

The COVID-19 and Dynamics in Financial Market: An Empirical Evidence in China

Xiaohan Lu*

Kenan Flagler Business School, University of North Carolina

*Corresponding author: xiaohan@live.unc.edu

Abstract. Stock markets are so sensitive that they respond to occurrences rapidly. In this paper, we examine the relationship between the Covid-19 pandemic and dynamics in the stock market of China. This paper analyzes the data between the daily increase of the confirmed cases of Covid-19 in China and worldwide and representative indices of China's stock market. We apply the unit root test to check the variables' stationary state. We also develop VAR and ARMA-GARCH models to analyze the dynamic relation. Based on the empirical results, we conclude that the Covid-19 pandemic does not have a significant influence on the return of China's financial market in the long term. China's financial market has some degree of resilience. But China and the world's new Covid-19 case growth rate has a significant impact on China's stock market volatility.

Keywords: Covid-19, financial market, ARMA-GARCH model, vector autoregression, impulse response.

1. Introduction

Since the breakout of Coronavirus disease 2019 in December 2019, the global economy has been greatly impacted and has experienced unexpected declines [1]. China reported the first case of the Covid-19 in Wuhan in December 2019. And the disease quickly diffused to other parts of the globe, affecting both people's lives and the world situation[2]. The World Health Organization(<https://covid19.who.int/>) indicates that 497,057,239 people in the world have been confirmed with COVID-19, including 6,179,104 deaths by the end of April 11, 2022, .

The impact of the Covid-19 is huge, drawing many researchers' attention to study its influence. Because stock markets are very sensitive, they respond quickly to major events[3]. The Covid-19 pandemic caused stock markets fluctuations in the countries affected by the outbreak[4]. On March 9, 2020, the inventory market meltdown began. The Dow Jones Industrial Average dropped 7.79 percent, which was the largest single-day point decline in the history of US market[5]. This paper examines the dynamic link between the influence of Covid-19 and China's stock market.

Most previous researches are broad and focus on the general influence of the Covid-19 on the economy, but few studies on its influence, especially on China's stock market. Stefan, Eduard, Tomá, and Peter used Google searches for the term "coronavirus" to gauge short-term investors' fear of the coronavirus. And they pointed out that the fear of the Covid-19 could explain the stock market volatility during the pandemic.

Researchers Abdullah, Khaled, Ahmad, and Salah believe that the daily increase in cases and total deaths caused by COVID-19 have a major negative impact on the stock returns of companies in the market [6]. They analyzed the stock market from January 10th to March 16th, 2020, using the Hang Seng Index and the Shanghai Stock Exchange Composite Index. And they concluded that both total deaths and the daily increased case numbers were inversely related to the stock returns.

Some researchers look at different industries' performance under the influence of Covid-19 in China. Using an event study approach, He, Sun, Zhang, and Li investigated the market performance and behavioral tendencies of Chinese enterprises to the Covid-19 epidemic. They found out that the Covid-19 epidemic had a detrimental impact on industries like transportation and environmental industries [7]. Industries like manufacturing and education, on the other hand, were shown to be resistant to the pandemic.

In addition, Yan and Qian use an event study technique to investigate the impact of the COVID-19 epidemic on the consumer industry's stock price fluctuations in China. Their finding suggests that

the COVID-19 epidemic had a significant short-term influence on China's consumer stock market [8]. The return on consumer stocks, nonetheless, progressively recovered as the event progressed. This conclusion demonstrates that the pandemic has a minor impact on consumer goods' stocks, and it may be seen as a conditional short-term phenomenon.

This paper focuses specifically on the influence of Covid-19 on China's financial market, analyzing the data from the breakout of Covid-19 to the date before the conflict between Russia and Ukraine. This paper will be updated and will fill the gap in research on China's financial market. It contributes to helping people understand the dynamic link between the influence of Covid-19 and China's financial market. This research will also be useful for investors to predict the economy and stock market, given the context of a global pandemic. It may help people to research the influence of a similar pandemic on the overall economy and market. And this paper may contribute to helping countries that endure covid-19 to make better policies in the way to promote economic growth.

By analyzing the data between the daily increase of the confirmed cases of Covid-19 in China and worldwide and the index of China's stock market, this paper will research the dynamic relation between the influence of Covid-19 and China's stock market. This paper will use the Shanghai Composite Index and Shenzhen Component Total Return Index as indicators for China's stock market. The pandemic caused China's financial market to increase uncertainty. For example, it had a negative influence on the consumption market but a positive influence on the healthcare market. So the relationship between them is unclear and valuable to study.

