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Reaction of US and Chinese Stock Markets to COVID-19 News

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Abstract: The COVID-19 outbreak slowed down global economic activities substantially, resulting in unrest in the financial markets, especially in the beginning of the pandemic outbreak. This study aims to investigate if COVID-19 caused abnormal returns in the US and the Chinese stock markets in the beginning of the pandemic outbreak. Event study methodology is adopted for this purpose. This study finds that a significant negative impact appeared immediately after the Wuhan lockdown in the Chinese markets, while the US markets were slow to pick up. The former was more severely hurt after lockdown, while the latter was more brutally affected after COVID-19 was labeled a global threat. COVID-19 also played a significant role in connecting these two stock markets. The US and China should collaborate further in combating this novel and notorious global pandemic.

Keywords: novel coronavirus; COVID-19 pandemic; stock market; abnormal returns; event study

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1. Introduction

On 9 January 2020, Chinese officials identified the virus found in Wuhan, China in December 2019 as the novel coronavirus disease (COVID-19) (European Centre for Disease Prevention and Control 2020). This deadly disease spread swiftly around the world with a total of 2,436,743 confirmed cases in just four months, including 776,907 cases in the US and 84,287 cases in China, the epicenter of the pandemic (Worldometer 2020). The US was then the worst-hit country in terms of total confirmed cases and total deaths (37,602), while China ranked ninth in both total cases as well as total deaths (4632). The first confirmed COVID-19 case in the US was reported on 20 January 2020, some 20 days after the first reported cluster of 27 cases in China on 31 December 2019. However, both the total cases and deaths in the US were nearly ten times those in China. We can observe from Figure 1 that the daily new cases increased explosively on 12 February 2020 with 14,108 cases and that afterward the total cases leveled off.

On the other hand, cases in the US progressed slowly until mid-March when the daily new cases started to explode, surpassing China on 25 March 2020 and peaking at 33,403 on 4 April 2020. While the graph of total cases for the US was still growing at the time of writing, judging from the decreasing pattern of its daily new cases, the graph was expected to reveal a turning point. The US surpassed China in terms of total deaths due to COVID-19 on 29 March 2020. There was no clear signal that the daily new death toll would fall any sooner. As in China, the death toll started to decline from the middle of February and fluctuated in the range of zero to ten after 18 March 2020. Nevertheless, there was a surprise spike of 1290 deaths per day on 17 April 2020[1].

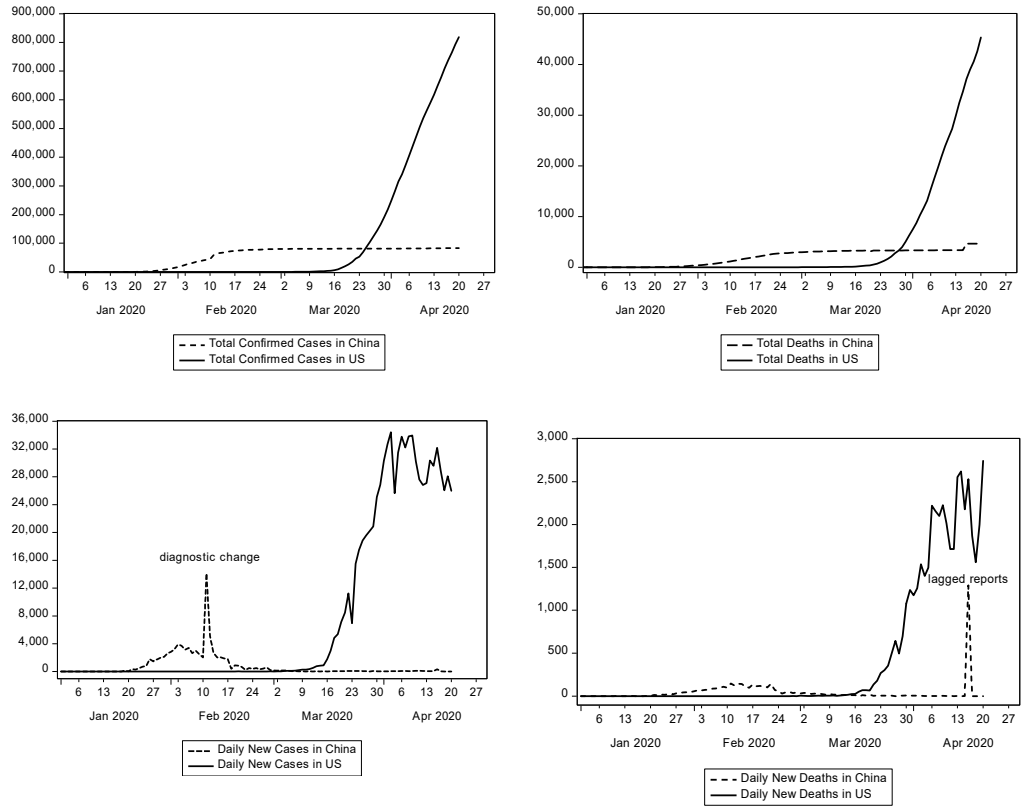

Figure 1. Confirmed Cases and Deaths in the Early Stages of the Pandemic Outbreak. Source: Worldometer (2020).

