

# COVID-19 and Volatility of China Concept Stocks

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## ABSTRACT

COVID-19 is now spreading all over the world, and the severity of the epidemic varies from region to region. In this case, people's investor sentiment is unstable, and the price of the stock market fluctuates accordingly, including China Concept Stocks. This paper aims at exploring the correlation between the Chinese concept stock price index and the severity of the epidemic in China and the United States. Findings suggest that the situation in China has no dynamic correlation with the China concept stock price, while the US is more related to the China concept stock price during the pandemic period. In conclusion, the volatility and the severity of the US pandemic show more similar trends than that of China, and they are more correlated.

**Keywords:** China Concept Stock, COVID-19, Pandemic, Stock Price Volatility.

## 1. INTRODUCTION

In the early days, due to the strict restrictions on the listing of companies in the Chinese market, the market structure was dominated by traditional industries, real estate, and industry, etc. [1] As a result of this, many Chinese companies listed overseas one after another, which was known as China concept stocks. In 2021, more than 250 companies are listed in the United States and most of them are under the model of Variable Interest Entities (VIE), including companies such as Sina, Tencent, and Alibaba [2]. Since being listed in the United States, China Concept Stocks have faced many crises such as policy crises, financial crises, etc. Throughout the period, China Concept Stock companies encountered short-selling by Muddy Waters and other institutions, the proposal of privatization, and the return to China. In addition, a black swan event, Coronavirus (COVID-19) outbreak in December 2019 and spread to the world in the early 2020. The epidemic was announced as a serious global public health emergency of International Concern (PHEIC) by WHO [3], which had a huge impact on the production, life, safety, and economic aspects of countries in the world [4]. The announcement of COVID-19 was suggested to be the most devastating event for the stock market[5]. Then, the emergence of the virus has brought a huge impact to society and economic recession[6]. The virus subsequently appeared in Europe, followed by the United States. Because of the timely measures of

Chinese authorities, the epidemic in China is under control. Normal foreign trade exchanges between countries have also been affected. Taking China's cross-border e-commerce industry as an example, the companies generally face foreign trade control, insufficient supply, declining demand, and slower logistics[7].

Some previous literature mentioned the reasons for the price volatility of China concept stocks. Based on the theory of information asymmetry, most of the companies that went public in the United States at the beginning had the problem of IPO underpricing. In addition to relying on venture capital companies for endorsements, companies were required to make good information disclosures[8]. In 2011, a number of mainstream US media and authoritative organizations revealed that more than one-third of Chinese concept stock companies were involved in accounting fraud and financial fraud[2]. Therefore, the price of China concept stocks has been underestimated and questioned, and many listed companies have left the capital market through privatization[9]. Since the trade war in 2018, China and the United States and even the global economy and trade have been greatly affected, and most of the Chinese concept stocks have poor operating performance[9]. In May 2019, Luckin Coffee landed on Nasdaq. It took only 18 months from establishment to listing. However, starting in 2020, 2 billion yuan of financial fraud was quickly revealed. Luckin's stock price plummeted 90%, on June 29, the company is

officially suspended on Nasdaq, which was regarded as a crisis of confidence. In addition, the price volatility also was caused by policy changes. The education reform and the strengthening of supervision of educational institutions mentioned in the 19th meeting of the Chinese Central Committee for Comprehensively Deepening Reforms caused the education stocks to plummet. In this case, New Oriental fell by 40.61%, setting a record for the largest one-day decline in history.

From the demand side, the uncertainty of virus prevention increased people's panic and changed people's investment behavior [10]. Investor sentiment is related to people's perception of future investment risks. According to the theory of behavioral finance, when people hear events reported in the media, they will underestimate or overestimate the impact of the event, thus resulting in the fluctuation of investor sentiment [11]. Some sentiment factors such as emotional factors, sociology factors, and psychology factors make people more likely to make irrational investments [11]. During the epidemic and pandemic period, the average volatility of China's stock market was lower, and the stock market was relatively stable, while, the volatility of the United States, the United Kingdom, South Korea and other countries has increased with the spread of the epidemic [4]. When the coronavirus changed from an outbreak to a pandemic, panic accelerated and the market situation deteriorated. [4].

