Research article

How does Chinese stock market react to breaking news about COVID-19? Evidence from event study

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A B S T R A C T

Although the COVID-19 pandemic is no longer considered a public health emergency of international concern, research is ongoing to determine whether and how financial markets have been affected. Using an event study methodology, we examine Chinese stock reactions to breaking news about COVID-19 during 2020–2023, covering nine important events from the first declaration of the novel coronavirus to classifying COVID-19 from top category A to B in China. The empirical results show that the Chinese stock market reacts negatively to bad news, such as the breakout of COVID-19 and the dynamic zero-COVID strategy, and positively to good news, such as COVID-19 vaccine approvals, ending the zero-COVID strategy, and reopening boards. The overall intensity of reactions to bad news is stronger than that to good news. Small-sized stocks react more positively to good news and more negatively to bad news. Different industries have different reactions to different events; however, the sector that responds strongly and negatively to bad news does not have to respond strongly and positively to good news, which, to some extent, reflects their profitability performance during the pandemic. In China, consumer discretionary, utilities and real estate are the most negatively affected by the pandemic, while materials, health care, and energy are the most positively affected. This study has important implications for reminding market participants to pay attention to breaking news announcements about COVID-19.

1. Introduction

On January 20, 2020, China identified the human-to-human novel coronavirus disease (COVID-19). On December 26, 2022, the China National Health Commission (CNHC) renamed COVID-19 from novel coronavirus pneumonia to novel coronavirus infection and declared their decision to reopen borders on January 8, 2023, which was viewed as the country's last step in shedding three years of zero-COVID and pivoting to live with the virus. Although the impact of the coronavirus on people's health has been minimal owing to widespread vaccination, research on the pandemic is still ongoing, paying more attention to how it has influenced social and economic life.

In this paper, we use the event study methodology to examine Chinese stocks' reactions to breaking news about COVID-19 during 2020–2023, covering nine events from the breakout of COVID-19 to the Chinese last step in shedding three years of zero-Covid and

pivoting to live with the virus. These events are China's announcement of the novel coronavirus to the public for the first time on January 20, 2020 (Event1), WHO's declaration about the COVID-19 pandemic on March 11, 2020 (Event2), the authorization of the COVID-19 CoronaVac vaccine to begin the Phase I–II trials in China on April 13, 2020 (Event3), China's joining the COVID-19 Vaccines Global Access on October 8, 2020 (Event4), China's announcement of the Sinopharm BIBP vaccine for freely emergency use by Chinese citizens on December 31, 2020 (Event5), the approval of the Sinopharm BIBP vaccine of China being approved for emergency use by World Health Organization (WHO) on May 7, 2021(Event6), China's introduction of the dynamic zero-COVID strategy to the public in the press conference on December 11, 2021(Event7), China's renaming the epidemic and declaring its plan to reopen borders on January 8, 2023, on December 26, 2022 (Event8), China's reopening of the borders and classifying COVID-19 from a top category A to a category B on January 8, 2023, (Event9). To compare the reactions to different events, we uniformly take the sample data from January 1, 2019, to December 31, 2019 (before the COVID-19 pandemic) as the estimation window to calculate the abnormal returns of Chinese stocks, while listed firms in the CSI800 stock index are selected as the proxy for the Chinese stock market. Both daily average abnormal returns (AARs) and cumulative average abnormal returns (CAARs) are considered to analyze the effects of the events.

The main findings of this study are as follows. First, the Chinese stock market reacts negatively to bad news about COVID-19 and positively to good news overall. Second, the Chinese stock market reacts differently to various events. Specifically, the negative shock from the information that the WHO declared during the COVID-19 pandemic in March 2020 was stronger than that from the information that China announced the novel coronavirus to the public for the first time in January 2020. The positive shock from the information about China joining the COVID-19 Vaccines Global Access in October 2020 was stronger than the information about China authorizing the COVID-19 CoronaVac vaccine to begin Phase I–II trials in April 2020. The positive shock from China announcing the free emergency use of the Sinopharm BIBP vaccine in December 2020 is stronger than the information that the Sinopharm BIBP vaccine of China was approved for emergency use by the WHO in May 2021. The cumulative reaction to the announcement of the dynamic zero-COVID strategy after massive vaccination in December 2021 is negative, whereas the stock market reacts positively to the announcement to end the strategy in December 2022. In addition, the Chinese stock market reacted more positively to the declaration of a plan to reopen borders in December 2022 than to the reopening of borders in January 2023. Third, at most times, small-sized stocks react more positively to good news and more negatively to bad news compared with middle- and big-sized firms. Fourth, the reactions of different sectors are heterogeneous. Real Estate (RE) and Consumer Staples (CS) are the top two sectors most likely to be exposed to bad news about COVID-19, whereas technology (IT), healthcare (HC), and consumer discretionary (CD) are the top three sectors possibly exposed to good news about COVID-19. Fifth, different stock reactions can be interpreted in terms of the financial performance of different sectors during the COVID-19 pandemic. Healthcare, materials, and energy are the top three sectors positively impacted by the COVID-19 pandemic, while real estate, consumer discretionary, and utilities are the top three sectors negatively impacted by COVID-19 pandemic.

The main contributions of this study are summarized as follows. First, this is the first study to systematically investigate the Chinese stock market's reactions to a series of breaking news reports on COVID-19, contributing to the literature on the relationship between financial markets and the COVID-19 pandemic. Although there is little previous literature on the Chinese stock market's reaction to COVID-19, they only concentrate on a single event, such as the outbreak of COVID-19 in early 2020 [1–7], or Covid-19 vaccine approvals [8]. However, our study covers nine important events from the outbreak of COVID-19 to the last Chinese step in pivoting to live with the virus, including breaking news on the outbreak of COVID-19, COVID-19 vaccine, COVID-19 vaccination, zero-COVID strategy, and reopening boards. Second, in contrast to previous studies that use the data of reported confirmed cases and deaths to examine the impact of COVID-19 on stock indices [9] or the relationship between government response to COVID-19 and stock markets [10], we use an event study methodology to explore the Chinese stock market's responses to breaking news about COVID-19. We consider a larger sample of data covering 539 Chinese listed firms. Third, we compare reactions to different events at the market level and the different performances categorized by firm size or industry, which is another important contribution of this study. This has significant implications for understanding how the Chinese stock market has reacted to the series of breaking news reports on COVID-19 in the past three years.

The remainder of this paper is organized as follows. Section 2 reviews literature on the impact of COVID-19 on stock markets. Section 3 introduces the methodology and describes the sample data. Section 4 details the empirical results. Section 5 discusses the main findings. Finally, Section 6 concludes the paper.

2. Literature review

Using different methods and perspectives, scholars in economics and management have conducted several studies on the impact of COVID-19 on financial markets [11–19]. Previous studies on COVID-19 and the Chinese financial market can be divided into the following categories.

