The Impact of COVID-19 on the Stock Market

-- Taking China's and the United States' Stock Markets as Examples

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Abstract: As COVID-19 spreads over the world, the economy has suffered greatly since the Great Depression of the early twentieth century. The outbreak has a significant negative influence on financial markets in China and the United States, the world's two largest economies. This study addresses the influence of COVID-19 on the stock market in China and the United States, and investigates the impact on emerging stock markets in China and the United States using weekly closing prices from June 1st, 2018 to June 30th, 2022. The paper also conducts an empirical investigation of the influence of COVID-19 on the stock market using the Augmented Dickey-Fuller Test, Moving Average model, and GARCH model, and then focuses on policy variations between two countries. According to the data, the COVID-19 epidemic has had a considerable detrimental influence on stock markets and volatility in both countries. According to the research, the United States' stock market is more likely to be affected by COVID-19 than that of China, and the volatility of stock market indexes is higher in the United States during the most dangerous period of the pandemic. When compared to the United States, China had a faster response and recovery rate when COVID-19 first surfaced, but as the pandemic normalizes, China had a higher volatility rate.

Keywords: COVID-19 impact, stock market, SSEC, SPX, volatility

1. Introduction

Nearly three years have passed since the COVID-19 breakout, and during that time we have all actually felt its effects on the economy, the stock market, and even our daily lives. Due to travel restrictions and flight cancellations made to lessen the impact of the COVID-19 coronavirus, the aviation industry has been negatively impacted by the pandemic. Additionally, as the coronavirus spreads across the globe, a lack of medical supplies testing capacity has put a tremendous strain on hospitals and medical facilities, preventing access to healthcare for those in remote and disadvantaged areas [1].

Because the new virus is so widespread and has spread around the world, the effects of the pandemic on China and the US are obvious. The global economy, particularly tourism, has been significantly impacted by the various levels of response and blockade actions that different countries have adopted. According to study, the travel and tourism sector could lose up to 2.1 trillion dollars in GDP by 2020. The coronavirus pandemic's extensive effects, according to the WTTC's estimate of

one million job losses per day in the tourism industry [2]. According to calculations made in China to assess the pandemic's effects on publicly traded tourism businesses, the average decline rate for scenic listed businesses is 31.24%, the average decline rate for tourism service listed businesses is 44.82%, the average decline rate for hotel and catering listed businesses is 38.58%, and the average decline rate for air transportation listed businesses is 50.71% [3]. Overall, both countries' economies have been impacted by the pandemic.

Using weekly closing prices from June 1, 2018, through June 30, 2022, this research examines the effects of COVID-19 on the stock markets in China and the United States as well as the emerging stock markets of China and the United States. The paper also examines the empirical analysis of COVID-19's effects on the stock market using the Augmented Dickey-Fuller Test, Moving Average Model, and GARCH Model before concentrating on the policy variations between two nations.

The two biggest economies in the world are those of China and the United States; China represents socialism and America represents capitalism. It makes sense to compare the effects of the epidemic on stock markets based on these two countries because they have unequal economic systems and very diverse approaches to coping with the pandemic.

2.   Theoretical Analysis

The stock market has taken a serious hit as a result of COVID-19. The COVID-19 outbreak has had a significant impact on economic activity. When there is a recession, this will lower people's income, which will then cause them to consume less, which will lower company earnings, which will then cause the stock market to collapse. The pandemic's effects caused the global financial market to experience extreme fluctuations, which greatly exacerbated market pressure. Since then, the epidemic's propagation has caused a large-scale cliff-like collapse in the global stock market, and circuit breakers have happened one after another in numerous nations' stock markets [4].

Additionally, stock market activity decreases as a result of the enormous increase in cases brought on by the outbreak. The experiment by four Kuwaiti researchers showed the effect of COVID-19 sickness on the Chinese stock market using panel data. The results of the experiment showed that both the daily growth rate of confirmed cases and deaths and stock returns of various organizations have an effect [5]. In March, the American stock market experienced several blows within a short period of time, and the Dow Jones index dropped from about 30,000 points to roughly 20,000 points, or 26% [6]. Regarding the effect on the stock market, the outbreak not only had a clear negative effect in the beginning but also brought about a lot of uncertainty and risk. In 2020, the stock market's volatility also hit a record high [7].

