IMPACT OF WUHAN LOCKDOWN IN EARLY STAGE OF COVID-19 OUTBREAK ON SECTOR RETURNS IN CHINESE STOCK MARKET

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Abstract

The unprecedented Wuhan lockdown due to the outbreak of the COVID-19 pandemic provides a natural experiment that will elucidate its immediate impact on the stock market. Event study methodology is adopted to identify any short-run abnormal returns in the Shanghai Stock Exchange Composite Index and its ten component sectors. This paper reports empirical evidence on the negative short-run impact of the Wuhan lockdown in the face of the pandemic outbreak on all component sectors of the Shanghai Stock Exchange Composite. The health care and information technology sectors, which helped considerably in the fight against the pandemic, were resilient and outperformed the general market in the Shanghai Stock Exchange despite the lockdown. The other 10 sectors performed at par with the general market. This confirmation of the counter-cyclical nature of the health care and information technology sectors during the lockdown, which enabled them to overcome the pandemic outbreak, provides valuable insights with which investors can adjust their portfolios in similar situations in the future in a timely manner.

Keywords: COVID-19 Pandemic, Wuhan Lockdown, Shanghai Stock Exchange Composite Index, Event Window Study

I. INTRODUCTION

The global outbreak of the novel coronavirus disease (COVID-19) has drawn the attention of numerous researchers, including [1], [2], [3], [4], and [5], toward stock market reaction. Particularly, [1] employed composite stock indices from stock exchanges across the world (top 10 COVID-19-affected countries plus Singapore, South Korea, and Japan) in volatility and correlation analyses. Sample data from January 22, 2020 to March 27, 2020 were analyzed. Their results suggested that the stock volatility (as measured by the standard deviations of market returns) in March, when COVID-19 was starting to spiral out of control in

Europe and the US, was substantially larger across the sample countries compared with that in February. Furthermore, [1] showed via minimum spanning tree plots that regional stock market integration occurred during the pandemic.

Another previous work [2] studied the Malaysian stock market reaction to COVID-19 and the movement control order (MCO) imposed by the government. Eight main market indices from Bursa Malaysia were analyzed for the period of January 2, 2020 to April 30, 2020. The authors reported an insignificant impact of daily new confirmed COVID-19 cases and deaths. Instead, the MCO had a significant and positive impact on all the index returns. Moreover, the impact of the MCO differed by the size of the indices' constituent companies. Moreover, [3] empirically quantified the nature and extent to which the tourism industry has been affected by COVID-19; the study discovered a rapid drop in the performance of the industry in the early stage of the COVID-19 outbreak. Using a dataset covering October 2, 2020 to 27 March 2020, the author showed that the Wuhan lockdown had significantly adverse direct and indirect effects on the tourism industry, represented by Trip.com, a tourism-related company incorporated in Shanghai, and two other companies of the same nature that are incorporated in the US.

From the perspective of China stock markets, [4] conducted a panel data analysis on all the individual stocks listed on the Hang Seng and Shanghai stock exchanges. With a dataset covering January 10, 2020 to March 16, 2020, the researchers found that stock returns were significantly negatively related to daily growth in both total confirmed cases and total deaths in the Chinese stock market. Via sector analysis, [4] revealed that the information technology and medical manufacturing sectors significantly outperformed the market amid COVID-19. In contrast, the beverage and transportation sectors of various forms performed significantly worse than did the market. Conducting an impact study using a different approach, [5] measured the immediate impact of COVID-19 on tourism shares in the Chinese stock exchanges using the event study methodology. The sample period of the study was March 11, 2019 to April 14, 2020. The findings indicated a significant immediate adverse impact (in terms of breadth and depth) of the novel coronavirus (COVID-19) pandemic on 21 individual tourism shares listed on the Shanghai and Shenzhen stock exchanges.

The current study investigates the immediate impact of the natural experiment that is the unprecedented Wuhan lockdown caused by COVID-19 on the Chinese stock market. Specifically, the event study methodology is applied to determine whether short-run abnormal returns exist in the Shanghai Stock Exchange Composite Index (SSEC) and its ten component sectors. While [3] and [5] focused on tourism-related shares or sectors, the current study includes all sectors in the SSEC to provide a more comprehensive view of the overall market response to events related to COVID-19.