There are literature mentioning the fluctuations in the price of Chinese concept stocks caused by policy crises, financial crises, trust crises, etc., but they lack consideration under the pandemic situation. Also, some literature talks about investor sentiment under the epidemic and the volatility of the stock market, but there is a lack of attention to China concept stocks. Due to China's effective implementation of pandemic prevention and control, China has gradually resumed work and production. Since most of the Chinese concept stock companies' main business is in China, this paper intends to discuss the impact of the epidemic on the price fluctuations of the Chinese concept stocks, so as to help people invest more rationally under the raging virus.

## 2. METHODS

### 2.1. Data collection

I intended to collect data that could represent the price of China concept stock as well as the severity of the pandemic outbreak in a specified period of time, conducting the research based on quantitative data by using Stata. Thus, I used the secondary data from the CSMAR database, which is the largest, most accurate and most complete economic and financial research database in China. The database CSMAR covered data

of MSCI China index in daily basis, and the number of the newly confirmed cases per day of COVID-19 in China and the USA from 30 September 2019 to 31 August 2021. I attempted to capture the relationship between the price volatility of China concept stock and the effect of the pandemic by making inferences from the sample 's characteristics.

### 2.2. Research design

I tested the relationship between the newly confirmed cases in two countries and the Chinese concept stock price index respectively, as well as the mixed condition of the two regions, with the date beginning from three months before the outbreak. Firstly, I did the stationarity test of time alignment. I used ADF test to check the original sequence of the MSCI China index, the logarithmic rate of return sequence of the MSCI China index, and the logarithmic newly diagnosed number (China and the United States) sequence in daily manner. Then, I used stationary sequences for further analysis, using Akaike Information Criterion (AIC) and Autocorrelation Function (ACF) to determine the order of AR and MA models. In order to further examine the correlation between the severity of pandemic and the logarithmic rate of return, I constructed the ARMAX model, which is as follow:

$$x_t = \varphi_0 + \sum_{i=1}^p \varphi_i x_{t-i} + a_t - \sum_{i=1}^q \theta_i a_{t-i} + \gamma_{11} x_{1,t-1} + \dots + \gamma_{1q_1} x_{1,t-q_1} + \gamma_{k1} x_{k,t-1} + \dots + \gamma_{kq_k} x_{k,t-q_k} \quad (1)$$

$a_t$  represents white noise sequence,  $p$  and  $q$  are both non-negative integers. Item  $\gamma_{11} x_{1,t-1}$  or so represent the sequence of other explaining variables, which is newly confirmed cases in this paper.

Finally, the GARCH model was constructed, and exogenous variables (newly confirmed cases) were introduced into the variance equation to examine the correlation between the severity of pandemic in different regions and price fluctuations. The formula is as follow:

$$\sigma^2 = a_0 + a_1 \varepsilon_{t-1}^2 + \dots + a_q \varepsilon_{t-q}^2 + \gamma_1 \sigma_{t-1}^2 + \dots + \gamma_p \sigma_{t-p}^2 \quad (2)$$

## 3. RESULTS

### 3.1. ADF Test

Since it is necessary to build a model to predict the future situation, the ADF test of the time series is required to verify that the data can be modeled. So, I test the stationarity of the original series and the null hypothesis is accepted, the original series do not pass the test. As for the logarithmic rate of return, the p-value is significant at the 1% level, so the sequence is stable. In addition, the daily newly diagnosed cases are also time series data. I test the logarithmic diagnosis rates in

China and the United States respectively. The result is that both variables reject the null hypothesis, and the sequence is stationary. The calculation formula of logarithmic rate of return is as follows :

$$r_t = \ln P_t - \ln P_{t-1}$$

(3)  
 $r_t$  represents the logarithmic rate of return ,  $P_t$  means the closing price at the time t ,  $P_{t-1}$  indicates the closing price at the time t -1.

**Table 1.** ADF Test of time series data

Sequences	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value	p-value for Z(t)
Original sequence					
Z(t)	-1.255	-3.960	-3.410	-3.120	0.8987
Logarithmic rate of return					
Z(t)	-14.535	-3.960	-3.410	-3.120	0.0000***
Logarithmic newly diagnosed number of China					
Z(t)	-3.338	-3.960	-3.410	-3.120	0.0602*
Logarithmic newly diagnosed number of the USA					
Z(t)	-5.081	-3.960	-3.410	-3.120	0.0001***

Note: \*\*\*, \*\*, and \* indicate the level of significance of 1%, 5%, and 10%, respectively.