Due to the global spread of the epidemic, coupled with the lack of awareness of the severity of the epidemic in many developed countries and incomplete prevention and control measures, or the sudden adoption of prevention and control measures such as "closure of cities" and border closures, it has increased the unpredictable investment risks of stock investors. This intensified people's panic. Worries and panic quickly spread to the economic and financial fields. The U.S. financial market was greatly affected. The U.S. stock market experienced four circuit breakers in two weeks in March 2020. The Asia-Pacific markets have plummeted across the board. It can be seen that the epidemic has caused large fluctuations in the global stock market and triggered violent turbulence in the international financial market [4].

3.   Data and Descriptive Statistics

For China, the author used the index SSEC, and for the United States, the author chose the index SPX. The author collected stock market indices from China and the United States before and during the COVID-19. As a composite index of all the equities listed on the Shanghai Stock Exchange, or SSEC,

or Shanghai Securities Composite Index, it represents changes in the prices of the stocks listed there. With over 900 stocks listed on Shanghai Stock Exchange, the SSEC index is the largest stock exchange in mainland China and the sixth largest in the world [8]. The Standard Poor Index, or SPX for short, tracks the stock index of 500 publicly traded American corporations, including those listed on the New York Stock Exchange, Nasdaq, and other significant American exchanges. Both indices are chosen as the weekly closing prices throughout the period from June 1 2018 to June 30 2022 during the epidemic, according to data from the website https://cn.investing.com.

Figure 1: Impacts on stock market index in China (on the left) and the United States (on the right) due to COVID-19.

From Figure 1, it can be seen that when COVID-19 first broke out, which is around February 2020, there is an obvious decline on both SSEC index and SPX index. This is because when the virus first emerged, people were panic due to the reason that this is a brand-new virus, with the features that are highly contagious and highly virulent. As seen in the picture on the left, the orange point is around late of January and the beginning of February, this is also the time when coronavirus first outbreak in Wuhan, China, the green point is around the beginning of March, this is the time when the outbreak in China is about to be brought under control. From the orange point to the green point, the stock market index in China decreases as the pandemic emerges. Based on the picture on the left, it can be roughly calculated that the SSEC index decreases for nearly 13% caused by the epidemic. For the picture on the right, the yellow point is around February and this is the time when the virus in the United States first emerged. From the yellow point to the grey point, there is an extremely decline in SPX index as the virus comes. It can be calculated roughly that the SPX index decreases for almost 32% caused by the pandemic. To conclude, the United States experiences a deeper reduction due to COVID-19, indicating that the United States is more likely to be affected by COVID-19 on stock market compared to China.

After the worst time of the epidemic, the pandemic tends to normalize. As demonstrated in Figure 1, as the economy gradually recover, there is a progressive increase on both stock market.

Here is another finding in Figure 1, for the SSEC index, there's a significantly decline on the stock market from March 2022 to June 2022. This is due to the reason that the epidemic in Shanghai has repeated. With 20,000 more cases per day, people can only stay at home and the whole city is silenced.

Based on the findings above, the paper concludes that the COVID-19 has affected the stock market in both China and the United States. During the worst stage of the epidemic, compare to China, the degree of trauma of the United States is larger. However, these results still require further empirical analysis based on the data, which are detailed in part 4.

4. Empirical Analysis

In order to verify the impact of COVID-19 on the stock market, the author has finished the empirical analysis including Augmented Dickey-Fuller Test, moving average model and the GARCH model. Augmented Dickey-Fuller Test is mainly used for testing the stationarity of the series and the rate of decline in returns. The Moving average model detects the deviation of the actual trend and the forecasting trend, and the GARCH model investigates the changes of the conditional volatility.

4.1. Stationarity Test Using Augmented Dickey-Fuller Test

In order to see the stationarity of the return of the market indices, the Augmented Dickey-Fuller test, also called the ADF test, is applied. Table 1 and Table 2 show that the p-value for both SSEC index and SPX index is 0.0000, which is significant, it can be deducted from the result that both the series are stationary.

Table 1: Results of Augmented Dickey-Fuller Test for SSEC index based on the whole sample.