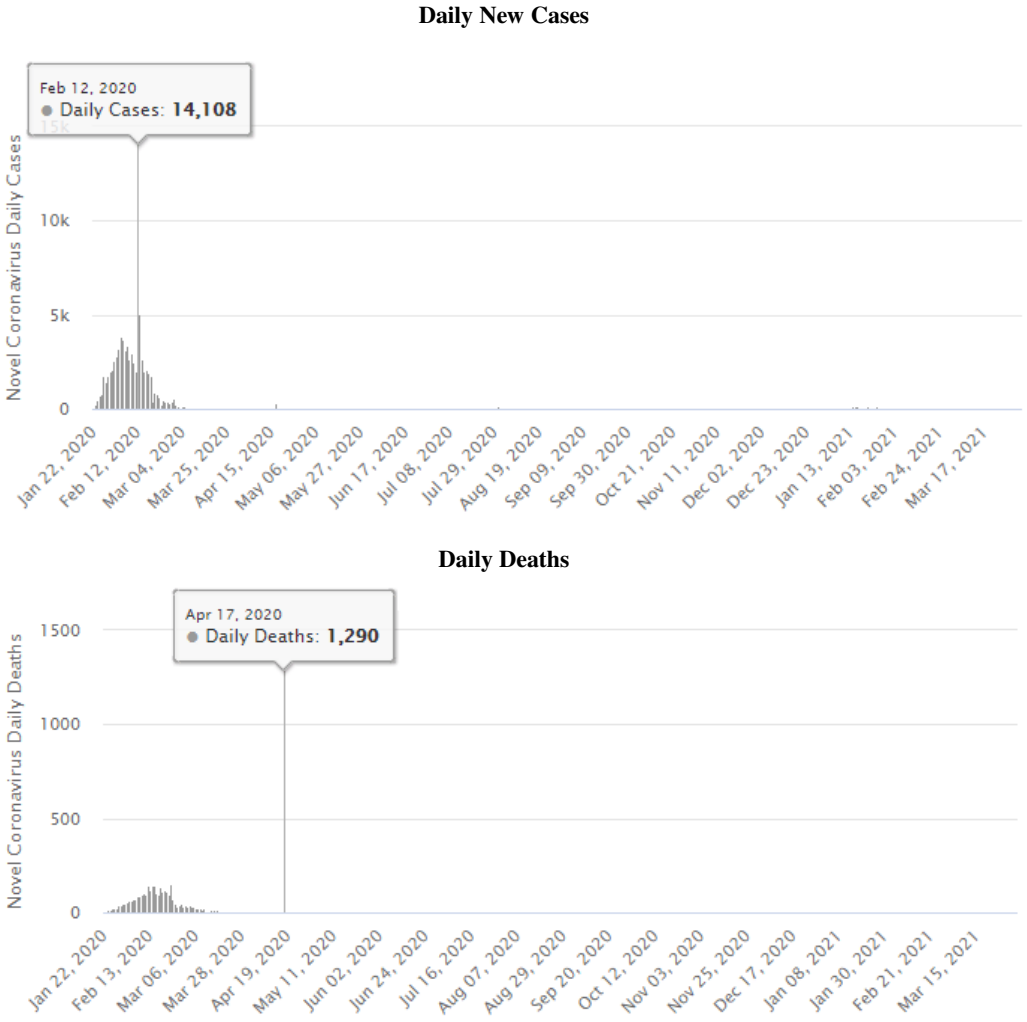
The remainder of this paper is organized as follows. The next section describes and explores the data of the study. Section III explains the methodology, while Section IV presents and discusses the empirical results. Section contains further analysis results. The concluding remarks are in the last section.

II. Data and Preliminary Analysis

The COVID-19 data are obtained from Worldometer [8]. The closing prices of the SSEC and its ten component sectors are collected from Investing.com [6]. These sectors are from the sectors of consumer staples (*CS*), consumer discretionary (*CD*), energy (*EN*), financials (*FIN*), health care (*HC*), industrials (*IND*), information technology (*INT*), materials (*MAT*), telecommunication services (*TS*), and utilities (*UT*). All indices are quoted in yuan. The dataset is for the period of March 11, 2019 to April 24, 2020.

A. COVID-19 Cases amid Lockdown

Figure 1 shows plots of the daily new confirmed COVID-19 cases and the daily death tolls around and after the lockdown period. It reveals that, after the Wuhan lockdown on January 23, 2020, the daily new cases increased to 3,694 (February 4, 2020). Afterward, this number gradually reduced to 2,015 (February 11, 2020). There was a spike on February 12, 2020 (14,108 cases) due to a diagnostic change in Hubei Province, where the pandemic epicenter—Wuhan City—belongs [7].



Note: Wuhan lockdown period is from January 23, 2020, to April 8, 2020. The spike on the daily new confirmed cases graph on February 12, 2020, was due to a diagnostic change in COVID-19 detection. On April 17, 2020, the spike in the daily deaths graph occurred due to additional reports of early lapses and deaths at home (Snapshot from [8])

Figure 1. Daily new confirmed new COVID-19 cases and deaths in China (January 22, 2020, to March 17, 2021)

Notwithstanding the spike, the new confirmed cases continued the previously decreasing trend, and they flattened to 100 and below beginning March 6, 2020, with occasional exceptions. There were 21 daily new cases as of April 4, 2021.

As for the death toll, it surpassed 100 deaths on February 10, 2020, and peaked two days later with 146 deaths. From then on, the death toll was on a declining trend, although there was a report of 150 deaths on February 23 and a huge spike of 1,290 deaths on April 17. According to [9], China's National Health Commission revised the total death toll by reporting an additional 1,290 on April 17, 2020 as the results of Wuhan's citywide investigation to include early lapses and patients dying at home. On March 24, 2020, there were 6 deathss. Daily deaths were essentially zero by April 18, 2020 onwards until the present (April 4, 2021).