The first string of research (including the largest number of studies) focuses on the Chinese stock market's overall reaction to the COVID-19 [1–7]. A previous study found that the pandemic increased the stock market crash risk in China [3,7], and the lead-lag structure jumps among Chinese stock indices changed significantly before and after the outbreak of COVID-19 [4]. The Chinese stock market declined significantly when Zhong Nanshan announced on January 20, 2020, that the new coronavirus could be transmitted from person to person on January 20, 2020 [2].

The second string of studies focuses on the impact of the COVID-19 pandemic on specific industries in China. Some scholars argue that the COVID-19 pandemic has severely impacted China's traditional industries, while creating opportunities for the development of high-tech fields [1]. Some scholars argue that abnormal returns for the medical and food industries were significantly positive, whereas those for the energy and public utility industries were negative after the outbreak of COVID-19 [6]. However, the contrasting view is

that the stock price crash risk of energy firms significantly decreases in the post-COVID-19 period [20]. Some studies argue that short- and long-term shocks from the outbreak of COVID-19 are different in certain industries. For example, it has a short-term negative impact and long-term positive impact on the insurance industry [21].

The third string of studies focuses on the impact of the COVID-19 pandemic on the co-movements between the Chinese stock market and other financial markets, such as bonds [22], crude oil [23], and futures [4], or the stock markets of other countries, such as the United America [24–27], Vietnam [28], other BRICS members [29], and Islamic stocks [30]. The main conclusion of these studies is that there were stronger volatility spillovers among different financial markets after the outbreak of COVID-19.

The fourth strand focuses on the relationship between investor sentiment and the Chinese stock market during COVID-19 [31–34]. Some scholars argue that the negative impact of COVID-19 on the Chinese stock market is sentimental and cannot be explained by the real losses [5]. In addition, a small amount of the literature focuses on the impact of COVID-19 on the Chinese stock market from other perspectives, such as risk disclosure [35], herding behavior [36], margin purchases and short sales [37], or Covid-19 vaccine approvals [8].

The impact of the COVID-19 pandemic on the Chinese stock market is still a topic deserving attention. First, there are few studies that systematically investigate the Chinese stock market's reactions to a series of breaking news reports about COVID-19, not only focusing on the beginning of COVID-19. It is necessary to examine how the stock market responds to the announcement of ending COVID-19 and a series of breaking news during the pandemic, such as the COVID-19 vaccine, COVID-19 vaccination, and the dynamic zero-COVID strategy of the Chinese government. Second, there is no uniform research conclusion regarding the impact of the COVID-19 pandemic on different industries in China. Third, whether stock reactions to COVID-19 news are only sentiments needs to be studied further. In this study, we examine stock reactions to different types of COVID-19 news (negative or positive) in China, analyze them at the market, size, and sector levels, and discuss the reasons for the different reactions by connecting them with sectors' profitability during COVID-19. This study makes an important contribution to the literature on the COVID-19 pandemic.

3. Methodology

3.1. Event study methodology

We use an event study methodology to examine the effect of breaking news about COVID-19 on the stock returns of listed Chinese companies from January 2020 to January 2023. An event study method was systematically proposed to analyze the impact of emergencies on the financial market [38,39]. This methodology can measure the impact of a specific event on a firm's value, which was developed by finance researchers and used in other areas of the social sciences [40,41]. This approach is suitable for examining stock reactions to different types of COVID-19 news. For each event, the event date is denoted as "0." We concentrate on analyzing the following event windows, namely, the event windows of [−1,0], [−1,1], [−7, −1], [−7,0], [−7,7], [0,0], [0,1], [0,3], [0,5], [0,7] [1, 3], [1,5], and [1,7] trading days.

In the first step, following a previous study [42], we estimate the expected return for each company during the event period using the following equation:

$$ER_{i,t} = \alpha_i + \beta_i R_{m,t} \tag{1}$$

where $ER_{i,t}$ is the expected stock return for firm i at time t, $R_{m,t}$ is the comprehensive market return of the Chinese A-share stock market at time t. α_i and β_i are the estimated alpha and beta parameters for firm i. In our study, we used data from the Chinese CSI800 stock index from January 1, 2019, to December 31, 2019, to compute the parameters α_i and β_i.

Second, we calculate the abnormal stock returns for each company during the event period using the following equation:

$$AR_{i,t} = R_{i,t} - ER_{i,t} \tag{2}$$

where $AR_{i,t}$ is the abnormal stock return of firm i at time t, $R_{i,t}$ is the realized stock return of firm i at time t, and $ER_{i,t}$ is the expected stock return of firm i at time t, as calculated using Equation (1). $R_{i,t} = 100 \times \left[\ln(P_{i,t}) - \ln(P_{i,t-1})\right]$, where $P_{i,t}$ and $P_{i,t-1}$ are the stock price of firm i at time t and t-1, respectively.

We analyzed the reactions of Chinese listed firms to events at the market, sector, and size levels. Thus, both average abnormal returns (AARs) and cumulative average abnormal returns (CAARs) are considered to analyze the effects of the event. For a given category, the AARs were calculated as follows:

$$AAR_{w,t} = \frac{1}{N} \sum_{n=1}^{N} AR_{i,t}\big|_{i \in w} \tag{3}$$

where $AAR_{w,t}$ is the average abnormal return (AARs) for category w at time t and N is the number of observations. For a given period [T, T + K], the CAARs are calculated as follows:

$$CAR_{T,T+K}^{i} = \sum_{t=T}^{T+K} AR_{i,t} \tag{4}$$

$$CAAR_{T,T+K}^w = \frac{1}{N} \sum_{i=1}^{N} CAR_{T,T+K}^i \big|_{i \in w} \tag{5}$$

where $CAR_{T,T+K}$ and $CAAR_{T,T+K}^w$ are the cumulative abnormal returns firm i and the cumulative average abnormal returns for category w in periods [T and T + K], respectively. We used the standardized cross-sectional test approach proposed to test statistical significance [43,44]. Python was the data processing software used in this study.

3.2. Definition and description of events

As described in Table 1, there were nine representative breaking news articles during the outbreak of COVID-19 to the Chinese last step in shedding three years of zero-Covid, which were selected in our study to examine the stock reactions to the announcements of those news articles, including three negative news articles and six positive news articles. Fig. 1 illustrates the change in Chinese CSI800 stock index prices for each event. For example, the stock market experienced sharp declines when the COVID-19 pandemic broke out in early 2020, witnessed rising tendencies when good news on the COVID-19 vaccine occurred during 2020–2021, re-experienced a declining tendency when China announced the dynamic zero-COVID strategy after mass vaccination in December 2021, and re-witnessed a rising tendency when China shed the zero-COVID strategy and pivoted to live with the virus in December 2022.

3.3. Sample selection and data pre-processing

Our sample selection begins with 800 companies listed on the Chinese CSI800 stock index in January2, 023.[1] We collected the daily closing price data of these stocks and the comprehensive market return of the Chinese A-share stock market from the CSMAR database. The original sample period was from January 1, 2019, to January 31, 2023. We deleted firms with missing values from January 1, 2020, to January 31, 2023, generating 539 companies in our final sample. The WIND industry classification, based on the Global Industry Classification System (GICS) categorizes firms into different sectors. In the final sample, the market capitalization of firms on December 31, 2022, is used to categorize firms into different sizes (large 30 %, middle 40 %, and small 30 %), as shown in Panel A of Table 2. For each sector, we also categorize firms into different sizes (large 30 %, middle 40 %, and small 30 %), as shown in Panel B of Table 2.