Remarkably, in order to contain the COVID-19 outbreak, China unexpectedly announced and implemented a series of strict movement controls on its citizens starting from Wuhan city on 23 January 2020, apart from closing borders. The then-famous Wuhan lockdown set an unprecedented model for a majority of the countries around the globe to fight against the pandemic, including a majority of the states in the US[2,3,4]. Lockdowns were essentially social distancing measures intended to break the chain of pandemic transmission by banning travel, shutting borders, and ordering citizens to stay at and work from home. At the same time, schools, universities, government services, and non-essential businesses were also ordered to close. This was at the expense of reducing productivity, increasing unemployment, and reducing the global economic outlook. JPMorgan, for instance, expected the world economy to contract by 12% in Quarter 1 of 2020 as a result of COVID-19, and the financial markets were then expected to be more turbulent in the second quarter of the year (Reuters 2020)[5].

Besides causing a global health crisis, the pandemic also disturbed domestic and global financial ecosystems. Studying the impact of the COVID-19 pandemic on financial markets in the early stages of the pandemic outbreak is therefore important for several reasons. Firstly, it provides insights into the short-term and long-term effects of the pandemic on the global economy by examining financial market fluctuations as early indicators of economic activity (Chia et al. 2020; Goodell 2020). Secondly, this research offers information for policymakers to make informed decisions on how to mitigate the pandemic's adverse effects on the economy (Ahmed et al. 2021). Finally, studying the pandemic's impact on financial markets helps investors and businesses make informed decisions regarding investments and risks. Understanding the implications of the pandemic on financial markets is essential for making informed decisions that can navigate the current economic landscape (Talwar et al. 2021).

Goodell (2020) stated that the impact of COVID-19 will have lasting consequences that could transform the underlying components of financial systems. While strict government measures aimed at mitigating the spread of COVID-19 might have caused economic hardships (Baker et al. 2020; Ashraf and Goodell 2022), there is the possibility of a significant change in the perspective of policymakers and investors in the future. According to Goodell (2020), prior to the pandemic, investors gave little thought to catastrophic risks.

Since the beginning of the COVID-19 pandemic, there has been an ever-increasing amount of research published on the impact of the pandemic on various financial markets. During the three years of COVID-19, research trends in finance have also changed (Boubaker et al. 2023). The studies on financial market risk are where the literature starts. Zhang et al. (2020) examined financial market volatility during the global COVID-19 pandemic. The authors analyzed stock market data from the first quarter (up to 27 March 2020) from Japan, South Korea, and Singapore, in addition to the top ten countries according to confirmed COVID-19 cases (except Iran, as data were unavailable). They reported that the "pandemic has led to great risk and uncertainty in the global financial markets". According to Akhtaruzzaman et al. (2022), media coverage had a significant impact on transmitting contagion to the equity markets of Brazil, China, India, Russia, and the US during the pandemic, especially in March and April 2020, which were the peak months. Their results also show that the US was the most affected country, as it was the net receiver of the shocks. The literature then focuses on the effects of COVID-19 on the financial markets of individual countries, such as Australia, China, and the US. In China, Liu et al. (2021) reveal that the pandemic increased the stock market crash risk, with fear sentiment exacerbating such risk. In the US, the pandemic resulted in a divergence in stock market performance, as some industries such as natural gas and healthcare earned high positive returns, while others such as petroleum and entertainment saw a dramatic fall in equity values (Mazur et al. 2021). Rahman et al. (2021) find that the stock market in Australia reacted negatively to the pandemic announcement, but positively to the "JobKeeper" package. Recently, research has focused on making use of the circumstances of COVID-19 in order to evaluate the suitability of cryptocurrencies as diversifiers (Smales 2022; Wen et al. 2022).

Even though a considerable amount of literature has been published on the effects of COVID-19 on the financial markets, these studies do not explicitly compare the market reactions of China and the US. While the correlation among stock market risks is the focus of Zhang et al. (2020), the current study attempts to examine the impact of the pandemic on stock markets' returns. Specifically, this study aims to address the research question regarding whether COVID-19 caused abnormal returns in the US and the Chinese stock markets in the beginning of the pandemic outbreak. This study concentrates on these two stock markets because of their ability to influence other financial markets (Akhtaruzzaman et al. 2021). Furthermore, China as the epicenter of COVID-19 and the US as the most-hit country are considered in this study[6]. Event study methodology is adopted for this purpose. Understanding the reactions of the US and Chinese markets to COVID-19 is important because these two countries are the world's largest economies and major players in global financial markets. The COVID-19 pandemic has created significant uncertainty and economic disruption, making it essential to understand how the markets in these countries have reacted to the crisis. The event study methodology can help to understand the importance of these reactions by analyzing the market's response to specific events, such as the announcement of COVID-19 as a global pandemic or government policy interventions. By examining the abnormal returns associated with these events, the methodology can provide insights into the market's perception of their significance and potential implications for the future. This information can be valuable for investors, policymakers, and other stakeholders seeking to navigate the ongoing impact of the COVID-19 pandemic on financial markets.

This paper is organized as follows. Section 2 describes the data used in this study. Section 3 explores the returns on indices by inspecting and comparing the behavior of different markets under COVID-19. Section 4 explains the event study methodology, and the results are presented and interpreted in Section 5. The last section concludes this paper.