[7] noted that the outbreak seemed to have been basically brought under control in China since early March. [10] also commented that the lockdown was "brutal but effective". Discounting the spikes on February 12 and April 17, 2020 due to diagnostic changes and early lapses, the effectiveness of the Wuhan lockdown is evident in Figure 2. From the graphs, it is obvious that the daily rate of change in total confirmed new COVID-19 cases and total deaths declined greatly day by day after the Wuhan lockdown. The rate of change for total confirmed cases was well below 1% one month after the lockdown. The rate further reduced to below 0.1% from March 6, 2020. The rate of change for total deaths fell consistently below 1% and 0.1% on March 4 and April 3, 2020, respectively. While this unprecedented natural experiment of the Wuhan lockdown provides some evidence of its effectiveness in containing the pandemic outbreak, its immediate impact on the financial market is yet to be identified and quantified.

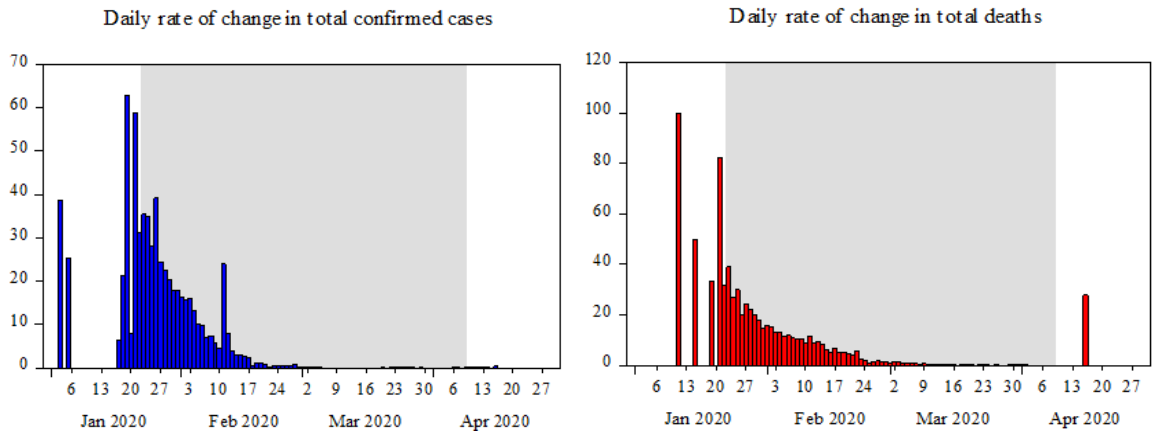


Figure 2. Daily rate of change in total confirmed cases and total deaths [8]

B. Returns on Indices amid Lockdown

The daily percentage returns on indices are computed and the time series plots are presented in Figure 3. Figure 3 shows that there was a dip of 2% to 4% for all indices on the day of lockdown. This was followed by a plummet of 6% to 9% on February 3, 2020 amid pandemic fears, when the Chinese stock exchange resumed trading after a prolonged Chinese New Year holiday. However, technical rebound on these indices

was quick on the following day to pull all the returns up into positive figures. Henceforth, the returns fluctuated around zero return level. In addition, compared to before the Wuhan lockdown, the returns were also seemingly fluctuating at a wider range after lockdown, especially in February and March.

The monthly percentage returns and standard deviations on these indices are summarized in Tables 1 and 2, respectively. Table 1 shows that the returns were a mixture of positive and negative while the closing prices of indices on January 23 were higher compared to their corresponding prices one month before. Notably, after incorporating substantial price plunge, the market was able to register for an average monthly return of 2.55% on January 23, 2020 with the help of CD, HC, ICT and TS, which were resilient. In fact, they all continued to be in the positive regime one month and also three months after. Meanwhile, EN, FIN, and UT were still in the negative regime a month after the Wuhan lockdown while others managed to overturn their previous month's profit loss on February 23, 2020.

Remarkably, all indices ended up with considerably huge monthly losses on March 23, 2020, probably because of the global COVID-19 outbreak in Europe and the United States that month. Consequently, the World Health Organization declared COVID-19 as pandemic on March 11, 2020. On April 23, 2020, the market as a whole managed to recover about half its losses in the previous month. Individually, HC outperformed the market by showing 17.07% returns on April 23 after a 9.54% loss on March 23, 2020.