4. Empirical results

4.1. Descriptive statistics

Table 3 reports descriptive statistics of stock returns in our final sample. Here, we concentrate on analyzing the average returns at the market level, sector level, size level and sector-size level, respectively. The total sample is divided into two parts, namely, pre-COVID period (01/01/2019-31/12/2019) and post-COVID period (01/01/2020-31/01/2023). Panel A of Table 3 shows that the average log return of the 539 stocks in our final sample is 0.0386, which is positive and implies the overall upward trend of Chinese stock market after 2019. However, the average return in the post-COVID period (0.0143) is less than the average return in the pre-COVID period (0.1131), suggesting the negative impact of the breakout of COVID-19 pandemic on stock market. Panel B of Table 3 shows that the average stock return of small firms (0.0542) is highest while that of big firms (0.0204) is lowest. And, small-size firms have been most affected by the COVID-19 pandemic, which is seen from the difference of average returns before and after the COVID-19 breakout. The average stock return of small-size firms deceases from 0.1415 in the pre-COVID period to 0.0256 in the post-COVID period, of which the difference is −0.1159. While the average stock return of middle-size firms deceases from 0.1042 in the pre-COVID period to 0.0197 in the post-COVID period (the difference is −0.0845), and that of big-size firms deceases from 0.0965 to −0.0045 (the difference is −0.1010). As seen from the sector level (Panel C of Table 3), financials, information technology and real estate are the three sectors that have been relatively more affected by the COVID-19 pandemic, in that their average stock returns shift from positive in the pre-COVID period to negative in the post-COVID period.

4.2. How do Chinese stocks react to breaking news about COVID-19 at the market level?

Table 4 reports the average abnormal returns (AARs) on the event dates and the cumulative average abnormal returns (CAARs) for different windows of [−1,0], [−1,1], [−7, −1], [−7,0], [−7,7], [0,1], [0,3], [0,5], [0,7] [1,3], [1,5], and [1,7]. The average abnormal returns (AARs) are calculated by the models specified in Equations (1)–(3), whereafter the cumulative average abnormal returns (CAARs) are calculated by the models specified in Equations (4) and (5). Let us focus on the average abnormal returns (AARs) on the event dates, which are shown in the sixth row of this table. Most of the estimated AARs are statistically significant, suggesting that breaking news about COVID-19 affect Chinese stock returns. On the event dates, the AARs at the market level for the nine events

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[1] The CSI800 index is compiled by the China Securities Index Co., LTD. Its constituent stocks are composed of the CSI 500 and CSI 300. The CSI 800 Index comprehensively reflects the overall situation of companies with large, medium and small market capitalization in Shanghai Stock Exchange and Shenzhen Stock Exchange of China.

Table 1
List of breaking news on COVID-19 in China.

Event Code	Event Date	Event Classification	Description for breaking news
Event 1	2020-01-21	Negative news	On January 20, 2020, China announced the novel coronavirus to the public for the first time. China National Health Commission (CNHC) confirmed that the virus was human-to-human transmissible.[a]
Event 2	2020-03-12	Negative news	On March 11, 2020, The World Health Organization (WHO) declared a global pandemic as the coronavirus rapidly spreads across the world.[b]
Event 3	2020-04-14	Positive news	On April 13, 2020, CoronaVac, a COVID-19 vaccine made by Sinovac Biotech was authorized by China National Health Commission (CNHC) to begin the Phase I–II trials in China.[c]
Event 4	2020-10-09	Positive news	On October 8, 2020, China joined the COVID-19 Vaccines Global Access (COVAX), which is a global scheme for the distribution of COVID-19 vaccine backed by the World Health Organization (WHO).[d]
Event 5	2021-01-04	Positive news	On December 31, 2020, China National Health Commission (CNHC) announced that the Sinopharm BIBP vaccine (BBIBP-CorV) has been approved through the conditional marketing authorization process, and declares that COVID-19 vaccination is free to Chinese citizens.[e]
Event 6	2021-05-10	Positive news	On May 7, 2021, the Sinopharm BIBP vaccine (BBIBP-CorV) of China was approved for emergency use by the World Health Organization (WHO).[f]
Event 7	2021-12-13	Negative news	On December 11, 2021, China National Health Commission (CNHC) introduced the dynamic zero-COVID strategy to the public in the press conference.[g]
Event 8	2022-12-27	Positive news	On December 26, China National Health Commission (CNHC) renamed the epidemic and declared that it would reopen borders and abandon quarantine after it downgrades its treatment of Covid-19 on January 8. The decision was the country's last step in shedding three years of zero-Covid and pivoting to living with the virus.[h]
Event 9	2023-01-09	Positive news	On January 8, 2023, COVID-19 in China was not managed as a top category A infectious disease any more. And, on this day, the Chinese government removed some immigration restrictions and started issuing more passports to Chinese citizens and more visas to foreign nationals after almost three years of significant restrictions due to anti-pandemic control measures. The Hong Kong government also announced it would start to reopen its border with mainland China, allowing people to travel without quarantine.[i]

Notes: This table describes the nine important events on the COVID-19 pandemic for China between 2020 and 2023. Since China is used to announce important news in non-trading time and the specific announcement time for each breaking news is not uniform, we define the first trading date after the announcement date as the event date for each breaking news. For example, China announced the novel coronavirus to the public for the first time in the evening of January 20, 2020, thus the event date of stock market is defined as January 21, 2020, which is the first trading date when the stock market received the information on this event.

  [a] See https://www.theguardian.com/world/2020/jan/20/coronavirus-spreads-to-beijing-as-china-confirms-new-c.
  [b] See https://www.cnbc.com/2020/03/11/who-declares-the-coronavirus-outbreak-a-global-pandemic.html.
  [c] See https://baike.baidu.com/reference/24286099/e96eMWFTfiEXDG9z6dPYoHwsn4XO42LWsY6oWgQO4nBjt8UzLJ1mZbXC7E704FG9-8NY5k4JrwJDj2NM9SlZsX4Sps5p2TfiHZJcjc0L89IM.
  [d] See https://www.scmp.com/news/china/diplomacy/article/3104924/coronavirus-what-chinas-decision-join-whos-vaccine-scheme?module=perpetual_scroll_0&pgtype=article&campaign=3104924.
  [e] See https://www.bbc.com/zhongwen/simp/science-55495307.
  [f] See https://www.who.int/news/item/07-05-2021-who-lists-additional-covid-19-vaccine-for-emergency-use-and-issues-interim-policy-recommendations.
  [g] See http://www.gov.cn/xinwen/gwylflkjz175/index.htm.
  [h] See https://www.scmp.com/news/china/science/article/3204601/china-reopen-borders-drop-covid-quarantine-january-8.
  [i] See https://www.npr.org/2023/01/08/1147734190/china-has-reopened-its-borders-to-tourists-after-three-years-of-covid-closure.