### 3.2. ARMAX Model

In order to introduce exogenous variables, I further use the ARMAX model. The ARMAX model consider the influence of historical data and the influence of random errors to predict the future while examining the contribution of other variables. On the basis of the ARMA model, I introduce the exogenous variable of the logarithmic newly confirmed cases, which is divided into three types: the independent impact of the epidemic in China, the independent impact of the epidemic in the United States, and the mixed impact of the two regions. EACF is used to determine the order of the ARMAX model, which is ARMAX (3,3).

#### 3.2.1. Empirical Results of newly confirmed cases in China

Table 2 reports the result of the ARMAX with China logarithmic newly confirmed cases as exogenous variables. According to the graph, I found that the coefficients at sight(t=0), lag one phase(t=-1), and lag two phase(t=-2) are not significant, which means that there is no dynamic correlation between the Chinese concept stock price index and the newly confirmed diagnosis in China.

**Table 2.** ARMAX with Logarithmic newly diagnosed number of China as exogenous variables

Variables	(1)	(2)	(3)
Logarithmic newly diagnosed number of China			
t=0	-0.0002	.0008	.0012

	.0004	.0013	.0013
t=-1		-.0010	.0002
		.0012	.0014
t=-2			-.0012
			.0013
AR	.4988**	.5277**	.5653***
	.2332	.2273	.2194
MA	-.6025***	-.6295***	-.6646***
	.2140	.2081	.1994
Constant	.0010	.0011	.0012
	.0015	.0015	.0015

Note: \*\*\*, \*\*, and \* indicate the level of significance of 1%, 5%, and 10%, respectively.

#### 3.2.2. Empirical Results of newly confirmed cases in the USA

Table 3 reports the result of the ARMAX with the USA logarithmic newly confirmed cases as exogenous variables. I find that the coefficients at sight(t=0) are not significant, while, lag one phase(t=-1) and lag two phase(t=-2) are significant at 1% level. Therefore, there is a dynamic correlation between the Chinese concept stock price index and the newly diagnosed cases in the United States. More precisely, when t = -1, if new diagnoses number in the United States increases by 1%, the current stock market's return rate increases by 0.07%. Also, when t = -2, if new diagnoses number in the United States increases by 1%, the current stock market's return rate decreases by 0.06%.

**Table 3.** ARMAX with Logarithmic newly diagnosed number of the USA as exogenous variables

Variables	(1)	(2)	(3)
Logarithmic newly diagnosed number of the USA			
$t=0$	.0001	-.0002	.0001
	.0001	.0002	.0002
$t=-1$		.0004	.0007***
		.0002	.0003
$t=-2$			-.0006***
			.0002
AR	.4586*	.4418*	.4381*
	.2478	.2606	.2617
MA	-.5615**	-.5437**	-.5374**
	.2299	.2424	.2447
Constant	-.0006	-.0009	-.0007
	.0012	.0013	.0013

Note: \*\*\*, \*\*, and \* indicate the level of significance of 1%, 5%, and 10%, respectively.

### 3.2.3. Empirical Results of newly confirmed cases in China & the USA

When the logarithmic new diagnoses in China and the United States are jointly used as exogenous variables, I find the similar result with Table 2 and Table 3, which is that there is no dynamic correlation between the Chinese concept stock price index and the new diagnoses in China. However, there is a dynamic correlation according to new diagnoses in the United States. Similarly, the coefficients at sight( $t=0$ ) are not significant, while, lag one phase( $t=-1$ ) and lag two phase( $t=-2$ ) are significant at 1% level. When  $t = -1$ , if new diagnoses number in the United States increases by 1%, the current stock market's return rate increases by 0.07%. Also, when  $t = -2$ , if new diagnoses number in the United States increases by 1%, the current stock market's return rate decreases by 0.06%. The estimation results in Table 4 are similar to the conclusions in Table 2 and Table 3, indicating that the conclusions of this model are robust.

**Table 4.** ARMAX with Logarithmic newly diagnosed number of China & the USA as exogenous variables

Variables	(1)	(2)	(3)
Logarithmic newly diagnosed number of China			
$t=0$	-.0004	.0007	.0012
	.0004	.0013	.0014
$t=-1$		-.0013	-.0002
		.0012	.0015
$t=-2$			-.0016

	Logarithmic newly diagnosed number of the USA		
$t=0$	-.0002	-.0002	.0001
	.0001	.0002	.0002
$t=-1$		.0004	.0007***
		.0002	.0003
$t=-2$			-.0006***
			.0002
AR	.5698***	.8146***	.8182***
	.2087	.0903	.0903
MA	-.6716***	-.8893***	-.8916***
	.1902	.0761	.0763
Constant	.0002	.0007	.0008
	.0017	.0015	.0015

Note: \*\*\*, \*\*, and \* indicate the level of significance of 1%, 5%, and 10%, respectively.