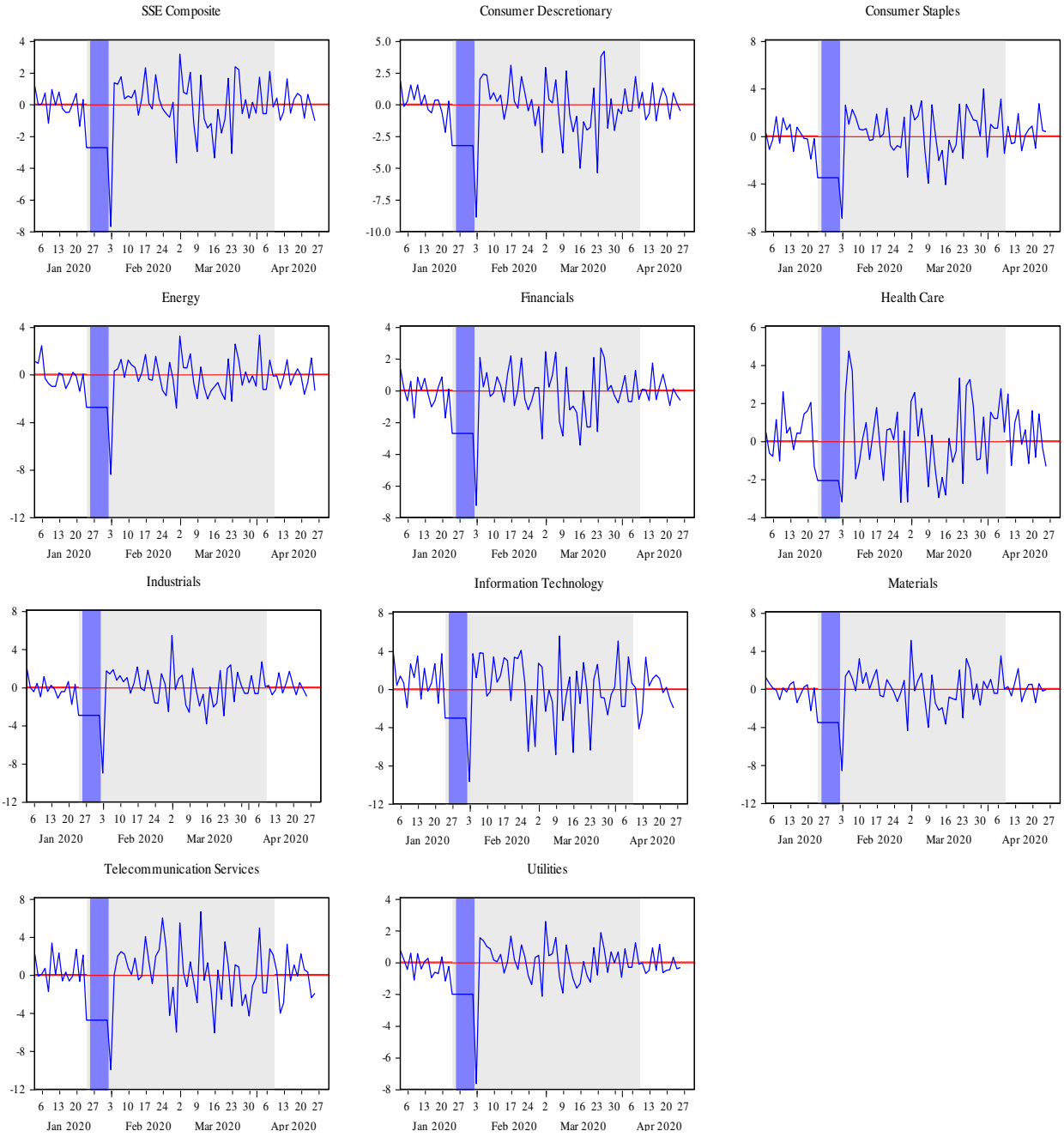
From the perspective of market risk, the standard deviations as a proxy for market risk were consistently larger after the Wuhan lockdown (Table 2). Moreover, the market risk increased by about onefold after one month and also two months after the lockdown. The market was calmer three months after lockdown, but it was still more volatile than the prelockdown period.

Table 1.

Monthly percentage returns

Date	CD	CS	EN	FIN	HC	ICT	IND	MAT	TS	UT
January 23, 2020	2.04	-1.15	-1.31	-2.20	7.38	17.69	-1.13	1.56	6.45	-4.31
February 21, 2020	4.20	4.30	-2.92	-0.85	5.28	19.17	2.14	2.85	6.60	-0.78
March 23, 2020	-20.12	-8.36	-12.16	-13.91	-9.54	-20.82	-11.30	-15.28	-3.71	-6.82
April 23, 2020	6.75	17.13	1.84	5.22	17.07	4.50	8.10	7.70	-4.88	2.00
Mean	-1.79	2.98	-3.64	-2.93	5.05	5.13	-0.55	-0.79	1.11	-2.48

Notes: This table shows the sample monthly percentage returns on sector indices by dividing the monthly yuan returns on their closing prices by the closing prices one month ago and then multiply by 100%. For example, monthly returns on January 23, 2020, are computed from two dates, vis-à-vis, December 23, 2019, and January 23, 2020. The symbols are explained as follows. SSEC: Shanghai Stock Exchange Composite Index, CS: consumer staples, CD: consumer discretionary, EN: energy, FIN: financials, HC: health care, IND: industrials, INT: information technology, MAT: materials, TS: telecommunication services, and UT: utilities



Notes: The symbols are explained as follows. The darker shaded region shows the stock market close (January 24 to 31, 2020). The lighter shaded region shows the Wuhan lockdown period (January 23, 2020, to April 8, 2020)

Figure 3. Daily percentage returns on indices

Table 2.