Fig. 1. Daily closing prices of Chinese CSI800 stock index during the COVID-19 pandemic
(Notes: This figure depicts the trend of Chinese stock prices from January 1, 2020, to February 28, 2023, taking the CSI800 stock index as a proxy for the Chinese stock market. There are nine purple dashed vertical lines for the nine special dates, corresponding to the nine events described in Table 1. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

Table 2
Final sample distribution.

	Small	Middle	Big	Total
Panel A: Sample distribution by size				
	162	216	161	**539**
Panel B: Sample distribution by sector and size				
Materials (MA)	27	35	27	89
Real Estate (RE)	5	5	5	15
Industrials (IN)	30	40	30	100
Utilities (UT)	5	7	5	17
Financials (FI)	17	21	17	55
Consumer Discretionary (CD)	17	22	17	56
Energy (EN)	5	7	5	17
Consumer Staples (CS)	14	17	14	45
Information Technology (IT)	25	32	24	81
Health Care (HC)	19	26	19	64

Notes: This table reports the final sample distribution in this study. In Panel A, the market capitalization of firms on December 31, 2022 is used to categorize the 539 firms into different size (big 30 %, middle 40 %, and small 30 %). In Panel B, similar method is used to categorize firms into different size (big 30 %, middle 40 %, and small 30 %) for each sector. The WIND industry classification which is based on the Global Industry Classification System (GICS) is used to categorize firms into different sectors.

Table 3
Descriptive statistics.

	Total Sample (01/01/2019-31/01/2023)		Pre-COVID (01/01/2019-31/12/2019)		Post-COVID (01/01/2020-31/01/2023)	
	Obs.	**Mean Return**	**Obs.**	**Mean Return**	**Obs.**	**Mean Return**
Panel A: Descriptive statistics at the market level						
Overall	530915	0.0386	130977	0.1131	399938	0.0143
Panel B: Descriptive statistics at the size-based categories						
Small	159570	0.0542	39366	0.1415	120204	0.0256
Middle	212760	0.0406	52488	0.1042	160272	0.0197
Big	158585	0.0204	39123	0.0965	119462	−0.0045
Panel C: Descriptive statistics at the sector-based categories						
Consumer Discretionary	55160	0.0302	13608	0.0735	41552	0.016
Consumer Staples	44325	0.0588	10935	0.1664	33390	0.0235
Energy	16745	0.0697	4131	0.1019	12614	0.0591
Financials	54175	0.0067	13365	0.1218	40810	−0.0311
Health Care	63040	0.0422	15552	0.1350	47488	0.0118
Industrials	98500	0.044	24300	0.0855	74200	0.0305
Information Technology	79785	0.0399	19683	0.1817	60102	−0.0065
Materials	87665	0.0506	21627	0.0772	66038	0.0418
Real Estate	14775	−0.0274	3645	0.1034	11130	−0.0703
Utilities	16745	0.0303	4131	0.0346	12614	0.0289

Notes: This table reports the average stock returns of the selected 539 firms at the market level, sector level, size level and sector-size level, respectively. The total sample is from January 01, 2019 to 31 January/2023, which is divided into the pre-COVID subsample (01/01/2019-31/12/2019) and the post-COVID subsample (01/01/2020-31/01/2023).

indicate that Chinese stock market negatively reacts to the breakout of COVID-19. Particularly, it is more affected by the event that WHO facially announce the COVID-19 pandemic in March 2020 (Event2, AAR = −1.5 %), compared with the event that China announced the novel coronavirus to the public for the first time in January 2020 (Event1, AAR = −0.82 %). For the breaking news about COVID-19 vaccine (Event3, Event4, Event5, and Event6), all the AARs on the event dates are positive, implying the positively first reaction of Chinese stock market to good news on COVID-19 vaccine and vaccination. Comparing the AARs on the announcement date of Event3 and Event4, we can find that the reaction to joining the COVID-19 Vaccines Global Access is stronger than that to the start of the Phase I–II trials of COVID-19 Vaccine (1.78 % > 1.43). Comparing the AARs on the announcement date of Event5 and Event6, we can see that the reaction to the announcement for emergency use of Sinopharm BIBP vaccine freely by China is stronger than the announcement for emergency use of Sinopharm BIBP vaccine freely by WHO (0.99 % > 0.04 %). For the breaking news about zero-COVID strategy (Event7, Event8, and Event9), Chinese stock market react more positively to the announcement for ending the dynamic zero-COVID strategy than the announcement for starting the dynamic zero-COVID strategy (0.48 % > 0.19 %). In addition, Chinese stock market react more positively to the declaration for a plan to reopen borders than the implement of reopening borders (0.48 % > 0.32 %).

Next, we analyze the CAARs in the window [0,7], which to examine the cumulative impact of the corresponding event on the Chinese stock market. As shown in Table 4. By comparing these CAARs, we can observe that the first reaction on the event date is supported by the cumulative performance of the [0,7] trading days for most events. Event7 is the only exception, in that its AAR on the event day is 0.19 % while its CAAR in the window [0,7] is −1.17 %. This highlights that the first reaction of the Chinese stock market to

Table 4
Daily cumulative average abnormal returns (CAARs) at the market level.

Windows	Event1 (2020-01-21)	Event2 (2020-03-12)	Event3 (2020-04-14)	Event4 (2020-10-09)	Event5 (2021-01-04)	Event6 (2021-05-10)	Event7 (2021-12-13)	Event8 (2022-12-27)	Event9 (2023-01-09)
(-1,0)	−0.03 %	−2.51 %***	0.87 %***	1.44 %***	1.95 %***	−0.69 %***	−0.15 %*	1.04 %***	0.23 %**
(-1,1)	0.41 %**	−3.36 %***	0.57 %***	3.26 %***	2.63 %***	−0.79 %***	−0.67 %***	0.61 %***	0.22 %**
(-7,-1)	0.77 %***	−1.21 %***	1.03 %***	−2.84 %***	1.20 %***	−1.69 %***	0.65 %***	−3.13 %***	0.82 %***
(-7,0)	−0.05 %	−2.71 %***	2.46 %***	−1.06 %***	2.19 %***	−1.65 %***	0.84 %***	−2.65 %***	1.14 %***
(-7,7)	−3.34 %***	−10.66 %***	2.67 %***	−0.49 %**	2.40 %***	−0.73 %**	−0.52 %*	−1.83 %***	1.88 %***
(0,0)	**−0.82 %***	**−1.50 %***	**1.43 %***	**1.78 %***	**0.99 %***	**0.04 %**	**0.19 %***	**0.48 %***	**0.32 %***
(0,1)	−0.38 %***	−2.35 %***	1.13 %***	3.59 %***	1.66 %***	−0.06 %	−0.34 %***	0.04 %	0.31 %***
(0,3)	−8.71 %***	−5.88 %***	1.63 %***	3.31 %***	1.62 %***	−0.35 %**	−0.27 %*	−0.05 %	−0.18 %*
(0,5)	−5.97 %***	−7.25 %***	1.36 %***	2.51 %***	0.66 %**	1.24 %***	−2.12 %***	0.64 %***	1.17 %***
(0,7)	−4.11 %***	−9.45 %***	1.65 %***	2.34 %***	1.20 %***	0.96 %***	−1.17 %***	1.30 %***	1.06 %***
(1,3)	−7.89 %***	−4.38 %***	0.20 %*	1.54 %***	0.63 %***	−0.39 %**	−0.46 %***	−0.53 %***	−0.50 %***
(1,5)	−5.15 %***	−5.75 %***	−0.08 %	0.74 %***	−0.33 %	1.20 %***	−2.31 %***	0.17 %	0.86 %***
(1,7)	−3.29 %***	−7.95 %***	0.21 %	0.57 %***	0.21 %	0.92 %***	−1.36 %***	0.82 %***	0.74 %***