### 3.3. GARCH Model

Because time series data also has Autoregressive Conditional Heteroskedasticity, I establish the variance equation to study the pattern of volatility under the influence of the epidemic. According to Figure 1, the logarithmic rate of return sequence of the MSCI China index shows obvious non-compiling and fluctuates around 0, as well as volatility clustering characteristics. Therefore, there might be conditional heteroscedasticity in the sequence. Then I further construct the GARCH model to examine the relativity of the pandemic and the price volatility of China concept stocks. In order to predict the logarithmic rate of return and volatility at the same time, I set the mean equation of the GARCH model with ARMA, that is, the ARMA-GARCH model.

#### 3.3.1. Empirical Results of newly confirmed cases in China

Table 5 illustrates the result of GARCH model with Chinese logarithmic newly diagnosed number as exogenous variables. In accordance with the result, I find that all the ARCH and GARCH terms are significant at the 1% level, indicating that there is conditional heteroscedasticity. The coefficient of the  $t=-2$  period is not significant, while, the coefficients of the  $t=0$  and  $t=-1$  period are both significant at the 1% level. Concerning this result, at  $t = 0$ , for each 1% increase in newly confirmed case, the stock price volatility measured by variance increases by 0.82 units. However, at  $t = -1$ , for each 1% increase in the number of confirmed cases in China, the current stock price volatility measured by variance decreases by 1.02 units.

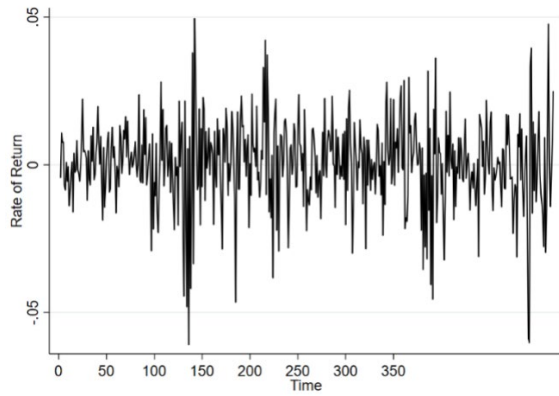


Figure 1 MSCI China index time series graph

Table 5. GARCH with Logarithmic newly diagnosed number of China as exogenous variables

Variables	(1)	(2)	(3)
Logarithmic newly diagnosed number of China			
$t=0$	.0978**	.8277***	.8020***
	.0564	.2357	.2199
$t=-1$		-.7362***	-1.0170***
		.2356	.3183
$t=-2$			.3052
			.2674
ARCH	.1659***	.1856***	.1778***
	.0424	.0430	.0421
GARCH	.6650***	.6333***	.6476***
	.0909	.0786	.0768
Constant	-	-	-
	10.5953***	-10.5931***	10.6557***
	.3858	.3348	.3428

Note: \*\*\*, \*\*, and \* indicate the level of significance of 1%, 5%, and 10%, respectively.

### 3.3.2. Empirical Results of newly confirmed cases in the USA

Table 6 shows the outcome of the GARCH model with the number of new US logarithmic diagnostics as exogenous variables. The coefficients of the  $t=0$  and  $t=-1$  period are not significant, while, the coefficient of the  $t=-2$  period was significant at the 1% level. Regarding this result, at  $t = -2$ , for every 1% increase in the number of confirmed cases in the US, the stock price volatility measured by variance increases by 0.21 units.

Table 6. GARCH with Logarithmic newly diagnosed number of the USA as exogenous variables

Variables	(1)	(2)	(3)
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Logarithmic newly diagnosed number of the USA			
$t=0$	.0356	-.1873***	-.1409
	.0207	.0452	.1131
$t=-1$		.2209***	-.1184
		.0459	.1344
$t=-2$			.2880***
			.0627
ARCH	.1693	.1578***	.1414***
	.0405	.0457	.0407
GARCH	.6778	.6747***	.6956***
	.0935	.0975	.0919
Constant	-10.6329	-10.6465***	-10.6780***
	.4015	.3948	.4114

Note: \*\*\*, \*\*, and \* indicate the level of significance of 1%, 5%, and 10%, respectively.