Variable		Coefficient	Standard error	t-statistic	Prob value
Augmented Dickey-Fuller test statistic		-	-	-15.40930	0.0000
R(-1)		-1.070417	0.069466	-15.40930	0.0000
C		0.000579	0.001672	0.346324	0.7295
Test critical values:	1% level			-3.461783	
	5% level			-2.875262	
	10% level			-2.574161	

Table 2: Results of Augmented Dickey-Fuller Test for SPX index based on the whole sample.

Variable		Coefficient	Standard error	t-statistic	Prob value
Augmented Dickey-Fuller test statistic		-	-	-15.71278	0.0000
R(-1)		-1.084726	0.069035	-15.71278	0.0000
C		0.001651	0.002000	0.825172	0.4102
Test critical values:	1% level			-3.461327	
	5% level			-2.875062	
	10% level			-2.574054	

In order to discuss whether the COVID-19 has caused a faster rate of decline in the return of the market indices, the author chooses two time periods, one from 2018.6-2022.6, which is the whole sample, the other from a period in 2020 with the worst degree of the pandemic. For SSEC index, the selected time period is 2020.1-2020.7, and for SPX index, 2020.2-2020.8 is the selected time period. Then, the author compares the coefficient of the R(-1) variable, discussing whether the COVID-19 has impact on the return of market indices.

From Table 1 and Table 2, for the whole sample period, it can be found that the coefficient of R(-1) variable is -1.070417 for SSEC index and -1.084726 for SPX index. Since both the coefficient is negative, this indicates that two indices are all experiencing a smooth descent process.

Table 3 and Table 4 illustrates the results of the ADF test for SSEC index and SPX index from a period in 2020. From the results, it shows that the p-value for SSEC index and SPX index is 0.0000

and 0.0438 respectively, since both p-value is less than 0.05, this indicates that both series is stationary. In Table 3, for SSEC index, the coefficient of the R(-1) variable from 2020.1-2020.7 is -1.164955. And for the SPX index in Table 4, the coefficient of the R(-1) variable from 2020.2-2020.8 is -1.269709, as both the coefficient is negative, indicating that two stock market indices experienced a steady decline.

Table 3: Results of Augmented Dickey-Fuller Test for SSEC index from 2020.1-2020.7.

Variable		Coefficient	Standard error	t-statistic	Prob value
Augmented Dickey-Fuller test statistic		-	-	-5.913272	0.0000
R(-1)		-1.164955	0.197007	-5.913272	0.0000
C		0.002820	0.006271	0.449751	0.6566
Test critical values:	1% level			-3.689194	
	5% level			-2.971853	
	10% level			-2.625121	

Table 4: Results of Augmented Dickey-Fuller Test for SPX index from 2020.2-2020.8.

Variable		Coefficient	Standard error	t-statistic	Prob value
Augmented Dickey-Fuller test statistic		-	-	-3.050713	0.0438
R(-1)		-1.269709	0.416201	-3.050713	0.0066
C		0.009287	0.010939	0.849040	0.4064
Test critical values:	1% level			-3.724070	
	5% level			-2.986225	
	10% level			-2.632604	

Compared to the coefficient of the R(-1) variable for two stock market indices from 2018.6-2022.6 and the time period from 2020, the results show that for both indices, the coefficient was found to be larger in the time period we chose from 2020. This indicates that due to the serious epidemic in 2020, there existed a faster decline in the stock market indices.

From the results of the ADF test, while both Chinese and the United States' stock market have shown a steady downward trend of return from 2018-2022, the rate of decline is more rapid in 2020 in both countries. Next, to investigate how much the COVID-19 has caused a derivation to the stock market from the theoretical market trend, the Moving average model is applied.

4.2. Moving Average Model

For each stock market indices, the author uses the moving average model to give a forecast over 0.5 month and 1 month during 2018.6-2022.6. Then, the paper shows the trend of the real data and the forecasting data on a line graph, with the difference between these two data with a bar graph.

For SSEC index, Figure 2 and Figure 3 shows the moving average forecasting over 0.5 month and the forecasting over 1 month. In both graphs, blue line indicates the real data and the orange line indicates the forecasting data, grey line is the gap between real data and forecasting data.