Notes: This table shows the cumulative average abnormal returns (CAARs) of different event windows at the market level, based on the models specified in Equations (1)–(5). The estimation period is from January 1, 2019 to January 31, 2019, during which there is totally 243 trading days. Event1 (2020-01-21), Event2 (2020-03-12), Event3 (2020-04-14), Event4 (2020-10-09), Event5 (2021-01-04), Event6 (2021-05-10), Event7 (2021-12-13), Event8 (2022-12-27), and Event9 (2023-01-09) represent the nine events which are described is Table 1, respectively. Rejection of the null hypothesis means that the cumulative average abnormal return (CAAR) is significantly non-zero. ***, **, and *indicate significance at the 10 %,5 %, and 1 % level, respectively.

the breaking news that China introduced the dynamic zero-COVID strategy to the public after massive vaccination was positive, but it reacted negatively in the long term. The positively higher AAR (0.48 % > 0.19 %) and CAAR (1.30 % > −1.17 %) for the event that China declaring to end the dynamic zero-COVID strategy (Event7) also can support this view.

4.3. Are the reactions different among stocks with different size?

After analyzing stock reactions to different breaking news items at the market level, we further examine whether Chinese stock reactions to different breaking news items on COVID-19 differ among firms of different sizes. Table 5 reports the estimation results for the size level. The different reactions of firms of different sizes to the dates of the nine events can be summarized as follows: First, when the novel human-to human coronavirus was introduced to the public for the first time (Event1), the big-size firms have a strongest negative reaction (−1.19 % < −0.83 %<-0.45 %), while the small-size firms have the strongest negative reaction (−1.89 %<-1.58 % <-0.99 %) when the COVID-19 pandemic was announced by WHO (Event2). Second, when China declared the dynamic zero-COVID strategy after massive vaccination (Event7), the first reaction of the three types of firms is positive. Third, the small-size stocks react more positively than the middle- and big-size firms to the COVID-19 news about vaccine (Event3), vaccination (Event4, Event5, Event6), ending the zero-COVID strategy (Event8) and reopening the borders (Event9).

The CAARs in the window [0,7] for the firms with different size reported in Table 5 reveal that Chinese stocks react negatively to Event1and Event2 but positively to Event3,4,5.6,8 and 9, which is in line with the reactions on the market level. Although the first reaction to the event of Event7 is negative, this reaction goes negative in a long-run period. Besides, except Event1 and Event5, the small-size firms react stronger, compared with the middle- and big-size firms. These conclusions are also supported by the CAARs in most other windows.

In summary, the empirical results reported in Table 5 suggest that the reactions of Chinese stocks differ with different firm sizes. Overall, small firms react the strongest most of the time.

4.4. Are the reactions different among stocks in different sectors?

Table 6 reports daily AARs on event dates and CAARs in the window [0,7] for each sector. The trends of daily AARs for each sector in the event window [−7,7] are depicted in Fig. 2, providing visual evidence for the shifts before and after the events.

Let us first focus on the response type (negative or positive) to different events. Panel A of Table 6 shows that except the fact that the first reactions of the 10 sectors are all negative in the event of Event2, and all positive in the events of Event3 and Event4, the first actions are not consistent in the other cases. Specifically, healthcare is the only sector that has a positively first reaction to Event1 (AARs = 1.31 %), highlighting the advent of the novel human-to human coronavirus positively shocked the stocks in health care sector. Healthcare is also the only one sector that has a negatively first reaction in the event of Event8 (AARs = −0.09 %), suggesting that the information of ending the dynamic zero-COVID strategy negatively shocked the stocks in health care sector but this shock was not statistically significant. On the event date when China declared the dynamic zero-COVID strategy after massive vaccination (Event7), utilities was most positively shocked (AARs = 0.98 %) while real estate was most negatively shocked (AARs = −0.76 %). On the event date when China reopened the borders (Event9), real estate and utilities are the exception in that their first reactions are negative.

Table 5

CAARs at the different size level.

Windows	Size	Event1 (2020-01-21)	Event2 (2020-03-12)	Event3 (2020-04-14)	Event4 (2020-10-09)	Event5 (2021-01-04)	Event6 (2021-05-10)	Event7 (2021-12-13)	Event8 (2022-12-27)	Event9 (2023-01-09)
(−7,−1)	**Big**	−0.65 % ***	−1.19 % ***	−0.07 %	−2.89 % ***	1.64 %***	−1.22 % ***	1.65 %***	−2.67 % ***	0.24 %
	Middle	0.43 %	−0.97 % ***	1.13 %***	−3.37 % ***	0.86 %**	−1.43 % ***	0.49 %*	−3.13 % ***	0.54 %**
	Small	2.63 %***	−1.56 % ***	1.98 %***	−2.08 % ***	1.22 %***	−2.51 % ***	−0.13 %	−3.59 % ***	1.76 %***
(−7,0)	**Big**	−1.84 % ***	−2.19 % ***	0.89 %***	−1.80 % ***	1.90 %***	−1.02 %**	1.81 %***	−2.18 % ***	0.33 %
	Middle	−0.40 %	−2.54 % ***	2.58 %***	−1.32 % ***	2.09 %***	−1.33 % ***	0.73 %**	−2.62 % ***	0.86 %***
	Small	2.19 %***	−3.45 % ***	3.86 %***	0.01 %	2.61 %***	−2.71 % ***	0.03 %	−3.15 % ***	2.31 %***
(0,0)	**Big**	−1.19 % ***	−0.99 % ***	0.96 %***	1.09 %***	0.27 %	0.20 %	0.15 %	0.49 %***	0.09 %
	Middle	−0.83 % ***	−1.58 % ***	1.45 %***	2.05 %***	1.23 %***	0.10 %	0.24 %**	0.50 %***	0.31 %***
	Small	−0.45 %**	−1.89 % ***	1.88 %***	2.09 %***	1.39 %***	−0.20 %	0.15 %	0.44 %***	0.55 %***
(0,7)	**Big**	−6.23 % ***	−8.24 % ***	−0.17 %	1.70 %***	1.59 %***	0.52 %	−0.81 % ***	0.73 %***	0.66 %***
	Middle	−3.51 % ***	−10.08 % ***	1.33 %***	2.48 %***	1.43 %***	0.70 %**	−1.08 % ***	1.04 %***	0.89 %***
	Small	−2.79 % ***	−9.82 % ***	3.88 %***	2.80 %***	0.52 %	1.74 %***	−1.66 % ***	2.20 %***	1.69 %***
(1,7)	**Big**	−5.04 % ***	−7.24 % ***	−1.13 % ***	0.60 %**	1.32 %***	0.32 %	−0.96 % ***	0.24 %	0.57 %***
	Middle	−2.68 % ***	−8.51 % ***	−0.12 %	0.43 %	0.20 %	0.60 %*	−1.32 % ***	0.54 %**	0.57 %***
	Small	−2.35 % ***	−7.93 % ***	2.00 %***	0.72 %*	−0.86 %	1.95 %***	−1.81 % ***	1.76 %***	1.14 %***