Monthly percentage standard deviation of returns

Date	CD	CS	EN	FIN	HC	ICT	IND	MAT	TS	UT
January 23, 2020	1.15	1.18	1.13	1.08	1.18	2.09	1.09	1.32	1.79	0.74
February 21, 2020	2.86	2.39	2.41	2.28	2.18	3.55	2.71	2.76	3.36	2.21
March 23, 2020	2.26	2.12	1.53	1.78	1.95	3.80	2.11	2.21	3.55	1.21
April 23, 2020	2.00	1.61	1.32	1.12	1.58	2.52	1.33	1.53	2.46	0.78
Mean	2.07	1.83	1.60	1.57	1.72	2.99	1.81	1.95	2.79	1.23

Notes: This table shows the sample standard deviation of returns on sector indices, in percentage, over the previous one-month period. For example, the monthly standard deviation on January 23, 2020, is computed from all daily percentage returns from December 23, 2019, to January 23, 2020, inclusively. The row mean is the average monthly standard deviations across different sectors in the Shanghai Stock Exchange. The column mean is the average monthly standard deviations for the same sector index from December 23, 2019, to April 23, 2020. See notes in Table 2 for the explanation of symbols

Table 3.

Abnormal returns

Day	CD	*t*	Sig	CS	*t*	Sig	EN	*t*	Sig	FIN	*t*	Sig	HC	*t*	Sig	ICT	*t*	Sig	IND	*t*	Sig	MAT	*t*	Sig	TS	*t*	Sig	UT	*t*	Sig	AAR	*t*	Sig
0	-3.27	-2.80	**	-3.58	-2.90	**	-2.69	-2.63	**	-2.74	-2.55	*	-2.10	-1.65		-3.20	-1.58		-2.92	-2.65	**	-3.55	-2.87	**	-4.82	-2.61	**	-1.98	-2.53	*	-3.09	-8.74	**
1	-8.91	-7.63	**	-7.00	-5.66	**	-8.35	-8.18	**	-7.29	-6.77	**	-3.24	-2.55	**	-9.85	-4.86	**	-8.98	-8.16	**	-8.62	-6.97	**	-10.02	-5.42	**	-7.62	-9.72	**	-7.99	-22.64	**
2	1.97	1.69	*	2.51	2.03	*	0.34	0.33		2.05	1.90	*	2.46	1.93	*	3.56	1.76	*	1.73	1.57		1.31	1.06		-0.01	-0.01		1.58	2.02	*	1.75	4.96	**
3	2.38	2.03	*	0.91	0.73		0.53	0.51		0.19	0.18		4.69	3.69	**	1.03	0.51		1.42	1.29		1.89	1.53		1.91	1.04		1.39	1.78	*	1.63	4.63	**
4	2.29	1.96	*	2.15	1.74	*	1.33	1.30		1.09	1.02		3.64	2.87	**	3.65	1.80	*	1.87	1.70	*	1.08	0.88		2.38	1.29		1.03	1.31		2.05	5.81	**
5	0.36	0.31		1.49	1.21		-0.19	-0.19		-0.41	-0.38		-2.02	-1.59		3.60	1.77	*	0.77	0.70		-0.22	-0.18		2.12	1.15		0.89	1.14		0.64	1.81	*
6	0.89	0.76		0.50	0.41		1.27	1.25		-0.19	-0.18		-1.17	-0.92		-0.88	-0.43		1.22	1.11		3.14	2.54	**	0.65	0.35		0.18	0.23		0.56	1.59	
7	0.21	0.18		0.43	0.34		0.86	0.85		0.83	0.78		0.10	0.08		-0.43	-0.21		0.58	0.53		0.57	0.46		-0.02	-0.01		0.07	0.08		0.32	0.91	
8	0.72	0.61		0.54	0.44		0.64	0.63		0.28	0.26		0.94	0.74		3.21	1.58		1.04	0.95		1.69	1.37		1.72	0.93		0.53	0.68		1.13	3.21	**
9	-1.21	-1.03		-0.45	-0.36		-0.52	-0.51		-0.77	-0.71		-1.00	-0.79		0.58	0.28		-0.60	-0.55		-0.03	-0.03		-0.58	-0.31		-0.65	-0.83		-0.52	-1.48	
10	0.11	0.09		-0.37	-0.30		0.21	0.20		0.99	0.92		0.35	0.27		1.25	0.62		0.43	0.39		1.04	0.84		-0.20	-0.11		0.06	0.08		0.39	1.09	

Notes: This table shows the abnormal returns for each day computed by subtracting the average returns on indices (from March 11, 2019, to January 22, 2020) from the returns on a specific day. Day 0 fell on January 23, 2020, when Wuhan lockdown was implemented at 10.00 am. t refers to the Student-t statistics, where "Sig" stands for significance of the abnormal returns with * and ** denoting significance at 5% and 1%, respectively. See notes in Table 2 for the explanation of symbols

Table 4.