As seen from Figure 2 and Figure 3, for both forecasting periods, from 2020.1 to 2020.4, which is the height of the outbreak, it is obvious that the forecasting value is higher than the real value. This means that due to the epidemic, the stock market index is being affected, it doesn't reach the

theoretical forecasting value according to the moving average model. Besides, the grey lines on the axis are mostly negative in the period from February to April, and on approximately 15th of March there exists the largest negative gap, which is greater than -210. These findings indicate that during the most serious period of the outbreak in China, the SSEC index is significantly lower than expected, indicating that the epidemic has affected the value of the stock market index.
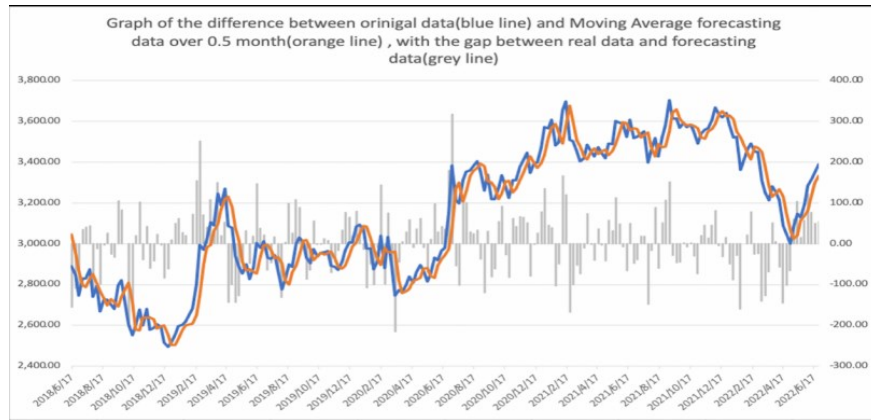

Figure 2: Graph of the difference between original data(blue line) and Moving Average forecasting data over 0.5 month(orange line) for SSEC index, with the gap between real data and forecasting data(grey line).
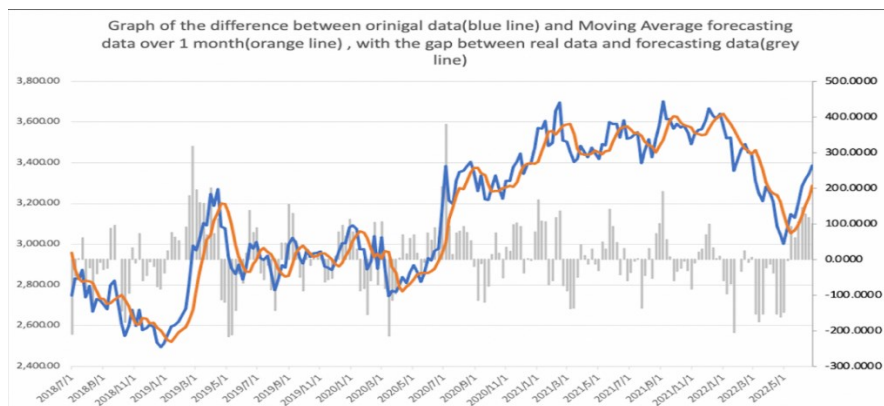

Figure 3: Graph of the difference between original data(blue line) and Moving Average forecasting data over 1 month(orange line) for SSEC index, with the gap between real data and forecasting data(grey line).

For SPX index, Figure 4 and Figure 5 shows the moving average forecasting over 0.5 month and the forecasting over 1 month. In both graphs, blue line indicates the original data and the orange line indicates the forecasting data, grey line is the gap between real data and forecasting data.