2. Data

This study analyzes two popularly studied US stock market indices, namely the NASDAQ Composite Index (ND) and NYSE Composite Index (NY), as well as the Shenzhen Stock Exchange Composite Index (SZ) and the Shanghai Stock Exchange Composite Index (SH) from the Chinese stock market. The sample period spans from 11 March 2019 to 25 March 2020. This study considers three COVID-19 related events. First, 31 December 2019, when the World Health Organization (WHO) was first officially informed of the first COVID-19 cluster, is taken as Day 0 (Wuhan Municipal Health Commission 2019). The second event is the announcement and implementation of the Wuhan lockdown on 23 January 2020 in containing the COVID-19 outbreak (Wuhan Center for Novel Coronavirus Disease Control and Prevention 2020). Finally, 11 March 2020, when the WHO officially declared COVID-19 to be a global pandemic, is set as the third Day 0 (World Health Organization 2020).

3. Returns on Indices

The daily percentage returns on indices are computed as[7]:

$$OR_{mt} = \frac{(P_{mt} - P_{mt-1})}{P_{mt-1}} \times 100\%, \quad (1)$$

where

OR_{mt} = daily observed return of index m at the closing of day t,
P_{mt} = closing price of index m on trading day t, and
P_{mt-1} = closing price of index m on the previous trading day.

A quick preview of the returns on these indices after the event announcement is given in Table 1. Apparently, both the US and Chinese stock markets were relatively calm following the official report of the first COVID-19 cluster to the WHO[8]. The standard deviations of the returns are less than unity. There were significantly more positive returns than non-positive returns in all markets, except for the Shanghai Stock Exchange. Moreover, the cumulative returns were all positive, with magnitudes ranging from 1.28% for NY to 3.46% for ND.

In contrast, after the Wuhan lockdown announcement, all the markets were more volatile as the standard deviations of their returns on indices were considerably larger than those in the first event. The market volatility in particular increased by four and two times, respectively, in the Chinese and US stock markets. Besides, the Chinese market was roughly three times as volatile as its US counterpart. Moreover, apart from ND, which remained positive in cumulative returns (2.07%), all other cumulative returns reversed from positive in the first event to negative in the second event. The cumulative returns for ND, NY, SZ, and SH were 2.07%, −0.48%, −1.68% and −4.42%, respectively, over the full event window period. Comparatively, the Chinese stock markets were much more severely impacted by the Wuhan lockdown. This is logical, as Wuhan was the epicenter of the Chinese economy, and the stock market was hence immediately affected by the lockdown. It also signifies that the Wuhan lockdown was more of a localized rather than a global economic threat, at least from the perspective of the US stock market[9]. In fact, SZ and SH experienced a cumulative plunge of 11.9% and 10.5% on Day 0 and Day 1 alone, while their US counterpart only fell by less than 1%. Although there were significantly more occurrences of positive returns in the majority of the stock markets at a 5% significance level over the event window, negative returns dominated the impact in terms of magnitude.

Table 1. Daily Percentage Returns After the Event Announcement.

Day	ND	NY	SZ	SH	ND	NY	SZ	SH	ND	NY	SZ	SH
	Day 0 = 31 December 2019				*Day 0 = 23 January 2020*				*Day 0 = 11 March 2020*			
0	0.30	0.27	0.55	0.33	0.20	−0.06	−3.45	−2.75	−4.70	−5.22	−1.48	−0.94
1	1.33	0.64	1.93	1.15	−0.93	−0.88	−8.41	−7.72	−9.43	−9.99	−2.20	−1.52
2	−0.79	−0.61	0.27	−0.05	−1.89	−1.49	1.80	1.34	9.35	7.86	−1.08	−1.23
3	0.56	0.18	0.44	−0.01	1.43	0.78	2.48	1.25	−12.32	−11.84	−4.83	−3.40
4	−0.03	−0.31	1.31	0.69	0.06	−0.24	2.90	1.72	6.23	5.18	−0.43	−0.34
5	0.67	0.26	−1.24	−1.22	0.26	0.13	0.52	0.33	−4.70	−6.74	−1.55	−1.83
6	0.81	0.45	1.76	0.91	−1.59	−1.79	1.21	0.51	2.30	0.82	0.28	−0.98
7	−0.27	−0.28	−0.15	−0.08	1.34	0.47	0.04	0.39	−3.79	−3.47	1.28	1.61
8	1.04	0.61	1.36	0.75	2.10	1.35	1.55	0.87	−0.27	−3.90	−4.26	−3.11
9	−0.24	−0.04	−0.23	−0.28	0.43	1.17	−0.77	−0.71	8.12	10.04	2.10	2.34
10	0.08	0.11	−0.22	−0.54	0.67	0.07	0.44	0.38	−0.45	3.14	2.92	2.17
Cum	3.46	1.28	5.77	1.66	2.07	−0.48	−1.68	−4.42	−9.68	−14.12	−9.24	−7.23
Max	1.33	0.64	1.93	1.15	2.10	1.35	2.90	1.72	9.35	10.04	2.92	2.34
Mean	0.31	0.12	0.52	0.15	0.19	−0.04	−0.15	−0.40	−0.88	−1.28	−0.84	−0.66
Min	−0.79	−0.61	−1.24	−1.22	−1.89	−1.79	−8.41	−7.72	−12.32	−11.84	−4.83	−3.40
S.D.	0.63	0.40	0.98	0.70	1.25	1.01	3.24	2.71	6.99	7.22	2.43	1.96
$p(-)$	0.76	0.76	0.76	0.08	0.76	0.83	0.76	0.76	0.03	0.08	0.03	0.01
$p(+)$	0.03	0.03	0.03	0.83	0.01	0.08	0.01	0.01	0.76	0.83	0.76	0.76

Notes: ND, NY, SZ and SH denote the Nasdaq Composite Index, NYSE Composite Index, Shenzhen Stock Exchange Composite Index, and Shanghai Stock Exchange Composite Index, respectively. Cum., Max., Min. and S.D. stand for cumulative returns, maximum, minimum, and standard deviation of the returns. Meanwhile, $p(\cdot)$ denotes the probability value of the binomial test to determine if there are significantly more negative (–) or positive (+) returns ($p < 0.05$) compared to non-negative or non-positive returns ($p > 0.05$) across all trading days.