Notes: This table shows the cumulative average abnormal returns (CAARs) of different event windows at different size levels. The estimation period is from January 1, 2019 to January 31, 2019, during which there is totally 243 trading days. Event1 (2020-01-21), Event2 (2020-03-12), Event3 (2020-04-14), Event4 (2020-10-09), Event5 (2021-01-04), Event6 (2021-05-10), Event7 (2021-12-13), Event8 (2022-12-27), and Event9 (2023-01-09) represent the nine events which are described is Table 1, respectively. That is, China announcing the novel coronavirus to the public for the first time (Event1), WHO declaring the COVID-19 pandemic (Event2), China first authorizing the COVID-19 CoronaVac vaccine to begin the Phase I–II trials (Event3), China joining the COVID-19 Vaccines Global Access (Event4), China first announcing the Sinopharm BIBP vaccine for freely emergency use (Event5), the Sinopharm BIBP vaccine of China being approved for emergency use by WHO (Event6), China introducing the dynamic zero-COVID strategy to the public after massive vaccination (Event7), China renaming the epidemic and declaring its plan to reopen borders (Event8), China reopening the borders and classifying Covid-19 from a top category A to a category B (Event9). Rejection of the null hypothesis means that the cumulative average abnormal return (CAAR) is significantly non-zero. ***, **, and *indicate significance at the 10 %,5 %, and 1 % level, respectively.

Next, we compared the response intensities to different events. Firstly, except the sectors of financials, real estate, and utilities, the first reactions to Event2 in other seven sectors are correspondingly stronger than the first reactions to Event1. Secondly, we can see that the first reactions to Event4 are positively stronger than the first reactions to Event3 in most sectors, except for consumer staples, financials, and real estate, which is in line with the first reactions on the market level. Thirdly, when comparing the first reactions of Event5 with Event6, the results show that only the first reactions of consumer staples, consumer discretionary, industrials, information technology, and materials are consistent with the first reactions on the market level, namely, a positively stronger first reaction to Event5 compared with Event6. Fourthly, different from other seven sectors, the first reactions of financials, healthcare, and real estate are negative to Event5, namely, announcing the Sinopharm BIBP vaccine for freely emergency use to Chinese citizens on December 31, 2020. However, this reaction was only statistically significant for real estate. Fifthly, by comparing Event7 with Event8, the positive reactions of utilities and information technology are stronger on the event date for starting the dynamic zero-COVID strategy than those for ending it, which is contrary to the overall first reaction on the market level. Seventhly, healthcare is a special case in that its first reactions to Event7 and Event 8, namely starting and ending dynamic zero-COVID strategy, are both negative. The negative reaction of healthcare is stronger on the event date for starting the dynamic zero-COVID strategy than for ending it (−0.10 %<-0.09 %). Eighth, except for utilities, information technology, and healthcare, the positive reactions of the other seven sectors are stronger on the event date for ending the dynamic zero-COVID strategy than that for starting it, which is in line with the comparison results at the market level. Ninthly, except information technology and healthcare, the positive reactions of other eight sectors are stronger on the event date for declaring a plan to reopen the borders (Event8) than that for executing the plan (Event9), which is also in line with the overall response on the market level.

Finally, we compare the response intensities of different sectors to a given event by comparing the CAARs in window [0,7] as

Table 6
Daily AARs on event dates and CAARs in the window [0,7] for each sector.

Windows	Sector	Event1 (2020-01-21)	Event2 (2020-03-12)	Event3 (2020-04-14)	Event4 (2020-10-09)	Event5 (2021-01-04)	Event6 (2021-05-10)	Event7 (2021-12-13)	Event8 (2022-12-27)	Event9 (2023-01-09)
Panel A: Daily AARs on the event date)										
(0,0)	CD	−1.26 %***	−1.49 %***	1.29 %***	1.61 %***	0.42 %	−0.12 %	0.12 %	0.28 %**	0.27 %
	CS	−1.47 %***	−2.16 %***	1.13 %***	0.93 %***	2.70 %***	−1.06 %***	−0.08 %	1.14 %***	0.76 %***
	EN	−0.73 %	−1.65 %***	0.96 %***	1.52 %***	0.68 %*	2.49 %***	0.92 %***	0.97 %***	0.29 %*
	FI	−1.05 %***	−0.48 %***	0.97 %***	0.63 %***	−0.30 %	−0.31 %***	−0.13 %	0.59 %***	0.53 %***
	HC	**1.31 %*****	−2.28 %***	1.53 %***	1.68 %***	−0.37 %	0.39 %	−0.10 %	−0.09 %	0.40 %**
	IN	−1.05 %***	−1.50 %***	1.40 %***	1.88 %***	1.60 %***	−0.31 %	0.25 %	0.50 %***	0.09 %
	IT	−0.63 %***	−1.53 %***	2.58 %***	2.93 %***	1.61 %***	−0.66 %***	0.48 %***	0.25 %**	0.35 %**
	MA	−1.36 %***	−1.46 %***	1.23 %***	2.32 %***	1.73 %***	1.30 %***	0.29 %	0.77 %***	0.55 %***
	RE	−1.91 %***	−1.03 %***	1.42 %***	0.66 %***	−2.13 %***	−1.05 %***	−0.76 %**	0.32 %*	**−0.74 %*****
	UT	−0.88 %***	−0.52 %***	0.22 %**	0.88 %**	0.29 %	0.60 %**	0.98 %**	0.22 %*	**−0.78 %*****
Panel B: Daily CAARs in the window [0,7])										
(0,7)	CD	−5.36 %***	−12.27 %***	1.61 %**	3.27 %***	1.19 %	1.76 %**	−0.68 %	0.94 %***	0.54 %*
	CS	−6.55 %***	−8.24 %***	2.69 %***	2.24 %***	3.52 %***	0.56 %	−1.93 %***	0.78 %	0.67 %
	EN	−6.21 %***	−8.74 %***	−0.10 %	1.37 %**	−0.55 %	−1.89 %**	1.90 %**	−0.88 %**	1.83 %***
	FI	−6.23 %***	−7.72 %***	−0.67 %**	1.23 %***	−1.32 %**	1.42 %***	−1.11 %***	1.04 %***	2.28 %***
	HC	**2.76 %*****	−7.60 %***	3.94 %***	2.02 %***	0.13 %	3.04 %***	−1.52 %**	2.32 %***	2.15 %***
	IN	−5.36 %***	−9.74 %***	1.56 %***	2.72 %***	1.95 %***	0.18 %	−1.52 %***	0.98 %***	0.26 %
	IT	−0.61 %	−11.04 %***	4.00 %***	2.26 %***	2.56 %***	2.23 %***	−0.59 %	2.09 %***	2.24 %***
	MA	−6.06 %***	−10.05 %***	0.17 %	3.38 %***	1.76 %**	−0.74 %	−2.36 %***	0.98 %***	0.84 %***
	RE	−9.63 %***	−10.83 %***	−0.89 %**	−0.23 %	−2.47 %***	0.78 %	0.50 %	1.75 %**	**−2.13 %*****
	UT	−4.58 %***	−3.03 %***	−1.08 %***	0.41 %	−1.48 %***	0.50 %	1.22 %	2.40 %***	**−1.86 %*****

