is also reflected in the stock market. And some scholars argue that the Covid-19 pandemic will have a significant negative impact on the stock market, the currency market, the foreign exchange market, and the bond market, with the stock market receiving (Fang, 2020, pp. 116-128). Another scholar argues that there is a U-shaped relationship between the development of the Covid-19 pandemic and stock price volatility. With the increase of new confirmed cases, the rate of decline of listed companies' stocks shifted from accelerating to slowing down (Wang, 2020, pp. 16-27). The fear and anxiety of investors brought on by the pandemic may stimulate investors to sell stocks leading to stock market volatility. The Covid-19 pandemic outbreak, some Chinese literature has analyzed the Covid-19 pandemic through. The mechanism of the Covid-19 pandemic affecting the capital market has been discussed in terms of the impact on the industry, the confidence of market players, and the capital market linkage.

Some scientists focused on the dynamic transmission of risks and the source of risk outbreak, and analyzed the risk spillover effect of the domestic stock market based on the risk spillover framework during the outbreak of the novel coronavirus pneumonia (Yang, 2020, pp. 13-35+7). And some studied the impact of the Covid-19 pandemic on the development of industries such as agriculture, forestry, animal husbandry, and fishery in China, which is directly constrained by the pandemic and the downstream flow of the supply chain may be truncated. China's pandemic prevention and control measures have affected the supply production of agriculture from the raw material supply side (Jiang, 2020, pp. 5-13). Some suggested that for the world economic system, the Covid-19 pandemic as an exogenous variable has caused a great impact on the world economy and largely influenced the change of world economic relations (Xu, 2020, pp. 25-36+189). On the other hand, focuses his study on the shock of the Covid-19 pandemic suffered by industrial chains, and from the input-output perspective, the risk of certain industries will be under the impact of the pandemic, and the input-output network will transmit this shock to the whole industrial chain. The transmission path will vary by industry chain (Wu, 2021, pp. 25-37). And they focus on how the economy is affected by the Covid-19 pandemic in the long run, and the results show that the Covid-19 pandemic poses an unknown risk to long-term economic stability in total factor productivity (TFP) perspective (Wang & Li, 2021, pp. 1-8).

Some foreign scholars examined the capital markets of the six countries most severely affected by April 10, 2020, and shows that stock market returns are more sensitive to confirmed cases compared to the Covid-19 pandemic deaths and that there is a negative impact of virus transmission on stock market returns in China, France, Germany, and Spain (Badar & Nadeem, 2020, pp. 167-189). They used data from stock markets and dividend futures to examine changes in investor expectations of economic growth in different sectors during the pandemic, arguing that news of fiscal stimulus boosts stock markets and long-term growth, but investors' expectations of short-term growth barely increase.

A review of the literature reveals that research on the impact of the Covid-19 pandemic on the stock market in China has been divided into three main directions. The first category has mainly studied the impact of the pandemic on stock returns, yields and volatilities from an overall perspective. Although there are differences in the models, samples, time windows and variables used by different scholars, the findings are basically the same,

namely, there is a negative impact of the pandemic on stock market returns and returns, and a positive impact on stock market volatility, which exacerbates stock market volatility. Most studies only focus on the effect of pandemic on overall stock market volatility, and there are fewer studies on the effect of pandemic on firm heterogeneity. The second category is to study the impact of pandemic on a certain sector or industry, and most studies focus on the impact on the healthcare industry and healthcare sector, and fewer studies are conducted on other industries and sectors. The studies generally concluded that the pandemic had a significant positive impact on the return of the healthcare sector. The third category focuses on the correlation between stock markets in different countries or regions in the context of the pandemic. The findings suggest that there is a contagion of financial and liquidity risk among major global stock markets during the pandemic.

### *1.3 Purpose and Significance*

The paper, in light of such concerns, carries out the modeling analysis on changes and development of China's stock market after the Covid-19 epidemic by making use of both the sample numbers collected from stock market of a certain region and the statistical approach of Event Study, and thus contributes to the stable and sustained development of the market economy with references for direction.

In a word, Covid-19 has caused severe impacts to global economy. The corresponding economic uncertainty is reflected in capital market in the form of sustained volatility. As a leading indicator of economic recovery, the performance of the stock market returns during the covid-19 epidemic reflects the negative impact of the epidemic on the stock market as a whole. The research in this paper finds that the covid-19 epidemic has a significant negative influence on stock market returns by affecting investor sentiment, which both refines investors' understanding of stock market volatility during the epidemic and provides policy recommendations for measures to mitigate the irrational shock to the stock market caused by the epidemic.