The paper consists of 5 sections: the first section is the introduction and literature review; the second part goes through the research design; the third section talks about the results of the model; the fourth part is the discussion of the report; the conclusion and possible researches to do in the future are provided in the fifth section.

2. Research Design

2.1 The source of the data

Our research focuses on the dynamic relationship between the influence of the Covid-19 and China's financial market. The SSEC and SZI are the two indices that we use to represent China's stock market. SSEC stands for SSE Composite Index, also referred to Shanghai Index in the following content. From the definition on Wikipedia (https://en.wikipedia.org/wiki/SSE_Composite_Index), it is a stock market index that includes all stocks listed on the Shanghai Stock Exchange. SZI stands for Shenzhen Component Total Return Index, which also refers to the Shenzhen index in the following content, is the 500-stock index that indicates the performance of stocks listed on the Shenzhen Stock Exchange according to Wikipedia (https://en.wikipedia.org/wiki/SZSE_Component_Index).

We collected the historical daily data of SSEC and SZI on Investing.com. Investing.com is a financial platform and news website that ranks among the world's top three financial websites. According to Wikipedia (<https://en.wikipedia.org/wiki/Investing.com>), this site provides market quotes, stocks, futures, and up-to-date financial news. In 2019, Investing.com was listed among the world's top 400 websites, having exceeded 10 million Android downloads and more than 21 million monthly users. As a result, the database from Investing.com is quite reliable. Besides, we used and evaluated the daily closing prices of SSEC and SZI.

We collected the daily number of new confirmed cases of Covid-19 in China and globally from https://raw.githubusercontent.com/owid/covid-19-data/master/public/data/jhu/new_cases.csv. The data originates from the Center for Systems Science and Engineering (CSSE) at Johns Hopkins University's COVID-19 Data Repository. The collection of cases is updated daily. We utilized the new cases variable for China and worldwide, the new confirmed case of Covid-19, to show the situation of Covid-19.

To select the range of the data, we chose the date between Jan 22nd, 2020, and Feb 24th, 2022. Because the conflict between Russia and Ukraine became a war on Feb 24th, 2022[9], we have to

avoid using the data after that date to minimize other factors' influence on China's stock market. While the number of new confirmed cases of Covid-19 exists, some dates do not have a valid daily closing price due to holidays or weekends. We set the daily closing price for SSEC and SZI to be indispensable. Otherwise, the respective dates would not be investigated due to the lack of an index in China's stock market.

2.2 The unit root test

We did the unit root test to determine whether the daily data of SSEC, SZI, increased new confirmed cases of the Covid-19 in China and worldwide. According to the researcher Xia Nan Xing, it is essential to determine whether there is a unit root in the time series before testing the time trend. Stable processes with trends can be used only after the unit root hypothesis is rejected. In this research, the Augmented Dickey-Fuller (ADF) test was utilized to determine the variables' stationary state in a time series. We checked all the variables and reported the results in table 1.

Table 1. ADF-test

Variables	t-statistic	p-value
Stock market		
SH index	-2.422	0.3682
SZ index	-1.748	0.7292
Rate of return, SH index	-16.565	0.0000***
Rate of return, SZ index	-16.633	0.0000***
The daily growth rate of confirmed cases		
China	-23.884	0.0000***
Global	-26.827	0.0000***

Table 1 demonstrates that although the p-values for the SH index and SZ index are not significant because they are greater than 0.1, the p-values for the rate of return of the SH index and SZ index are both 0.0000. And the p-values for China and the global daily growth rate of confirmed cases are all 0.0000. Hence, the unit root hypothesis is rejected, and stable processes with trends can be used in the next step.

2.3 VAR model Specification

Vector autoregression (VAR) is a type of stochastic process model used to determine the connection between numerous quantities as they mutate and vary over time[10]. Use VARSOC to rank the Shanghai Stock exchange rate, Shenzhen stock Exchange rate, China Stock Exchange rate, and global stock exchange rate, and build the VAR model. The order of the VAR model relates to how many prior periods the model will employ. The value of a variable in a preceding period is called a lag. A p-order VAR is a VAR model that contains lags over the previous p periods. A p-order VAR model can be expressed as

$$y_t = c + A_1 y_{t-1} + A_2 y_{t-2} + \dots + A_p y_{t-p} + e_t \quad (1)$$

In this model above, A_i represents a time-invariant $(k \times k)$ -matrix. The variables y_{t-i} are referred to y_t 's "ith lag", reflecting variable's value i periods earlier. The model's intercept is represented by the variable c, which is a k-vector of constants. e_t is the error terms' k-vector [11].