Turning to the third event, it is observed from Table 1 that after the WHO declared COVID-19 to be a global pandemic, there were significantly more occurrences of negative returns for ND and SZ at 5%, in addition to SH at a 1% significance level. Nevertheless, there was a reduction in market volatility in China compared to the second event. In sharp contrast, market volatility shot up about six times in the US and seven times for ND and NY compared to their own preceding standard deviations. More drastically, cumulative returns on Day 10 for ND went from a profit of 2.07% to a loss of 9.68%. Meanwhile, NY enlarged its preceding cumulative loss of 0.48% by nearly thirty times, and registered a cumulative loss of 14.12% after the WHO's declaration of a global pandemic on 11 March 2020. This is rational, as the US market weighted in more sentiments of pandemic fears upon this declaration, and the next day Maryland was the first state in the US to declare a shelter-in-place or stay-at-home order (Hodge 2020). As for the Chinese stock market, the declaration of a global pandemic led to higher cumulative losses in SZ (−9.24%) and SH (−7.23%) compared to the preceding event, which was much more localized.

The Kendall's tau-*b* pairwise correlation coefficient matrices among the four indices are presented in Table 2. It is remarkable that returns on indices were significant and strongly correlated intra-country only during the first and second events. No correlation is detected inter-country, suggesting no spillover effect occurred among the stock markets in the two countries. Nevertheless, during the third event, while the intra-country correlation remained significant and strong, an additional inter-country correlation can be detected via the average but significant connection of NY in the US with both SZ and SH in China. Using different sub-sample periods, the current finding cross-validates Zhang et al.'s (2020) finding that the global stock markets were more connected after the announcement of the global pandemic. Hence, COVID-19 played a significant role in connecting the two stock markets only after the WHO announced it as a global threat.

Table 2. Correlation among Stock Markets after the Event Announcement.

Index	ND	NY	SZ	SH
		Day 0 = 31 December 2019		
ND		0.86 **	0.38	0.35
NY	[0.00]		0.38	0.35
SZ	[0.10]	[0.10]		0.96 **
SH	[0.14]	[0.14]	[0.00]	
		Day 0 = 23 January 2020		
ND		0.82 **	0.06	0.13
NY	[0.00]		0.02	0.02
SZ	[0.82]	[0.94]		0.86 **
SH	[0.59]	[0.94]	[0.00]	
		Day 0 = 11 March 2020		
ND		0.84 **	0.40	0.37
NY	[0.00]		0.56 *	0.53 *
SZ	[0.09]	[0.02]		0.82 **
SH	[0.12]	[0.02]	[0.00]	

Notes: ND, NY, SZ and SH denotes the Nasdaq Composite Index, NYSE Composite Index, Shenzhen Stock Exchange Composite Index, and Shanghai Stock Exchange Composite Index, respectively. The figures in the upper triangular correlation matrix are the correlation coefficients, while figures quoted in brackets in the lower triangular matrix stand for probability of the correlation test of null hypothesis, H_0: absent of pairwise correlation, against the alternative hypothesis, H_a: present of pairwise correlation. H_0 can be rejected in favor of H_a if the probability value is less than or equal to 0.05 or 0.01 for the 5% (*) or 1% (**) significance level, respectively.

4. Event Study Specification

This study examines whether COVID-19 caused abnormal returns in the stock markets in general during the early stages of the outbreak by analyzing the corresponding composite indices. Daily abnormal returns (AR_{it}) of composite index m at the closing of day t can be calculated as follows:

$$AR_{mt} = OR_{mt} - \overline{R}_m \tag{2}$$

$\overline{R}_m$ is the daily expected return of index m, under normal conditions should there be no occurrence of the event considered. In the literature, it is usually modeled by taking the average closing price of index m over the estimation window (Tao 2012; Nazir et al. 2014). This study adopts this simple constant mean model. Besides, for sensitivity analysis, this study also considers the average of the expected returns of a few composite indices, computed by:

$$\overline{\overline{R}}_m = \frac{1}{N}\sum_{m=1}^{N} \overline{R}_m, \tag{3}$$

where N is the total number of composite indices in the stock markets of a country.

To scrutinize the daily impact of COVID-19 in the stock market after its occurrence, the daily average abnormal return (AAR_t) of the stock market is obtained by taking the daily mean of AR_{mt}. Specifically,

$$AAR_t = \frac{1}{N}\sum_{m=1}^{N} AR_{mt} \tag{4}$$

The daily average abnormal return is the simple average of the abnormal returns of stock market composite indices in the country. The average abnormal return for the US stock market on day t is the average abnormal returns on day t for the NASDAQ Composite Index and NYSE Composite Index. Similarly, the abnormal returns for the Shanghai Stock Exchange Composite Index and the Shenzhen Stock Exchange Composite Index are used to calculate the average abnormal returns for the Chinese stock market.