Covid-19 has changed people's way of life and the way of social production while business and industry, formed under different historical conditions, are precisely ways to meet people's survival needs. In fact, the biggest change covid-19 has brought to human society so far is the rise of the "non-contact economy". In the post-epidemic era, China should seize the opportunity brought by the epidemic to reshape its economic development, social production, and the way of life for its people. Digitalization, artificial intelligence, and networking will be more thoroughly integrated into people's life. Therefore, launching empirical analysis to the manufacturing sector of China's stock market is conducive to both the betterment in planning and operation of the country's manufacturing industry and the development of its real economy.

## **2. Basic Theoretical Framework**

Cognitive bias theory is one of the representative theories of behavioral finance theory. The theory argues that the strong uncertainty of financial decisions can significantly impact investors' cognitive biases. When making financial decisions, investors' judgment criteria are likely to be based on rules of thumb, and certain cognitive bias phenomena will exist before, during, and after the decision. Specifically, individual investors tend to use historical data as a rule of thumb to predict stock market movements, which is simple and easy to do, but very prone to bias.

Meanwhile, some foreign scholars critiqued expected utility theory as a descriptive model for risky decisions and proposed an alternative model, namely, prospect theory. Prospect theory assumes that individuals have different attitudes toward risk depending on the starting state and that trends in people's behavior can be predicted based on different risk predictions. (Kahneman & Tversky, 1979. pp. 263-291). The theory can be derived from four basic conclusions: 1) The deterministic effect, that is, most people do not like risk in the profit state; 2) The reflexive effect, that is, most people have a risk preference when facing losses; 3) Loss aversion, that is, most people are more sensitive to losses than gains; 4) Reference dependence, that is, most people's judgment of gains and losses is often determined by the reference point. These four basic conclusions provide a reasonable picture of the psychological state of investors when faced with investment decisions, and today prospect theory has become an important theory in behavioral finance.

Some scholars built on the outlook theory. based on psychological evidence and the outlook theory (Barberis, Shleifer, & Vishny, 1998, pp. 307-343). They proposed the BSV sentiment model to investigate the relationship between investor underreaction, overreaction, and sentiment; stock prices respond to a series of There are overreactions to a series of good or bad news, and investor sentiment affects the equilibrium price of assets in the stock market. The results of behavioral finance research are increasingly used in investment practice and guide investors' investment behavior. In addition, behavioral finance theory is a very useful tool for developing and improving laws and policies in the areas of corporate and securities law. Finally, the emergence of

behavioral finance provides a solid theoretical foundation for theories related to investor sentiment, which is becoming a hot topic of research.

The “herd effect” theory is an important theory of behavioral finance for studying group behavior. Some scientists found that this herding psychology leads to behavioral biases by studying imitation and herding psychology among people. They found that noise traders use public information to make trading decisions (Brown, Michael, & Cliff, 1989, pp. 405-440). They also suggested through an empirical study that some people summarize information by observing the behavior of other investors before obtaining other information and then deciding how to trade. And they further studied and proposed a phenomenon in which both institutional and individual investors analyze the same types of stocks or operate in the same way (Shiller & Pound, 1989, pp. 1-66).

### 3. Sample Selection and Applicability Analysis of the Research Method

Event Study is mainly used to analyze the impact of unexpected events on the stock market. This method requires that unexpected events are not expected and no other events interfered during the event. The novel coronavirus outbreak is an emergency, which is obviously not expected by market investors in advance. Meanwhile, the outbreak period is during the Chinese Spring Festival, and the interference of other events is relatively low, which meets the basic research requirements. Therefore, this paper selects the event study method to quantitatively analyze the impact of the novel coronavirus epidemic on the stock market, and then adopts the intervention analysis method to study the impact time of the epidemic epidemic on the stock market