Cumulative abnormal returns

Window	CS	*t*	Sig	CD	*t*	Sig	EN	*t*	Sig	FIN	*t*	Sig	HC	*t*	Sig	ICT	*t*	Sig	IND	*t*	Sig	MAT	*t*	Sig	TS	*t*	Sig	UT	*t*	Sig	CAAR	*t*	Sig
[0, 1]	-10.58	-6.05	**	-12.18	-7.37	**	-11.04	-7.65	**	-10.03	-6.59	**	-5.34	-2.97	**	-13.05	-4.55	**	-11.90	-7.65	**	-12.18	-6.96	**	-14.85	-5.68	**	-9.60	-8.66	**	-11.07	-10.39	**
[0, 2]	-8.07	-3.77	**	-10.21	-5.05	**	-10.70	-6.05	**	-7.98	-4.28	**	-2.88	-1.31		-9.49	-2.70	**	-10.17	-5.34	**	-10.86	-5.07	**	-14.86	-4.64	**	-8.02	-5.90	**	-9.32	-6.18	**
[0, 3]	-7.16	-2.90	**	-7.83	-3.35	**	-10.18	-4.98	**	-7.79	-3.62	**	1.81	0.71		-8.46	-2.09	*	-8.75	-3.98	**	-8.97	-3.63	**	-12.94	-3.50	**	-6.63	-4.23	**	-7.69	-4.16	**
[0, 4]	-5.01	-1.81	*	-5.54	-2.12	*	-8.85	-3.88	**	-6.70	-2.78	**	5.45	1.92	*	-4.81	-1.06		-6.88	-2.80	**	-7.89	-2.85	**	-10.56	-2.56	**	-5.60	-3.19	**	-5.64	-2.65	**
[0, 5]	-3.52	-1.16		-5.18	-1.81	*	-9.04	-3.61	**	-7.10	-2.70	**	3.43	1.10		-1.22	-0.25		-6.12	-2.27	*	-8.11	-2.68	**	-8.45	-1.87	*	-4.71	-2.45	**	-5.00	-2.10	*
[0, 6]	-3.02	-0.92		-4.29	-1.39		-7.77	-2.87	**	-7.29	-2.56	**	2.25	0.67		-2.10	-0.39		-4.89	-1.68	*	-4.97	-1.52		-7.80	-1.60		-4.53	-2.18	*	-4.44	-1.70	*
[0, 7]	-2.59	-0.74		-4.08	-1.24		-6.90	-2.39	**	-6.46	-2.12	*	2.36	0.66		-2.53	-0.44		-4.31	-1.38		-4.40	-1.26		-7.82	-1.50		-4.46	-2.01	*	-4.12	-1.46	
[0, 8]	-2.05	-0.55		-3.37	-0.96		-6.26	-2.04	*	-6.18	-1.92	*	3.30	0.87		0.69	0.11		-3.26	-0.99		-2.71	-0.73		-6.10	-1.10		-3.93	-1.67	*	-2.99	-0.99	
[0, 9]	-2.49	-0.64		-4.57	-1.24		-6.78	-2.10	*	-6.95	-2.04	*	2.30	0.57		1.26	0.20		-3.86	-1.11		-2.74	-0.70		-6.68	-1.14		-4.58	-1.85	*	-3.51	-1.10	
[0, 10]	-2.86	-0.70		-4.47	-1.15		-6.57	-1.94	*	-5.97	-1.67	*	2.64	0.63		2.51	0.37		-3.43	-0.94		-1.70	-0.42		-6.88	-1.12		-4.52	-1.74	*	-3.12	-0.93	

Notes: This table shows the daily abnormal returns shown in Table 4 that have been accumulated over the event window. For instance, event window [0, 1] reports the sum of abnormal returns on Day 0 and Day 1. Day 0 fell on January 23, 2020, when Wuhan lockdown was implemented at 10.00 am. t refers to the Student-t statistics, where "Sig" stands for significance of the cumulative abnormal returns with * and ** denoting significance at 5% and 1%, respectively. See notes in Table 2 for the explanation of symbols

III. EVENT WINDOW STUDY METHODOLOGY

Event study methodology, see for instance, [5], [11], and [12], is adopted to determine if short-run abnormal returns exist in the Shanghai Stock Exchange Composite Index and its 10 component sectors.

Daily abnormal returns (AR_{it}) is specified as follows [11]:

$$AR_{it} = R_{it} - \bar{R}_i, \quad (1)$$

where R_{it} = percentage returns on index i at the end of trading day t, and $\bar{R}_i$ = average daily returns on index i over the estimation period, which is 200 days in this study.

The cumulative impact of the Wuhan lockdown over the event period could be measured by

$$CAR_t = \sum_{t=0}^{l} AR_{it}, \quad (2)$$

$$CAAR_t = \sum_{t=0}^{l} AAR_{it}, \quad (3)$$

where CAR_t and $CAAR_t$ are correspondingly the cumulative abnormal returns and cumulative average abnormal returns on all indices at day t. AAR_{it}, in turn, is the daily average abnormal return on indices across all the ten sectors. Besides, $l \in \{2, 3 \ldots, 10\}$ is the length of the event window. [5] showed that event window length should not exceed 10 days. Otherwise, the results might be contaminated with other incoming events.