For the cumulative impact of the pandemic after its occurrence over a period, AR_{mt} and AAR_t can be accumulated over a number of trading days in the event window. The resulting cumulative AR_{mt} and AAR_t are given as:

$$CAR_t = \sum_{t=0}^{T_e} AR_{mt}, \text{ and} \tag{5}$$

$$CAAR_t = \sum_{t=0}^{T_e} AAR_t, \tag{6}$$

where T_e is the total number of trading days in the event window.

The deadly COVID-19 pandemic that extensively limited global economic activities is expected to induce excess negative stock returns compared to normal times before this pandemic. Hence, the null hypothesis, $H_0 : r_{mt} \geq 0$ (COVID-19 had no negative effect on the stock returns) can be tested against the alternative hypothesis, $H_a : r_{mt} < 0$ (COVID-19 had a significant negative effect on the stock returns), for $r \in \{CAR_t, CAAR_t\}$, using the Student t-test (Brown and Warner 1985). H_0 can be rejected in favor of H_a if the computed t statistic is smaller than -1.645 or -2.236 for the 5% or 1% significance levels, respectively.

5. Cumulative Abnormal Returns on Indices

The daily stock market returns are studied until the tenth trading day after the announcement of each of these events to determine if there is any significant negative cumulative abnormal return (CAR_t). As such, the event window length is 11 days including the event day[10]. The estimation window length is 200 trading days. The computed results using $\overline{R}_m$ and $\overline{\overline{R}}_m$ as expected returns under normal conditions are presented in Tables 3 and 4, respectively.

Table 3. Cumulative Abnormal Returns Calculated from $\overline{R}_m$.

	United States *Day 0 = 31 December 2019*			**China** *Day 0 = 31 December 2019*		
Window	**ND**	**NY**	**CAAR**	**SZ**	**SH**	**CAAR**
[0, 1]	0.59	0.19	0.39	2.39	1.45	1.51
	(0.66)	(0.40)	(0.61)	(1.20)	(1.29)	(1.01)
[0, 2]	0.94	0.56	0.75	2.62	1.38	1.59
	(0.73)	(0.83)	(0.82)	(0.93)	(0.87)	(0.76)
[0, 3]	1.09	0.59	0.84	3.02	1.36	1.78
	(0.69)	(0.72)	(0.75)	(0.87)	(0.70)	(0.69)
[0, 4]	1.09	0.51	0.80	4.29	2.03	2.75
	(0.60)	(0.53)	(0.62)	(1.07)	(0.91)	(0.92)
[0, 5]	1.79	0.79	1.29	3.00	0.79	1.49
	(0.88)	(0.74)	(0.90)	(0.67)	(0.32)	(0.45)
[0, 6]	1.53	0.77	1.15	4.71	1.69	2.79
	(0.69)	(0.66)	(0.73)	(0.96)	(0.61)	(0.77)
[0, 7]	0.78	0.24	0.51	4.52	1.59	2.64
	(0.32)	(0.19)	(0.30)	(0.85)	(0.53)	(0.67)
[0, 8]	0.99	0.46	0.73	5.84	2.32	3.67
	(0.39)	(0.34)	(0.40)	(1.03)	(0.73)	(0.87)
[0, 9]	2.25	1.05	1.65	5.56	2.03	3.38
	(0.83)	(0.74)	(0.85)	(0.93)	(0.60)	(0.76)
[0, 10]	1.38	0.40	0.89	5.30	1.47	2.97
	(0.48)	(0.26)	(0.44)	(0.84)	(0.41)	(0.63)