### 3.3.3. Empirical Results of newly confirmed cases in China & the USA

Table 7 gives information about the result of GARCH model with the number of China and US logarithmic diagnostics jointly as exogenous variables. As for the effect of pandemic in China, the coefficients of the  $t=0$  period and  $t=-1$  period are significant at 1% level, while, the coefficients of the  $t=-2$  period is not significant. Thus, at  $t = 0$ , for each 1% increase in the number of confirmed cases in China, the stock price volatility measured by variance increases by 0.89 units. However, at  $t = -1$ , for each 1% increase in the number of confirmed cases in China, the stock price volatility measured by variance decreased by 1.19 units. For the newly confirmed cases in the USA, the coefficient is not significant at the 1% level when  $t=1$  and  $t=-1$ . However, it is significant when  $t=-2$  and the figure is positive, which means at  $t = -2$ , for every 1% increase in the number of confirmed cases in the US, the stock price volatility measured by variance increases by 0.30 units at the current period. The estimation results in Table 7 are similar to the conclusions in Table 5 and Table 6, which means the conclusions of this model are robust.

Table 7. GARCH with Logarithmic newly diagnosed number of China & the USA as exogenous variables

Variables	(1)	(2)	(3)
Logarithmic newly diagnosed number of China			
$t=0$	.0758	.8729***	.8887***
	.0625	.2467	.2120
$t=-1$		-.8348***	-1.1931***
		.2438	.3321
$t=-2$			.3443
			.2884

Logarithmic newly diagnosed number of the USA			
$t=0$	.0180	-.2015***	-.1664*
	.0228	.0469	.0976
$t=-1$		.2262***	-.1195
		.0517	.1190
$t=-2$			.3009***
			.0686
ARCH	.1674***	.1630***	.1353***
	.0438	.0458	.0430
GARCH	.6577***	.6554***	.6932***
	.0996	.0852	.0806
Constant	-	-10.7438***	-10.8426***
	10.6304**		
	.3896	.3551	.3659

Note: \*\*\*, \*\*, and \* indicate the level of significance of 1%, 5%, and 10%, respectively.

#### 4. DISCUSSION

This article finds that the severity of the pandemic in China has no dynamic correlation with the China concept stock price, while the US pandemic had a dynamic correlation with the China concept stock price index. The volatility of the Chinese concept stock index represented by MSCI China index has a characteristic of volatility clustering, which reflects the autoregressive conditional heteroscedasticity of volatility. However, the ARMA-GARCH model can eliminate the heteroscedasticity and explain its volatility. The volatility of stock price is positively correlated with the number of newly confirmed cases in China during the  $t=0$  period and the number of newly confirmed cases in the United States during the  $t=-2$  period, while, is negatively correlated with the newly confirmed numbers in China during the  $t=-1$  period. Previous studies have already shown that COVID-19 has caused a negative shock in global equity markets[12]. It is demonstrated that at least part of turbulence of stock market was caused by short-term investor sentiment, which is the fear created by the coronavirus[6]. This is consistent with the result that the increasing volatility in the USA when  $t=-2$  and China when  $t=0$ . Furthermore, according to one study, Chinese market shows relative calm with lower volatility during the outbreak and pandemic periods[4]. However, average volatility in U.S. equity market increases as the coronavirus progressed from epidemic to pandemic[4]. This result is consistent to this paper, which shows that the dynamic correlation between Chinese pandemic severity and China concept stock price is not significant. On the other hands, a negative trend is shown between the volatility and the epidemic severity in China in some periods. However, the American pandemic severity do affect the China concept stock price a lot, and it is positively related to

the stock price volatility.

#### 5. CONCLUSION

Because of the fact that the study about the correlation between China Concept Stock price volatility and the severity of COVID-19 is very limited, and China's effective responses against the spread of virus, this article aims to find out the virus in which place is more related to the stock price. According to the result, although the main businesses of the China Concept Stock companies are in China, the price of the stock is more correlated with the USA. Moreover, the volatility of stock price and the newly confirmed cases number in the USA shows a similar trend. People who hold China concept stock could be beneficial from this paper, because people's investment sentiment are affected under such a severe condition, which might cause overreaction and market correction. They could be more rational and make more sensible choice after knowing this study.

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