To further explore the Covid-driven variation in Chinese stock market and analyze the impact of stocks of different levels or industries under substantial changes in market economy, this study selects data from China's Growth Enterprise Market (GME) and Small and Medium Enterprises Board (SMEs) as well as those collected from Shenzhen Stock Exchange Component Index and Shanghai Securities Composite Index (Liu, 2022, pp. 28-38). Meanwhile, in order to investigate the magnitude of impact Covid-19 has on major industries, this study calculated the development index for industries listed in the SZSE (Shenzhen Stock Exchange) according to the data classification calculation model provided by the CSRC (China Securities Regulatory Commission). For statistical and comparative analysis purposes, the sample data are collected from GuotaiJunan Securities database and database of the Wind. Furthermore, to ensure its comprehensiveness, the selected empirical data covers both those in the mid of 2019 (before the outbreak) and all those after the outbreak (up to the present when the epidemic situation gets relatively stable) as such spectrum provides a more scientific basis for further revealing the impact the epidemic has on Chinese stock market.

Given the selected sample data used for empirical study are all sourced from databases, the statistical event study approach is chosen as the primary method for analyzing changes in China's stock market caused by the epidemic (Yang, 2021, pp. 15-24+134). The method requires that all sudden events during the outbreak are in an unpredicted state at the time of research, and all parameters involved are not subject to the direct influence of other events. Now that it is apparent that the target of the study is an epidemic event, which is a social public health emergency that no investors could predict in advance. Meanwhile, the epidemic broke out in China in late 2019 during the Spring Festival holiday, which could be seen as an incident that was hardly affected or disrupted by external factors. Therefore, the statistical event study method is applicable for the research as all preconditions are perfectly met.

### 4. Model Based Calculation of Chinese Stock Market Return

With the above mentioned research method and sample data, the study applied the existing rate of return model as an auxiliary tool for calculation (Li & Chong, 2021, pp. 337-344). At present, the commonly used models include the market average constant return model, the market economy change model, and the industrial structure adjustment model. Compared with other statistical models, the market mean constant return model is more applicable for stock market returns. Upon overall assessment, this model is selected as the tool for statistical calculation that provides numbers for event study. The model takes the variation index during the stock valuation period as the index for calculating returns. By calculating and evaluating comprehensively the index, it is possible to grasp the normal rate of return of the Chinese stock market after the outbreak or during a specific time period. After collecting sample data, the normal rate of return of the Chinese stock market during the specific time period is calculated by the following formula.

$$R_{it} = \alpha_i + e_{it} \quad (1)$$

In formula (1),  $R$  stands for the rate of return of the Chinese stock market,  $\alpha$  the expected rate of return for stock index,  $e$  the perturbations,  $i$  the mean value, and  $t$  the statistical time of the target time period. The formula

replaces the normal rate of return during the target time period with the expected rate of return. In light of this, a second-time calculation is made by the following formula to obtain the rate of return.

$$E(R_{it} | X_t) = \alpha_i \quad (2)$$

In formula (2),  $E$  stands for the number of times of the calculation, and  $X$  the expected stock market return. Here  $E = 2.0$ , which means the second-time calculation of the rate of return. According to the known parameters obtained from the above calculations, influencing factors that might occur during the outbreak are examined statistically. Meanwhile, during such statistical process Chinese stock market return is modeled by way of event study, and the abnormal rate of market return during the outbreak is also calculated by the following formula.

$$AR_{it} = K_{it} - R_{it} \quad (3)$$

In formula (3),  $AR_{it}$  stands for the abnormal rate of return of Chinese stock market during the outbreak,  $K$  the ratio of the two parameters namely real return and normal return. To further analyze the impact of sudden events, the study introduces  $CAR_{it}$ , a parameter denoting the abnormal rate of return which refers to the cumulative statistical value of the abnormal return of average index (i) within a specified time. The calculation of  $CAR_{it}$  is expressed by the following formula.

$$CAR_{it}(t_1, t_2) = \sum_{t=t_1}^{t_2} AR_{it} \quad (4)$$

In formula (4),  $t_1$  and  $t_2$  stand respectively for the target time period and outbreak period. When the calculation points to a  $CAR_{it}$  value of below 0, it means that the sudden outbreak event has a negative impact on the Chinese stock market as a whole, namely the epidemic shall cause a downward effect on the price of a single stock, which brings losses to China's market economy. However, when the calculation points to a  $CAR_{it}$  value of above 0, it then means the sudden outbreak of the epidemic has in general a positive impact on the Chinese stock market, causing the price of a single stock to rise, and to a certain degree, promoting the country's market economy. The study matches the calculation results with the rate of return model and thereby achieving the rate of return model based calculation of Chinese stock market return.