The alternative hypothesis of negative (positive) returns can be tested against the alternative hypothesis of non-negative (non-positive) returns by Student's t-test [5], [12]. The following four t statistics are computed accordingly:

(i) $$t_{AR} = \frac{AR_{it}}{\sqrt{\sigma^2_{AR_i}}}, \quad (4)$$

where $\sigma^2_{AR_i}$ is the variance of AR_{it}.

(ii) $$t_{CAR} = \frac{CAR_i}{\sqrt{l\sigma^2_{AR_{及}}}}, \quad (5)$$

(iii) $$t_{AAR} = \sqrt{n}\frac{AAR_d}{\sqrt{\sigma^2_{AAR_d}}}, \quad (6)$$

where n =10 sectors and $\sigma^2_{AAR_d}$ is the variance of AAR_d.

(iv) $$t_{CAAR} = \frac{CAAR_d}{\sqrt{l\sigma^2_{AAR_d}}}. \quad (7)$$

As the one-tail test is adopted, the null hypothesis can be rejected in favor of the alternative hypothesis when the computed t statistics (with the appropriate sign) is larger in magnitude than 1.645 or 2.236 at the 5% or 1% significance level, respectively.

IV. EMPIRICAL RESULTS AND DISCUSSION

Tables 3 and 4 summarize the abnormal returns and cumulative abnormal returns for the 10 sector indices, respectively. It is evident from Table 3 that all the indices had significant negative abnormal returns for Day 0 (January 23, 2020) and Day 1 (February 3, 2020). HC and ICT were the only two exceptions in such a manner that their abnormal returns were insignificantly negative on Day 0 due to their resilient nature. The average abnormal returns across the 10 sectors on the Shanghai Stock Exchange were -3.09% and -7.99%, respectively, and they are both significantly negative at the 1% significance level. After two consecutive trading days of deep price correction, the sector indices were quick to rebound on Day 2, with significant positive abnormal returns observed in 6 of the 10 sectors. The overall market remained significantly positive in continuous abnormal returns from Day 2 up to Day 5.

Table 4 shows that the cumulative abnormal returns were significant and negative up to Day 4 for all cases, except HC and ICT. For HC, the abnormal return was only significantly negative up to Day 1, while it remained negative but insignificant on Day 2. The abnormal returns turned positive from Day 3 onwards, with a significant impact observed on Day 4. In this respect, previously [13] reported that pharmaceutical stocks benefited from the outbreak of severe acute respiratory syndrome (SARS) in 2003.

For ICT, its negative abnormal returns were significant up to Day 3, reducing the size of cumulative losses day after day. The abnormal returns eventually turned positive from Day 8 onwards, but the impact was insignificant. In sharp contrast, EN, FIN, and UT were worst hit by the lockdown as their abnormal returns were significantly negative from Day 1 to Day 10. Reducing size in abnormal negative returns was also observed for the market via the $CAAR_t$ measurement, with a significant cumulative impact from Day 1 to Day 6.

V. FURTHER ANALYSIS

Notably, abnormal returns are essentially the excess returns resulting from the event, compared to normal returns that would be obtained should there be no occurrence of the event. Thus, average daily returns are adopted in this study as it is a better proxy of the normal returns in times of no occurrence of lockdown. The benchmark market composite index is deemed inappropriate here as it is subjected to the impact of the same lockdown. Nevertheless, further analysis is conducted in this study using the returns on the Shanghai Stock Exchange Composite Index to obtain the market-adjusted abnormal returns. The purpose is to identify the sector that outperformed or underperformed the overall market amid the experience of the same lockdown. The results are reported in Table 5. Table 5 shows that HC and ICT had significant and positive market-adjusted cumulative abnormal returns from day 0 to day 10. This suggests that these two sectors significantly outperformed the market. In other words, these two sectors produced significantly more cumulative profits than the overall market in the times of lockdown due to the pandemic. In sharp contrast, EN produced significantly more cumulative losses than the overall market throughout the event window. Thus, EN underperformed the overall market significantly, as most likely it was simultaneously affected by the months-long crude oil crisis [14]. Note that the crude oil price free falls from

$ 61.19 on January 2, 2020, to $7.71 on April 27, 2020, partly due to a no-deal in oil producing and exporting Corporation (OPEC), and partly due to substantially less demand amid the pandemic and lockdowns.

For other sectors that were shown to have significant cumulative abnormal returns in the preceding section, they were no more significant after accounting for the general market risk. It reveals that their performances are just on par with the overall market in times of lockdown to contain the pandemic.