From these Figures, for both forecasting periods, from 2020.2 to 2020.4, when the outbreak first started, it is obvious that the forecasting value is higher than the real value. This means that due to the epidemic, the stock market index is being affected, it does not reach the value according to the moving average model. Besides, the grey lines on the axis are mostly negative in the period from February to March, and on approximately the middle of March there exists the largest negative gap reaches more than -500. These findings indicate that during the most serious period of the outbreak in the United States, the SPX index is significantly lower than expected, indicating that the epidemic has affected the value of the stock market index.
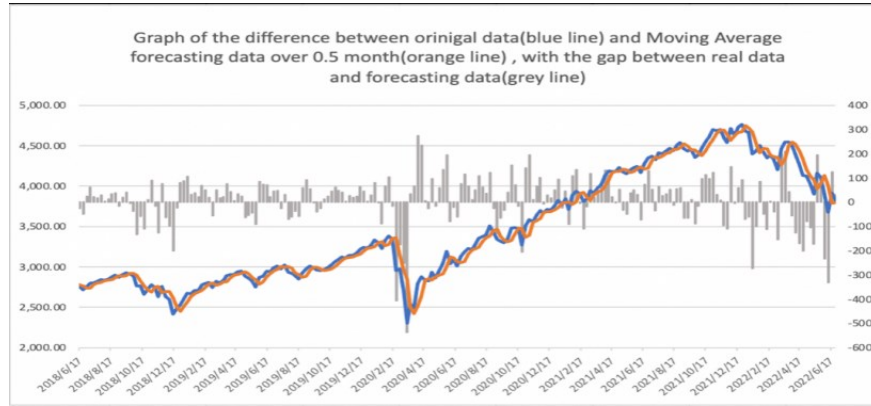
Figure 4: Graph of the difference between original data (blue line) and Moving Average forecasting data over 0.5 month (orange line) for SPX index, with the gap between real data and forecasting data(grey line).
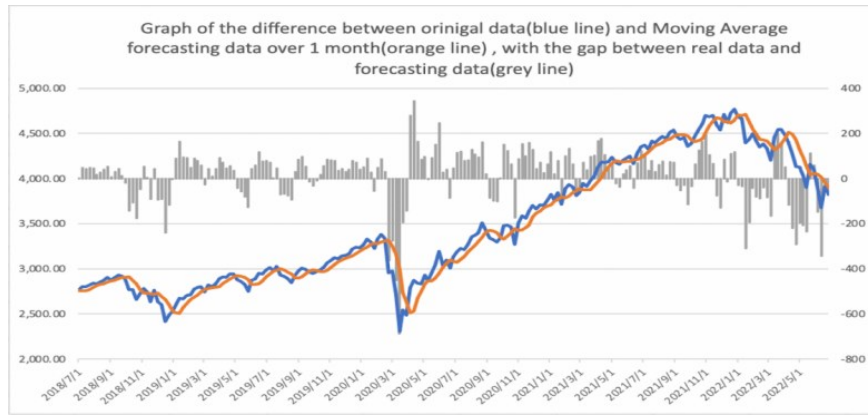

Figure 5: Graph of the difference between original data (blue line) and Moving Average forecasting data over 1 month (orange line) for SPX index, with the gap between real data and forecasting data(grey line).

Based on the Moving Average model, it can be found that the COVID-19 has indeed caused a deviation from the forecasting trend on both China and the United States stock market, and for the United States, the divergence between the real value and the forecasting value is more serious. Apart from investigating the value and return of the stock market indices, the paper further explored the conditional volatility based on the GARCH model.

4.3. GARCH Model

GARCH model is called Generalized Auto Regressive Conditional Heteroskedasticity model. This model is particularly suitable for volatility analysis and forecasting. The expression for GARCH (p, q) is as follows:

$$\begin{cases} R = \mu_t + a_t, where\ a_t = \sigma_t z_t \\ \sigma_t^2 = \alpha + \sum_{i=1}^{p} \beta_i\, a_{t-i}^2 + \sum_{j=1}^{q} \gamma_j \sigma_{t-j}^2 \end{cases}$$

In general, the fitting effect of GARCH (1,1) is appropriate enough for most of the condition. The expression for GARCH (1,1) is as follows:

$$\begin{cases} R = \mu_t + a_t, where \ a_t = \sigma_t z_t \\ \sigma_t^2 = \alpha + \beta a_{t-1}^2 + \gamma \sigma_{t-1}^2 \end{cases}$$

In order to capture important features of return data, a GARCH (1,1) model is applied.

For the both SSEC index and SPX index, as seen in Table 5 and Table 6, the p-value for the SSEC index and SPX index is 0.0316 and 0.0000, respectively. Both p-value is less than 0.05, which is significant. According to the correlogram and the p-value, the fit of the model is appropriate and the GARCH (1,1) model for both stock market index is suitable.

Table 5: Results of GARCH (1,1) model for SSEC index.