Table 3. *Cont.*

Window	United States *Day 0 = 23 January 2020* ND		NY		CAAR		China *Day 0 = 23 January 2020* SZ		SH		CAAR	
[0, 1]	0.94 (1.07)		0.55 (1.21)		−0.22 (−0.35)		−3.88 (−4.90)	**	−7.71 (−8.00)	**	−8.08 (−4.46)	**
[0, 2]	−0.34 (−0.39)		−0.09 (−0.20)		−0.19 (−0.22)		−6.66 (−2.73)	**	−6.36 (−4.67)	**	−6.51 (−2.94)	**
[0, 3]	−0.02 (−0.02)		0.06 (0.13)		0.58 (0.54)		−4.21 (−1.41)		−5.10 (−3.06)	**	−4.66 (−1.82)	*
[0, 4]	0.97 (1.10)		0.58 (1.27)		0.82 (0.66)		−1.34 (−0.39)		−3.37 (−1.75)	*	−2.36 (−0.82)	
[0, 5]	0.24 (0.28)		0.24 (0.53)		0.39 (0.28)		−0.85 (−0.22)		−3.03 (−1.40)		−1.94 (−0.62)	
[0, 6]	−0.29 (−0.33)		−0.57 (−1.25)		0.38 (0.25)		0.34 (0.08)		−2.51 (−1.06)		−1.09 (−0.32)	
[0, 7]	0.04 (0.05)		−0.05 (−0.11)		0.38 (0.23)		0.35 (0.08)		−2.11 (−0.83)		−0.88 (−0.24)	
[0, 8]	0.10 (0.12)		−0.11 (−0.25)		−0.60 (−0.34)		1.88 (0.39)		−1.23 (−0.45)		0.33 (0.09)	
[0, 9]	−1.03 (−1.17)		−0.93 (−2.04)	*	−2.36 (−1.27)		1.09 (0.21)		−1.93 (−0.67)		−0.42 (−0.10)	
[0, 10]	−1.98 (−2.26)	*	−1.55 (−3.40)	**	−1.33 (−0.68)		1.50 (0.28)		−1.54 (−0.50)		−0.02 (0.00)	
Window	United States *Day 0 = 11 March 2020* ND		NY		CAAR		China *Day 0 = 11 March 2020* SZ		SH		CAAR	
[0, 1]	−4.75 (−5.50)	**	−5.20 (−11.18)	**	−9.73 (−6.65)	**	−3.88 (−1.85)	*	−2.49 (−2.01)	*	−1.91 (−1.19)	
[0, 2]	−9.49 (−10.98)	**	−9.97 (−21.44)	**	−1.14 (−0.55)		−5.05 (−1.70)	*	−3.74 (−2.14)	*	−3.13 (−1.38)	
[0, 3]	9.29 (10.76)	**	7.89 (16.97)	**	−13.23 (−5.22)	**	−9.99 (−2.74)	**	−7.16 (−3.34)	**	−7.30 (−2.62)	**
[0, 4]	−12.37 (−14.33)	**	−11.81 (−25.41)	**	−7.54 (−2.58)	*	−10.51 (−2.50)	**	−7.52 (−3.04)	**	−7.75 (−2.41)	*
[0, 5]	6.18 (7.15)	**	5.21 (11.20)	**	−13.28 (−4.06)	**	−12.17 (−2.59)	**	−9.36 (−3.38)	**	−9.50 (−2.64)	**
[0, 6]	−4.76 (−5.51)	**	−6.72 (−14.46)	**	−11.73 (−3.27)	**	−11.99 (−2.33)	**	−10.36 (−3.41)	**	−9.90 (−2.51)	*
[0, 7]	2.25 (2.60)	**	0.84 (1.81)	*	−15.38 (−3.97)	**	−10.81 (−1.94)	*	−8.76 (−2.68)	**	−8.52 (−2.00)	*
[0, 8]	−3.84 (−4.45)	**	−3.44 (−7.41)	**	−17.48 (−4.22)	**	−15.17 (−2.55)	**	−11.89 (−3.40)	**	−12.26 (−2.70)	**
[0, 9]	−0.33 (−0.38		−3.87 (−8.33)	**	−8.41 (−1.92)	*	−13.16 (−2.09)	*	−9.57 (−2.58)	**	−10.10 (−2.09)	*
[0, 10]	8.07 (9.34)	**	10.06 (21.64)	**	−7.09 (−1.53)		−10.34 (−1.56)		−7.41 (−1.89)	*	−7.61 (−1.50)	

Notes: ND, NY, SZ and SH denote the Nasdaq Composite Index, NYSE Composite Index, Shenzhen Stock Exchange Composite Index, and Shanghai Stock Exchange Composite Index, respectively. Parentheses ( ) denote the *t*-statistics. * and ** denote 5% and 1% significance level, respectively.

Table 4. Cumulative Abnormal Returns Calculated from $\overline{\overline{R}}_m$.

	United States *Day 0 = 31 December 2019*			China *Day 0 = 31 December 2019*		
Window	**ND**	**NY**	**CAAR**	**SZ**	**SH**	**CAAR**
[0, 1]	0.61	0.17	0.39	2.42	1.42	1.51
	(0.67)	(0.36)	(0.61)	(1.21)	(1.27)	(1.01)
[0, 2]	0.97	0.53	0.75	2.66	1.35	1.59
	(0.76)	(0.78)	(0.82)	(0.94)	(0.85)	(0.76)
[0, 3]	1.14	0.54	0.84	3.07	1.30	1.78
	(0.73)	(0.65)	(0.75)	(0.89)	(0.67)	(0.69)
[0, 4]	1.16	0.44	0.80	4.35	1.97	2.75
	(0.64)	(0.46)	(0.62)	(1.09)	(0.88)	(0.92)
[0, 5]	1.87	0.70	1.29	3.08	0.72	1.49
	(0.92)	(0.66)	(0.90)	(0.69)	(0.29)	(0.45)
[0, 6]	1.63	0.67	1.15	4.80	1.60	2.79
	(0.74)	(0.57)	(0.73)	(0.98)	(0.58)	(0.77)
[0, 7]	0.90	0.12	0.51	4.62	1.49	2.64
	(0.37)	(0.09)	(0.30)	(0.87)	(0.50)	(0.67)
[0, 8]	1.13	0.32	0.73	5.95	2.21	3.67
	(0.44)	(0.24)	(0.40)	(1.05)	(0.70)	(0.87)
[0, 9]	2.40	0.90	1.65	5.69	1.90	3.38
	(0.88)	(0.63)	(0.85)	(0.95)	(0.56)	(0.76)
[0, 10]	1.55	0.23	0.89	5.44	1.33	2.97
	(0.54)	(0.15)	(0.44)	(0.86)	(0.37)	(0.63)