On another note, the previous estimation window started from March 11, 2019, when in fact the pandemic occurred only in December 2019. On a separate analysis, only the data set spanning from January 2, 2020, is considered in the estimation window to obtain the proxy measurement of normal returns under a no lockdown event, in the era of pandemic outbreak only. The results (available upon request) showed consistently significant and negative abnormal returns on all sector indices due to the lockdown. Besides, the Chinese stock market was also found to be significantly affected by the global pandemic development such as WHO's announcement that COVID-19 was a global pandemic on March 11, 2020. Hence, it empirically explains the double-digit negative monthly returns on sector indices as reported in Table 2. Finally, none of the sector indices had abnormal returns when the Wuhan lockdown was lifted on April 8, 2020. Empirical results from the event study on WHO's announcement and the Wuhan lockdown exit were also not shown to conserve space in this document. However, they are available upon request.

Table 5.

Market-adjusted cumulative abnormal returns

Window	CS	*t*	Sig	CD	*t*	Sig	EN	*t*	Sig	FIN	*t*	Sig	HC	*t*	Sig	ICT	*t*	Sig	IND	*t*	Sig	MAT	*t*	Sig	TS	*t*	Sig	UT	*t*	Sig	CAAR	*t*	Sig
[0, 1]	-0.52	-0.46		-1.12	-1.47		-2.12	-2.54	**	-0.08	-0.11		4.78	4.00	**	3.69	1.99	*	-0.88	-1.69	*	-0.87	-0.92		0.92	0.58		-2.58	-4.30	**	0.27	1.31	
[0, 2]	0.73	0.53		-0.57	-0.61		-2.98	-2.91	**	0.70	0.77		5.95	4.07	**	5.18	2.29	*	-0.59	-0.93		-1.02	-0.88		-1.10	-0.57		-1.94	-2.64	**	0.58	2.00	*
[0, 3]	0.47	0.29		0.47	0.44		-3.58	-3.03	**	-0.30	-0.29		9.44	5.59	**	4.28	1.64		-0.52	-0.71		-0.50	-0.38		-1.06	-0.47		-1.43	-1.68	*	0.87	2.45	*
[0, 4]	0.99	0.56		0.93	0.78		-3.79	-2.86	**	-0.83	-0.72		11.42	6.05	**	5.25	1.80	*	-0.50	-0.61		-1.30	-0.87		-1.26	-0.50		-1.60	-1.68	*	1.08	2.62	**
[0, 5]	2.19	1.12		0.93	0.71		-4.31	-2.98	**	-1.56	-1.22		9.09	4.40	**	8.38	2.62	**	-0.11	-0.12		-1.90	-1.17		0.37	0.13		-0.97	-0.93		1.36	2.95	**
[0, 6]	2.23	1.06		1.28	0.90		-3.53	-2.25	*	-2.22	-1.61		7.43	3.33	**	6.75	1.95	*	0.55	0.56		0.67	0.38		0.26	0.09		-1.16	-1.03		1.37	2.72	**
[0, 7]	2.31	1.02		1.07	0.70		-3.05	-1.82	*	-1.76	-1.19		7.17	3.00	**	5.76	1.56		0.70	0.67		0.80	0.43		-0.34	-0.11		-1.39	-1.16		1.28	2.34	*
[0, 8]	2.04	0.85		0.85	0.53		-3.20	-1.81	*	-2.31	-1.47		7.27	2.87	**	7.65	1.95	*	0.79	0.72		1.53	0.77		0.07	0.02		-1.49	-1.17		1.47	2.52	*
[0, 9]	2.30	0.91		0.38	0.23		-3.16	-1.69	*	-2.40	-1.45		6.96	2.61	**	9.41	2.28	*	0.91	0.78		2.25	1.07		0.57	0.16		-1.69	-1.26		1.70	2.75	**
[0, 10]	1.59	0.60		0.08	0.05		-3.33	-1.70	*	-1.77	-1.02		6.95	2.48	**	10.11	2.33	**	0.92	0.75		2.86	1.30		-0.19	-0.05		-1.91	-1.36		1.68	2.58	*

Notes: This table shows the daily abnormal returns (obtained using Shanghai Stock Exchange Composite Index) that have been accumulated over the event window. For instance, event window [0, 10] reports the sum of abnormal returns from Day 0 through Day 10. Day 0 fell on January 23, 2020, when Wuhan lockdown was implemented at 10.00 am. t refers to the Student-t statistics, where "Sig" stands for significance of the cumulative abnormal returns with * and ** denoting significance at 5% and 1%, respectively. See notes in Table 2 for the explanation of symbols

VI. CONCLUDING REMARKS

This paper adopts the window event study to show the immediate stock market reaction in response to the unprecedented Wuhan lockdown, which provides us with a natural experiment to attest its immediate impact on the stock market. In particular, it reports empirical evidence of the significant and negative immediate impact of the Wuhan lockdown in the face of the pandemic outbreak on all sector components of the Shanghai Stock Exchange. In line with the findings in [4], the healthcare and information technology sectors that helped greatly in the fight against the pandemic were found to be resilient despite the lockdown. In contrast, energy sectors underperformed the market as they are probably simultaneously affected by the global crude oil crisis. The confirmation of healthcare and information technology sectors as countercyclical, while all other sectors are severely affected in times of lockdown due to the pandemic, provides useful information to investors to consider when managing their portfolio in similar catastrophic situations in the future.

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