Variance equation: $\sigma_t^2 = \alpha + \beta a_{t-1}^2 + \gamma \sigma_{t-1}^2$				
Variable	Coefficient	Standard error	z-statistic	Prob value
α	0.000168	0.000130	1.284890	0.1988
a_{t-1}^2	0.148697	0.076710	1.938447	0.0526
σ_{t-1}^2	0.557548	0.259384	2.149511	0.0316

Table 6: Results of GARCH (1,1) model for SPX index.

Variance equation: $\sigma_t^2 = \alpha + \beta a_{t-1}^2 + \gamma \sigma_{t-1}^2$				
Variable	Coefficient	Standard error	z-statistic	Prob value
α	0.000063	0.000036	1.697458	0.0896
a_{t-1}^2	0.390362	0.131102	2.977533	0.0029
σ_{t-1}^2	0.607293	0.117772	5.156520	0.0000

Then, the SSEC index and SPX index's volatility can be seen from the conditional standard deviation graph. The conditional standard deviation graph for the SSEC index and SPX index is shown in Figures 6 and 7.

Figure 6 indicates that during the first 3 month in 2020, the volatility of the SSEC index reaches approximately 0.035, there has been a sharp rise in volatility compared to 2019, indicating that COVID-19 increases the volatility of the stock market in China.
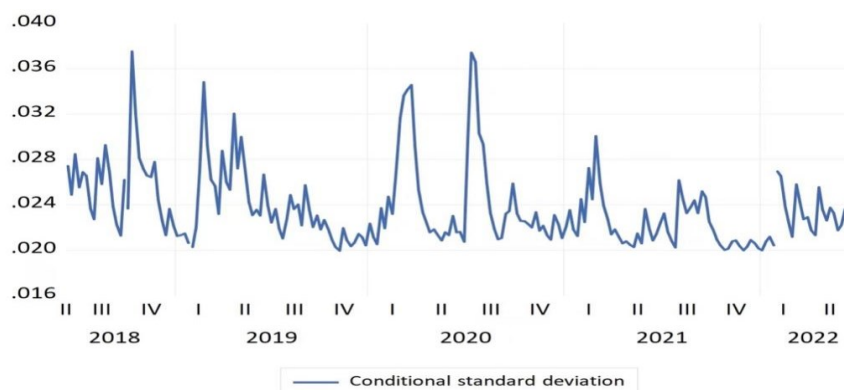

Figure 6: Conditional standard deviation graph for SSEC index.

Figure 7 shows the conditional standard deviation graph for SPX index, it can be seen from the graph that the conditional standard deviation reaches almost 0.12 in February of 2020, and the

volatility increases to the highest point in the first quarter of 2020 during 2018-2022. The result indicates that the epidemic increases the volatility of the stock market in the United States.
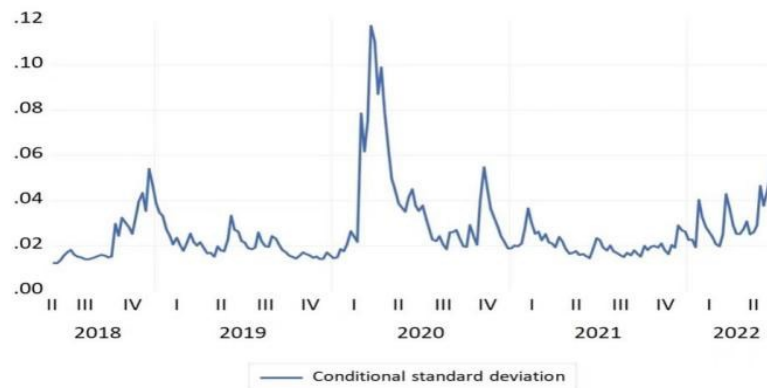

Figure 7: Conditional standard deviation graph for SPX index.

Conclusion shows that the epidemic has increased the volatility of China and the United States stock market, and Compared with China, the epidemic has caused a greater impact on the volatility of the United States stock market at the worst time of the pandemic.

After the estimation of the volatility of the stock market indices, the ARCH effect of the residual sequence is then tested by the ARCH-LM test. As seen in the Table 7, the result shows that for SSEC index and SPX index, the Prob.F value is 0.9091 and 0.5952, respectively. This means that for both stock market index, the Prob.F value is not significant, meaning that the apparent ARCH effect has been eliminated and there's no ARCH effect left after estimating the GARCH(1,1) model. Overall, the GARCH (1,1) model can describe the heteroskedasticity of returns of SSEC index and SPX index well.