	United States *Day 0 = 23 January 2020*				China *Day 0 = 23 January 2020*			
Window	**ND**	**NY**		**CAAR**	**SZ**	**SH**		**CAAR**	
[0, 1]	0.96	0.53		−0.22	−3.79 **	−7.73	**	−8.08	**
	(1.10)	(1.17)		(−0.35)	(−4.89)	(−8.02)		(−4.46)	
[0, 2]	−0.32	−0.11		−0.19	−6.62 **	−6.40	**	−6.51	**
	(−0.36)	(−0.25)		(−0.22)	(−2.72)	(−4.70)		(−2.94)	
[0, 3]	0.00	0.04		0.58	−4.15	−5.16	**	−4.66	*
	(0.01)	(0.09)		(0.54)	(−1.39)	(−3.09)		(−1.82)	
[0, 4]	0.99	0.56		0.82	−1.26	−3.45	*	−2.36	
	(1.13)	(1.22)		(0.66)	(−0.37)	(−1.79)		(−0.82)	
[0, 5]	0.27	0.22		0.39	−0.75	−3.13		−1.94	
	(0.30)	(0.48)		(0.28)	(−0.20)	(−1.45)		(−0.62)	
[0, 6]	−0.27	−0.59		0.38	0.46	−2.63		−1.09	
	(−0.31)	(−1.30)		(0.25)	(0.11)	(−1.11)		(−0.32)	
[0, 7]	0.06	−0.07		0.38	0.49	−2.25		−0.88	
	(0.07)	(−0.16)		(0.23)	(0.11)	(−0.88)		(−0.24)	
[0, 8]	0.12	−0.13		−0.60	2.04	−1.38		0.33	
	(0.14)	(−0.29)		(−0.34)	(0.42)	(−0.51)		(0.09)	
[0, 9]	−1.01	−0.95	*	−2.36	1.26	−2.10		−0.42	
	(−1.15)	(−2.09)		(−1.27)	(0.24)	(−0.73)		(−0.10)	
[0, 10]	−1.96 *	−1.57	**	−1.33	1.70	−1.73		−0.02	
	(−2.24)	(−3.45)		(−0.68)	(0.31)	(−0.57)		(0.00)	

	United States *Day 0 = 11 March 2020*					China *Day 0 = 11 March 2020*				
Window	**ND**		**NY**		**CAAR**	**SZ**		**SH**		**CAAR**	
[0, 1]	−4.72	**	−5.24	**	−9.73 **	−3.79	*	−2.58	*	−1.91	
	(−5.46)		(−11.27)		(−6.65)	(−1.81)		(−2.08)		(−1.19)	
[0, 2]	−9.45	**	−10.00	**	−1.14	−4.93	*	−3.87	*	−3.13	
	(−10.94)		(−21.52)		(−0.55)	(−1.66)		(−2.21)		(−1.38)	
[0, 3]	9.33	**	7.85	**	−13.23 **	−9.82	**	−7.33	**	−7.30	**
	(10.80)		(16.88)		(−5.22)	(−2.70)		(−3.42)		(−2.62)	
[0, 4]	−12.34	**	−11.85	**	−7.54 *	−10.30	**	−7.73	**	−7.75	*
	(−14.28)		(−25.49)		(−2.58)	(−2.45)		(−3.12)		(−2.41)	

Table 4. *Cont.*

	United States *Day 0 = 11 March 2020*					China *Day 0 = 11 March 2020*				
Window	**ND**		**NY**		**CAAR**	**SZ**		**SH**		**CAAR**	
[0, 5]	6.22 (7.20)	**	5.17 (11.12)	**	−13.28 (−4.06)	**	−11.91 (−2.54)	**	−9.62 (−3.47)	**	−9.50 (−2.64)	**
[0, 6]	−4.72 (−5.46)	**	−6.76 (−14.54)	**	−11.73 (−3.27)	**	−11.69 (−2.27)	*	−10.65 (−3.51)	**	−9.90 (−2.51)	*
[0, 7]	2.28 (2.64)	**	0.80 (1.73)	*	−15.38 (−3.97)	**	−10.47 (−1.88)	*	−9.10 (−2.78)	**	−8.52 (−2.00)	*
[0, 8]	−3.81 (−4.41)	**	−3.48 (−7.49)	**	−17.48 (−4.22)	**	−14.79 (−2.49)	**	−12.27 (−3.50)	**	−12.26 (−2.70)	**
[0, 9]	−0.29 (−0.33)		−3.91 (−8.41)	**	−8.41 (−1.92)	*	−12.74 (−2.02)	*	−9.99 (−2.69)	**	−10.10 (−2.09)	*
[0, 10]	8.11 (9.38)	**	10.02 (21.56)	**	−7.09 (−1.53)		−9.88 (−1.49)		−7.87 (−2.01)	*	−7.61 (−1.50)	

Notes: ND, NY, SZ and SH denotes the Nasdaq Composite Index, NYSE Composite Index, Shenzhen Stock Exchange Composite Index, and Shanghai Stock Exchange Composite Index, respectively. Parentheses ( ) denote the *t*-statistics. * and ** denote 5% and 1% significance level, respectively.

It is evident from Table 3 that after the announcement of the first COVID-19 cluster to the WHO, all the CAR_t were consistently insignificant regardless of country. This signifies the absence of abnormal returns. In other words, the markets were unaffected by this announcement. However, the Chinese stock markets were very reactive to the announcement of the Wuhan lockdown and implementation on 23 January 2020. A considerable large and significant negative CAR_t appeared with immediate effect on Day 0 through Day 2 for both SZ as well as the $CAAR_t$ for the overall Chinese stock markets. For SH, the impact persisted until Day 4. In contrast, the response from the US markets was rather slow and a significant negative impact only appeared towards the end of the event window periods.