2.4 ARMA-GARCH model Specification

The conditional mean and variance of the ARMA model and the GARCH model are entirely consistent with each other. Therefore, we can utilize the ARMA-GARCH model in order to analyze our dataset.

$$\sigma_t^2 = \alpha_0 + \alpha_1 \varepsilon_{t-1}^2 + \beta_1 \sigma_{t-1}^2 \quad (2)$$

Equation (2) is the equation for the ARMA-GARCH model by combining the output of the ARIMA and GARCH models.

We constructed 3 ARMA-GARCH models, and the mean equation is ARMA. We added new confirmed case of Covid-19 in China to the variance equation of the first model. Then, in the second model, we added the global new confirmed cases of Covid-19. Finally, both two were added the third ARMA-GARCH model.

3. Empirical Results and Analysis

3.1 Results of the VAR model

The PACF and ACF were used to rank the return series of the Shanghai index and Shenzhen Index respectively to determine the order of AR and MA. Figures of results of PACF and ACF are shown in the figures below.

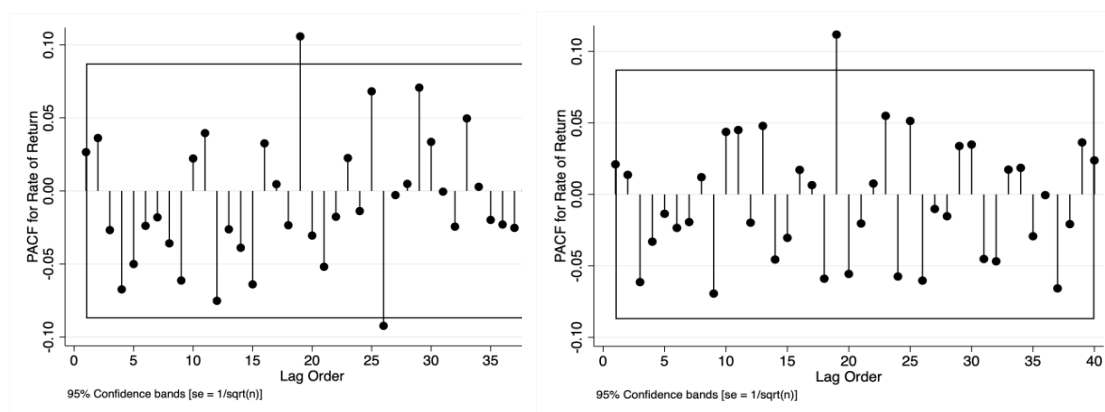


Figure 1 PACF for AR identification

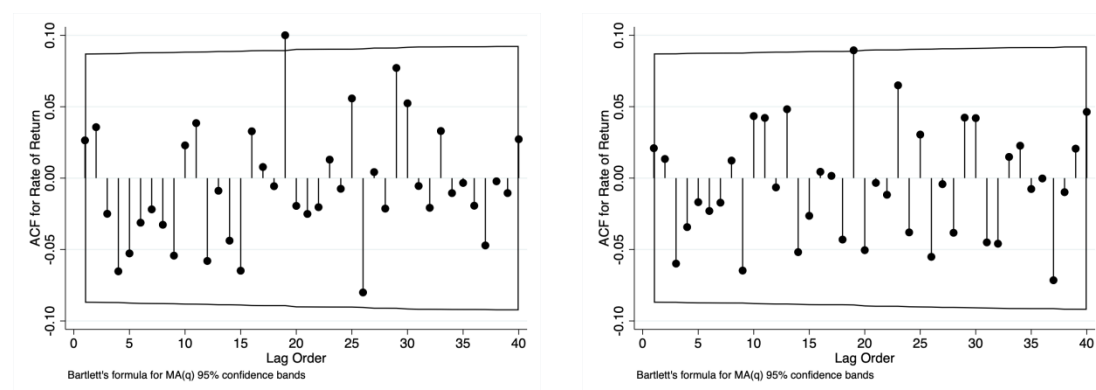


Figure 2 ACF for MA identification

From the PACF and ACF graphs, we can see that the $p=19$ and $q=19$. We would use this p and q value for the order of ARMA function in the ARMA-GARCH model later.

In addition, because the stationary state of a series has been established, the selection of lag-length can begin by utilizing AIC and HQIC. The VAR model's output with lags ranging from 1 to 12 is given below. The lag order of the VAR was determined using these information and data.