Notes: This table shows AARs on event dates and CAARs in the window [0,7] for each sector. The estimation period is from January 1, 2019 to January 31, 2019, during which there is totally 243 trading days. Event1 (2020-01-21), Event2 (2020-03-12), Event3 (2020-04-14), Event4 (2020-10-09), Event5 (2021-01-04), Event6 (2021-05-10), Event7 (2021-12-13), Event8 (2022-12-27), and Event9 (2023-01-09) represent the nine events which are described is Table 1, respectively. CD, CS, EN, FI, HC, IN, IT, MA, RE, and UT represent the 10 different industries, namely, Consumer Discretionary, Consumer Staples, Energy, Financials, Health Care, Industrials, Information Technology, Materials, Real Estate, and Utilities, respectively. The t-statistics are in parentheses. Rejection of the null hypothesis means that the cumulative average abnormal return (CAAR) is significantly non-zero. ***, **, and *indicate significance at the 10 %,5 %, and 1 % level, respectively.

reported in Panel B of Table 6. The top three sectors that are negatively shocked by Event1 are real estate, consumer staples, and financials. The top three sectors that are negatively shocked by Event2 respectively are consumer discretionary, information technology, and real estate. The top three sectors that are positively shocked by Event3 respectively are information technology, health care and consumer staples. The top three sectors that are positively shocked by the event of Event4 respectively are materials, consumer discretionary, industrials. The top three sectors that are positively shocked by the event of Event5 respectively are consumer staples, information technology, and industrials. The top three sectors that are positively shocked by Event6 and Event7 respectively are health care, information technology, and consumer discretionary. The top three sectors that are negatively shocked by Event7 are materials, consumer staples, and industrials. The top three sectors that are positively shocked by Event8 respectively are utilities, health care and information technology. The top three sectors that are positively shocked by Event9 respectively are financials, information technology, and health care.

In summary, the empirical results shown in Table 6 and Fig. 2 indicate that stock reactions to COVID-19 news differ among different sectors, but most sectors can react consistently (negative or positive reaction) to the same event, which is consistent with the overall market level.
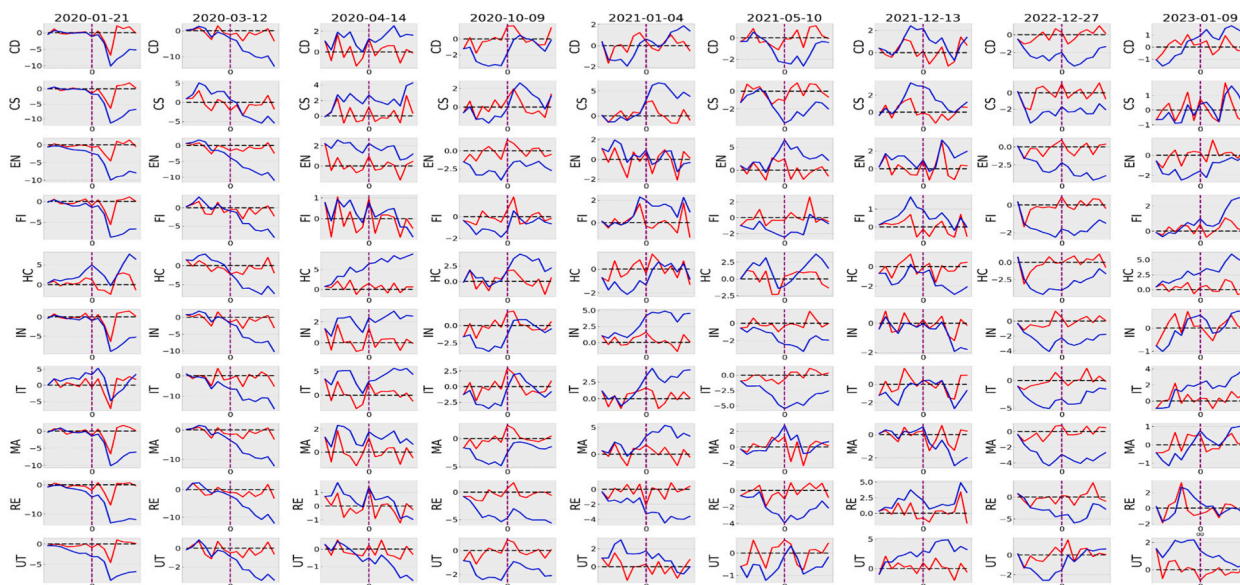
Fig. 2. Plot for daily AARs and CAARs in different sectors
(Notes: This figure depicts the daily average abnormal returns (AARs) and cumulative average abnormal returns (CAARs) in the window [-7,7] at different industries for each event as described in Table 1, namely, Event1 (2020-01-21), Event2 (2020-03-12), Event3 (2020-04-14), Event4 (2020-10-09), Event5 (2021-01-04), Event6 (2021-05-10), Event7 (2021-12-13), Event8 (2022-12-27), and Event9 (2023-01-09). The red lines and the blue lines plot AARs and CAARs in the window [-7,7], respectively. The horizontal black dotted lines mark zero values. Vertical black dotted lines indicate event dates. CD, CS, EN, FI, HC, IN, IT, MA, RE, and UT represent 10 industries: Consumer Discretionary, Consumer Staples, Energy, Financials, Health Care, Industrials, Information Technology, Materials, Real Estate, and Utilities, respectively. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

4.5. Are the reactions different between good and bad news?

As analyzed in the previous subsections, although there are different stock reactions to the nine breaking COVID-19 news reports at the overall market level, size level, and sectors, there are still some commonalities that can be observed. In other words, most firms react negatively to bad news, and positively to good news. Thus, we further taking the nine events together to evaluate the stock reactions, grouping them into negative news (Event1, Event2, and Event7) and positive news (Event4, Event5, Event6, Event8, and Event9). To test our expectations, we calculated the mean values of the CAARs of events in the same classification, as shown in Table 1. The mean CAARs in windows [0,0], [−7, −1], and [1,7] represent the average first reaction to the event dates of a given type of news, the average accumulative excess return seven days before the event dates, and the average accumulative excess return seven days after the event dates, respectively. And we measure the overall shock from a given type of news by subtracting the mean CAARs in the window [−7, −1] from the mean CAARs in the window [1,7].