Nevertheless, the stock markets in these two countries were equally fast and persistent in picking up the third announcement as a negative sentiment right from the beginning until the end of the event window period. This signifies that the WHO's labeling of COVID-19 as a global pandemic threat had struck a nerve in the stock markets of both countries simultaneously due to their enhanced stock market connections via NY, as revealed by the correlation analysis on their returns earlier on. Note that the $CAAR_t$ in the US markets was substantially more negative than in the Chinese markets until Day 8, except for Day 4. The largest $CAAR_t$ for the US (−17.48%) and Chinese (−11.89%) markets occurs on Day 8, with a difference of a nearly 6% additional loss for the US compared to China. This outcome may be associated with the pessimistic pandemic conditions in the US, where the total case and death numbers were then ready to explode. In contrast, the pandemic conditions in China had been much better since the middle of February. Last but not least, the results as shown in Table 4 are both qualitatively and quantitatively consistent with those in Table 3. As such, there is a negligible difference in the use of mean returns on individual index ($\overline{R}_m$) or mean returns on market average ($\overline{\overline{R}}_m$) as far as abnormal returns are concerned[11].

6. Concluding Remarks

This study finds that stock markets in both the US and Chinese stock markets remained calm after China's official report on the first cluster of 27 pneumonia cases with an unknown cause to the WHO on 31 December 2019. No cumulative abnormal return was observed following this event.

However, market volatility increased by two times in the US and four times in China after the announcement and implementation of the unprecedented Wuhan lockdown on 23 January 2020. Moreover, SZ and SH experienced a cumulative plunge of 11.9% and 10.5%, while their US counterparts fell by less than 1% on Day 0 and Day 1. A considerably large

and significant negative CAR_t showed up with immediate effects on the announcement day, while a significant negative impact eventually appeared towards the end of the event window period. These findings are logical, as the Wuhan lockdown was a localized order that had an immediate impact on China's economic activities.

In contrast, the stock markets in both countries reacted immediately and persistently once the WHO declared COVID-19 to be a global threat on 11 March 2020. As a result, negative cumulative abnormal returns appeared right from the beginning until the end of the event window period in all the composite indices. The US markets were more severely affected by this event than the Chinese stock markets, probably due to the worsening development of the COVID-19 outbreak as the US was a net receiver of the transmission of shocks during the pandemic as a result of media coverage (Akhtaruzzaman et al. 2022). Correlation analysis revealed a significant connection between the US and Chinese stock markets that appeared only during this event. Hence, apart from having a significant undesirable impact on the stock markets, COVID-19 played a significant role in connecting the two stock markets only after the WHO announced it to be a global threat. Additionally, according to Akhtaruzzaman et al. (2021), the increase in correlations between financial firms in China and the G7 was considerably higher during the COVID-19 outbreak, suggesting the critical role of these firms in the transmission of financial contagion. China had shown to the world that it could better manage this pandemic with the commitment of its leaders and medical professionals, as well as its citizens from all walks of life, and its ICT and medical advancement and experience in this area. The US could look into extending its collaboration with other countries in combating this novel and notorious global pandemic.

The findings of this research have significant practical implications for the understanding of how Chinese and US markets reacted to the COVID-19 pandemic. Firstly, such studies can help investors and market participants to better understand the impact of global pandemics and the like on financial markets, allowing them to make more informed decisions about their investments, especially in the early stages. Secondly, policymakers can use the insights from these studies to design more effective economic policies and regulations to mitigate the negative impact of future pandemics on the financial system. Thirdly, regulators can use these studies to identify areas of weakness in the financial system and take proactive measures to address them. Finally, companies can use the findings of these studies to better understand the impact of pandemics on their operations and to develop strategies to mitigate any negative effects.

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Notes

[1] As of 26 February 2023, the US has the world's highest number of total cases (105,251,154) and total deaths (1,145,293), whereas China ranked 41st in terms of total cases (503,352) and 89th in terms of total deaths (5272) (Worldometer 2023).

[2] This lockdown seems to have successfully brought down the daily new cases and deaths to a low level within 3 months. Nevertheless, soon after the lockdown was lifted on 8 April 2020, many new cases were imported from outside (The Star 2020).

[3] At least 80% of Americans were subject to lockdowns in the US by their respective state governors from 12 March 2020, although the federal government was against the practice (The Hindu Bisnessline 2020). See Hodge (2020) for a map of states that imposed full or partial shelter-in-place and stay-at-home orders (with implementation dates) as of 24 March 2020. See also Gershman (2020) for updates until 15 April 2020.

[4] Secon et al. (2020) report a list of countries that were on lockdown due to COVID-19.

[5] In actual fact, the US gross domestic product contracted by 4.6% and 29.9% respectively in the first and second halves of 2020 (Trading Economics 2023).

[6] Besides, they are known to be not quite on par in their fight against the pandemic, let alone other aspects of misunderstandings.

[7] All returns are measured in percentages in this study.

[8] The virus was then reported as unidentified pneumonia with an unknown cause. Chinese officials identified the virus as a new coronavirus on 9 January 2020, which is trading day 6 in this study (World Health Organization 2020).

[9] There were 830 confirmed COVID-19 cases with 25 deaths in China on 23 January 2020 (Worldometer 2020). However, while COVID-19 had already proven threatening and deadly in China, it was just in the initial stages of development, with the first known COVID-19 case confirmed in the US on 20 January 2020 (Holshue et al. 2020).

[10] The events occurred one after another back-to-back; for instance, the second event occurred on Day 16 after the first event. As a result, this study only considers up to Day 10 to reduce the probability of the overlapping effect (Schweitzer 1989). Liew (2020) points out that studying events up to Day 10 is considered long enough, as otherwise it might run into another incoming event.

[11] The $CAAR_t$ is essentially the same, while negligible differences are observed for returns on each individual index.

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