Table 2. VAR model identification

Lag	FPE	AIC	HQIC	SBIC
1	3.6e-11	-12.6945	-12.6811	-12.6604
2	3.0e-11	-12.8813	-12.8143	-12.7106*
3	2.9e-11	-12.9007	-12.7801	-12.5935
4	3.1e-11	-12.8534	-12.6792	-12.4097
5	2.4e-11	-13.113	-12.8316*	-12.3962
6	2.4e-11	-13.1055	-12.7705	-12.2522
7	2.5e-11	-13.0773	-12.6886	-12.0874
8	2.4e-11	-13.0898	-12.6475	-11.9633
9	2.4e-11	-13.0929	-12.597	-11.8299
10	2.2e-11	-13.1765	-12.627	-11.777
11	2.2e-11	-13.1706	-12.5674	-11.6345
12	2.2e-11*	-13.1881*	-12.5314	-11.5156

The result showed that the order can be either 5 or 12 because of the small AIC or HQIC value. The order of 5 was used to simplify the process, so the VAR model in this paper will be analyzed by 5-order lag.

Then we proceeded to test the VAR model's stability by using the roots of the companion matrix. The figure below demonstrates the stability of the VAR model because all roots lie within the unit circle, satisfying the VAR stability requirement.

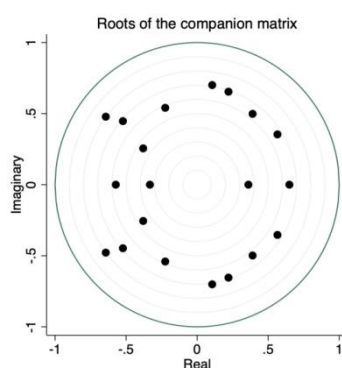
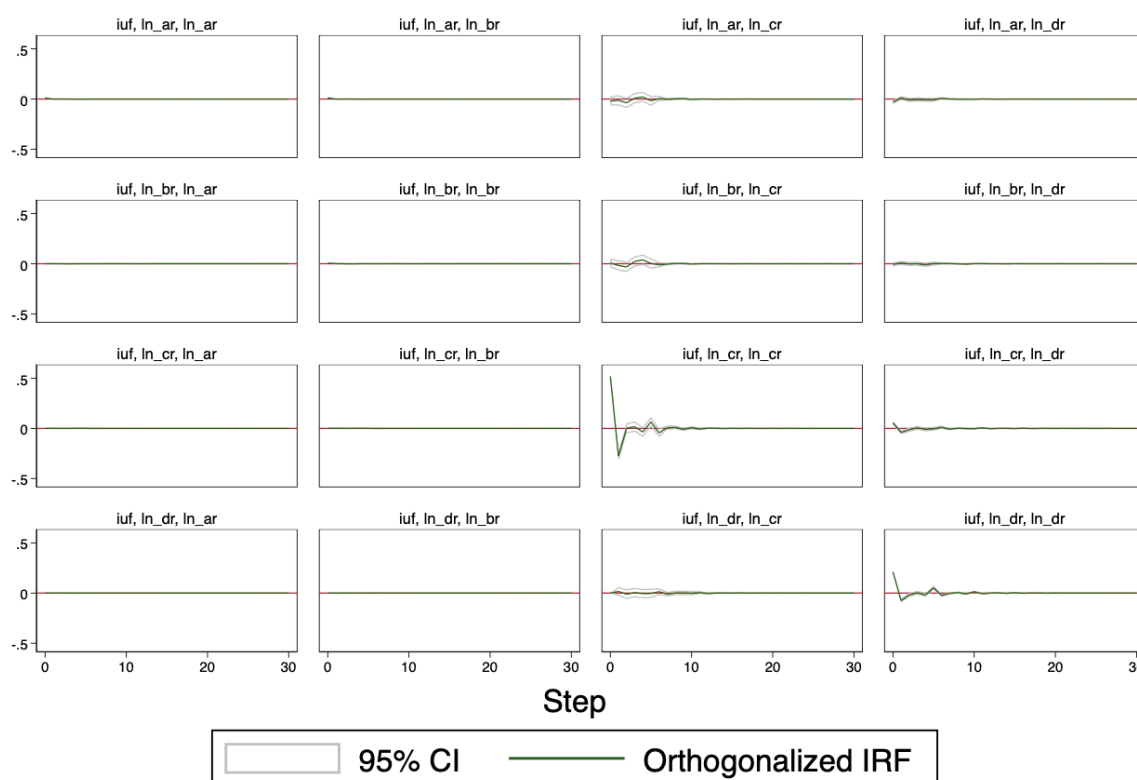


Figure 3 Test of VAR model stability

3.2 Impulse and response

Impulse responses provide information about the dynamic behaviors of a VAR model[6]. In this paper, we used the new cases of Covid-19 in China and the globe as impulse variables and used Shanghai and Shenzhen indexes as response variables.