Table 7: Results of the ARCH-LM test for SSEC index and SPX index.

Statistic	SSEC index	SPX index
F-statistic	0.013082	0.283229
Prob.F	0.9091	0.5952

5.   Reason Discussion

First and foremost, the conclusion can be drawn that COVID-19 has a detrimental effect on the stock markets of China and the United States based on the facts we obtained above. Second, given that the country didn't take the proper precautions to deal with the epidemic, the United States is more likely to see stock market losses during the pandemic's worst period. The United States implements the normalization of the pandemic, as the U.S. has not blocked the source of the spread of the epidemic, the number of confirmed new cases and deaths remain extremely high, causing labor shortage, this will affect economic production, investment and consumption, leading to a decrease in stock market index.

Third, it can be seen from the Figure 1 that the impact of COVID-19 to China stock market is not so huge. And from Figure 4 and Figure 5, it is acknowledged that throughout the peak of the epidemic, the highest volatility for SSEC index is approximately 0.036 and the highest volatility for SPX index is almost 0.12, indicating that COVID-19 has a greater impact on the volatility of the United States' stock market during the most serious time of the pandemic. This might be the reason that Chinese investors trust Chinese markets. It is generally believed that although the epidemic will have a short-term impact on the economy, due to the strong resilience of China's economy, it will not

change the basic trend of long-term improvement [9]. In addition, compared with the United States, the degree of openness of Chinese markets to the world is relatively low, therefore, to a large extent, Chinese stock market are likely to be affected by domestic economy, and will not be greatly affected by the global epidemic. The United States is highly open and therefore subject to the fundamentals of its own economy as well as the state of the global economy. As COVID-19 evolves into a worldwide recession, the United States will be more negatively impacted, thus showing that the stock market in the United States is sinking deeper than China.

Finally, Figure 1, Figure 4 and Figure 5 indicate that as the epidemic tends to normalize, the volatility of the SSEC index is higher than the SPX index. From these figures, SSEC stock index in China fluctuates up and down during the recovery phase of the pandemic, and the volatility for SSEC index in 2021-2022 always reaches higher than 0.024. However, the volatility for SPX index in 2021-2022 are always approximately 0.02. This is because of the comprehensive elimination policy in China. Community-based controls are becoming the most crucial aspect of citizens' quarantine in China. The so-called "grid closed management" has been put into place on a community-by-community basis in several places of mainland China [10]. This means that people have to be isolated even there is only one positive case, the tough policy have hindered the normal growth of the economy, leading to a fluctuated stock market index. In terms of the United States, the nation is implementing the normalization of the pandemic, there has been a surge in protests calling for the economy to be reopened, including some armed protests, and there have been demonstrators backing false claims that COVID-19 is not any more dangerous than the seasonal flu [11]. As the United States implements the coexistence with the virus, this enables a steadily economy development, so the stock market index in the United States has achieved a sustained and stable rise during the recovery stage of the epidemic.

6. Conclusion

Based on the analysis above, when the COVID-19 emerged, it has impact on both China and the United States stock market. By comparison, COVID-19 has a huger impact on the United States during the most serious time of the pandemic, and as the pandemic tends to normalize, the volatility in Chinese stock market is higher than in the United States. This is related to the country's policies and measurements dealing with the pandemic. In addition to the epidemic prevention and control policies, the stock market is also affected by the development of the financial market itself, such as the degree of financial market openness and the completeness of financial infrastructure. Therefore, in the post-epidemic era, governments of various countries should adopt a more cautious attitude when introducing epidemic prevention and control policies, and achieve a better balance between lockdown and normality, so that financial markets will not be greatly affected. Furthermore, countries should actively promote the improvement of the financial market to improve the stability of the financial market in the face of systemic risks such as the new virus.

As the same with all studies, this paper has limitation. The impact of COVID-19 to the stock market in the paper at present is not accurate enough. In the research, the author only divides the impact of the epidemic on the stock market in terms of the time period, but there are still many other factors that will affect the stock market during this period. The paper did not further dissociate of the COVID-19 shock from other factors, so the effect we identified is not a pure effect. In the future, more complex and advanced quantitative empirical techniques will be used to identify the pure effect of the impact of COVID-19 on the stock market.

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