## 5. Analysis of the Stock Market Changes Caused by Covid-19

### 5.1 The Macro-Trend of CAR for the Chinese Stock Market Before and After the Outbreak

To capture the macro CAR trend for the Chinese stock market, data of different time periods from the GEM, SMEs, Shenzhen Stock Exchange Component Index, and Shanghai Securities Composite Index are calculated with the above CAR formula (Yao & Yu, 2021, pp. 95-106+232). The results for different time periods are linked with broken lines which constitute the Figure below.

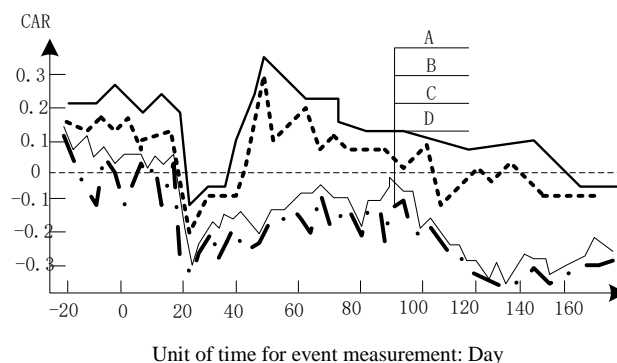


Figure 1. The macro-trend of CAR for the Chinese stock market before and after the outbreak

In Figure 1, A represents the CAR trend of the Shanghai Composite Index, B the Shenzhen Component Index, C the SMEs, and D the GEM. The “-20” on the horizontal axis indicates the time before of the outbreak and “0” indicates the specific time of the outbreak.

As can be seen, CAR of Shanghai Composite Index and Shenzhen Component Index both plunged after the outbreak which then stabilized at a relatively low point, indicating a decrease in the number of buying and selling as well as the price of all stocks. However, figures for GEM and SMEs experienced a short-lived decline after the outbreak and a surge afterwards. This indicates a large-scale improvement in secondary markets after the outbreak event and an upward trend for the potential and competitiveness of markets for small and

medium-sized enterprises. To sum up, the changes and development of different industries in the Chinese stock market caused by Covid-19 epidemic are radically different.

### 5.2 The Magnitude of Impact on Major Industries of the Stock Market

With statistical analysis above, the study takes construction, finance, cultural tourism, and catering and hotel industry as examples to illustrate the magnitude of impact that Covid-19 has on major industries of the Chinese stock market (Sun, Li, & Du, 2021, pp. 151-169). Data of industry development is put into the CAR calculation formula to obtain the CAR value of major industries in different time periods. The results are shown in Table 1.

Table 1. The Magnitude of impact on major industries of China's stock market

Representative Industries	Time Periods before and after the outbreak			
	-50~0 days	0~50 days	50~100 days	100~150 days
Construction	0.241	-0.054	-0.097	-0.023
Finance	0.345	-0.019	-0.058	-0.154
Cultural tourism	0.568	-0.025	-0.054	-0.241
Catering and hotel	0.157	-0.099	-0.157	-0.248
Agriculture and Fishing	0.951	0.874	0.654	0.165
Real Estate	0.514	0.325	0.201	0.154
Education	0.541	-0.024	-0.002	0.021
Pharmaceuticals	0.451	0.058	0.064	0.247

As can be seen, construction and education were heavily affected by the epidemic as the overall stock market returns for these industries declined, yet the two industries gradually recovered as the epidemic got relatively under control. Market returns for finance, cultural tourism, and catering and hotel industries, however, declined steadily as a whole and were likely to go further downward. Agriculture and real estate were hardly affected though a downward trend, which seemed to have little influence on the overall market return, was also apparent. Nevertheless, market returns for pharmaceuticals were on the rise. Such analysis makes it evident that stock market returns for different industries experienced basically changes of different magnitude.

## 6. Conclusion

By choosing sample data, verifying the applicability of research method, calculating Chinese stock market returns with rate of return model, capturing the macro-trend of CAR for Chinese stock market, and analyzing the magnitude of impact on its major industries, this paper launched an event study based statistical analysis on the stock market changes brought by Covid-19 outbreak in China. The paper provides not only further guidance for the macro development of China's stock market, but also directions for the sustained improvement of relevant units in the stock market. In the follow-up researches, multiple statistical tools and more industry data would be applied so as to make predictions to the future development of China's stock market.

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