Graphs by irfname, Impulse variable, and Response variable

Figure 4 Impulse and response

In Figure 4 above, the green lines represent the Orthogonalized Impulse Response Function and they are plotted at the 95% confidence interval.

The figure indicates that neither global nor China's new confirmed cases of Covid-19 had a significant impact on the return of China's stock market. Furthermore, the third graph in the third row and the fourth graph in the fourth row only indicate that the increasing speed of new cases has a limited amount of autocorrelation.

Based on this result, the Covid-19 pandemic does not have a significant influence on the return of China's financial market in the long term. China's stock market has some degree of resilience.

3.3 The results of the ARMA-GARCH model

Table 3 below shows the ARMA-GARCH model's result.

According to the results of the ARMA-GARCH model above, when ARMA is included in the mean equation, that is, after the mean equation has included the autocorrelation of return rate itself, China and the world's new Covid-19 case growth rate significantly influence the stock market volatility.

As of the Shanghai index, the estimated results in Column 1 indicate that the rising of daily growth rate of China's new confirmed Covid-19 cases will lead to the increase in volatility. However, after the new confirmed cases in China and the world are included in the estimation in Column 3, we find that the growth rate of China's new confirmed cases is significantly negatively correlated with the Shanghai index volatility, while the daily growth rate of confirmed cases in the world is significantly positively correlated with the volatility. This demonstrates that the Shanghai index is mainly affected by the global epidemic.

For the Shenzhen Index, the estimation results in column 4 demonstrate that the increase in the daily growth rate of new confirmed cases in China lead to an increase in volatility. However, after the 6th column of the estimation included both new confirmed cases in China and the world, it was found that the growth rate of new confirmed cases in China was significantly negatively correlated

with the volatility of the Shenzhen Index, and the daily growth rate of confirmed cases in the world was significantly positively correlated with the volatility. This shows that Shenzhen Index is primarily impacted by the global epidemic.

Table 3. ARMA-GARCH model, variance equation

Variables	(1)	(2)	(3)	(4)	(5)	(6)
		Shanghai			Shenzhen	
ARCH (-1)	.1067*** (.0211)	.1679*** (.0192)	.0402** (.0176)	.0788*** (.0258)	.0775*** (.0246)	.0630* (.0229)
GARCH (-1)	.8080*** (.0318)	.7653*** (.0409)	.8941*** (.0291)	.8711*** (.0348)	.8714*** (.0360)	.8869*** (.0347)
Constant	- 11.8120*** (.2995)	- 11.6726*** (.3432)	- 12.5797*** (.3799)	- 11.7859*** (.4426)	- 11.6546*** (.4443)	- 11.9713*** (.5281)
		The daily growth rate of confirmed cases				
China	.9453*** (.0990)		-1.5750*** (.1459)	.9754*** (.1270)		-1.1369*** (.3363)
Global		-1.5275 (1.2305)	2.6886*** (.2063)		1.0169*** (.1288)	2.2028*** (.4035)

4. Discussion

This paper finds that neither the global nor China's new confirmed cases of Covid-19 had a significant impact on the return of China's stock market. But according to the impulse and response, the increasing growth rate of new cases has a limited amount of autocorrelation. And in the long term, COVID-19 has had no significant impact on Chinese stock market yields, and the Chinese economy is resilient.

Compared to previous research, our study demonstrates that the Shanghai index and Shenzhen index are mainly influenced by the global pandemic based on the ARMA-GARCH model. The growth rate of China and the world's new Covid-19 case have an important impact on stock market volatility.

Further research can study more on two more aspects. To begin with, existing literature pays more attention to the direct influence of the pandemic on the stock market, while the indirect effects and mechanisms receive less attention. Therefore, it might be beneficial to explore more of the indirect effect of occurrences on the economy. Secondly, a lot of small to medium public companies are not listed in the Shanghai index or Shenzhen index. It might be interesting to research the relationship between these two representative indices and the performance of these companies in the economy.

5. Conclusion

Factors that influence China's stock market are always attractive fields to explore. Because stock markets are extremely sensitive, they react fast to important occurrences.

This paper focuses on the dynamic relationship between the influence of Covid-19 and China's financial market. Specifically, we analyzed the data from the breakout of covid-19 to the date before the conflict between Russia and Ukraine. The Augmented Dickey-Fuller test was first applied to check the stationary of variables in a time series. Moreover, by utilizing empirical model, including the ARMA-GARCH model, this paper comes to the conclusion that Covid-19 pandemic does not have significant influence on the return of China's stock market in the long term. China's stock market has some degree of resilience. But China and the world's new Covid-19 case growth rate has an vital impact on China's stock market volatility.

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