Table 7 reports the comparing results between negative and positive news. As shown in the left part of this table, no matter looking from the perspective of market, size or sector, the average first reactions to bad news are negative. All the average CAARs in the window [1,7] and the difference before and after events are negative. As shown in the right part of this table, except the sector of real estate, the average first reactions calculated from other perspectives to good news are positive. Besides, except two sectors (real estate and utilities), all other differences as shown in the last column are positive. It highlights that stock market responds positively to positive news while negatively to negative news on COVID-19. Besides, by comparing the average CAARs in the window [1,7] and their differences from the average CAARs in the window [−7,-1], we can find that the negative news on COVID-19 give stronger shocks to stock market than the good news does. These findings make the scattered analysis results in the previous subsections more robust.

Next, we are curious about the sensibility of firms of different sizes, namely, whether firms of a given size that have stronger responses to negative news can also have stronger responses to good news. As shown in Panel B of Table 7, both the average AARs on the event dates and the average CAARs seven days after the announcement of the events provide evidence that small firms react most strongly to both bad and good news about COVID-19, supporting the conclusion observed in Table 5.

Next, we compare the sensibility of firms in different sectors, testing whether a given sector with stronger responses to negative news could also have stronger responses to good news. As shown in Panel C of Table 7, negative news about COVID-19 negatively shocked the consumer staples sector the most, followed by real estate, consumer discretionary, industrial, information technology (IT), financials, energy, healthcare, and utilities. However, positive news on COVID-19 shocked the materials sector the most, followed by information technology, energy, consumer staples, industrials, consumer discretionary, healthcare, financials, utilities, and real estate. Sectors that respond strongly and negatively to bad news do not have to respond strongly or positively to good news.

Table 7
Summary of stock reactions to negative and positive news.

Negative News					Positive News				
	(0,0)	(-7,-1)	(1,7)	Difference		(0,0)	(-7,-1)	(1,7)	Difference
Panel A: Market level)									
Overall	**−0.71 %**	0.07 %	−4.20 %	**−4.27 %**	Overall	**0.84 %**	−0.77 %	0.58 %	**1.35 %**
Panel B: Size level)									
Small	**−0.73 %**	0.31 %	**−4.03 %**	**−4.34 %**	Small	**1.03 %**	−0.54 %	**1.12 %**	**1.66 %**
Middle	**−0.72 %**	−0.02 %	**−4.17 %**	**−4.15 %**	Middle	**0.94 %**	−0.90 %	**0.37 %**	**1.27 %**
Big	**−0.68 %**	−0.06 %	**−4.41 %**	**−4.35 %**	Big	**0.52 %**	−0.83 %	**0.32 %**	**1.15 %**
Panel C: Sector level)									
Real Estate (RE)	**−1.23 %**	−0.22 %	**−5.42 %**	**−5.20 %**	Health Care (HC)	0.59 %	0.18 %	**1.68 %**	**1.50 %**
Materials (MA)	**−0.84 %**	−0.61 %	**−5.32 %**	**−4.71 %**	Information Technology (IT)	1.18 %	−1.26 %	1.39 %	**2.65 %**
Consumer Discretionary (CD)	**−0.88 %**	0.25 %	**−5.23 %**	**−5.48 %**	Consumer Discretionary (CD)	0.63 %	−1.17 %	0.93 %	**2.09 %**
Industrials (IN)	**−0.77 %**	−0.21 %	**−4.78 %**	**−4.58 %**	Consumer Staples (CS)	0.93 %	−0.81 %	0.81 %	**1.62 %**
Financials (FI)	**−0.55 %**	0.11 %	**−4.47 %**	**−4.58 %**	Industrials (IN)	0.86 %	−0.68 %	0.42 %	**1.09 %**
Consumer Staples (CS)	**−1.24 %**	1.87 %	**−4.34 %**	**−6.21 %**	Financials (FI)	0.35 %	−0.65 %	0.31 %	**0.96 %**
Energy (EN)	**−0.49 %**	−1.30 %	**−3.86 %**	**−2.56 %**	Materials (MA)	**1.32 %**	−0.79 %	−0.25 %	**0.54 %**
Information Technology (IT)	**−0.56 %**	−0.42 %	**−3.52 %**	**−3.10 %**	Real Estate (RE)	−0.25 %	−2.10 %	−0.28 %	**1.82 %**
Utilities (UT)	**−0.14 %**	−0.21 %	**−1.99 %**	**−1.78 %**	Utilities (UT)	0.24 %	−0.35 %	−0.43 %	**−0.08 %**
Health Care (HC)	**−0.36 %**	1.11 %	**−1.77 %**	**−2.87 %**	Energy (EN)	1.15 %	−0.60 %	−1.19 %	**−0.59 %**

Notes: This table summarizes the stock reactions to good and bad news about COVID-19 pandemic, which are classified in Table 1. Panel A, B and C report the average CAARs calculated on market level, size level and sector level, respectively. The left part is for negative news while the right part is for good news. The column titled by "Difference" reports the difference between the CAARs in window [1,7] and the CAARs in window [-7,-1].

4.6. Does the reactions reflect the financial performance of different firms?

In this subsection, we concentrate on whether stock reactions to COVID-19 news reflect the financial performance of firms in different sectors. Since we did not find that sectors that are more negatively impacted by bad news are more positively impacted by good news (Panel C of Table 7), we continue to determine the reasons behind this phenomenon, connected with the profitability of these sectors during the COVID-19 pandemic.

Table 8 reports the financial profitability of Chinese firms during from 2019 to 2022, covering 539 A-share listed companies in our study. For each year, the financial profitability is measured on market level and sector level, respectively. The average amount of net profit and the mean value of return on assets (ROA) are used to measure the profitability. We take the year of 2019 as the benchmark to calculate the average change rate of profitability, measuring the impact of the three-year COVID-19 pandemic on the financial performance of Chinese companies, which is reported in the last column of Table 8.

As Table 8 shows, the overall average net profit of Chinese listed companies during the COVID-19 pandemic increased by 13.37 %, whereas the average return on assets decreased by 1.83 %. This highlights the overall negative impact of the COVID-19 pandemic on Chinese firms, despite the positive difference in net profits before and after the pandemic.

Let us further examine the financial performance in different sectors, as shown in Table 8, linking them to their different stock reactions to negative and positive COVID-19 news, as reported in Table 7. According to the financial performance shown in Table 8, we can divide the ten sectors into three types. The first type consists of materials, healthcare, and energy, of which both the average growth rates of net profit and return on assets were positive during COVID-19. These are the top three sectors positively impacted by the COVID-19 pandemic. The second type consists of consumer discretionary, utilities, and real estate, for which the average growth rates of both net profit and return on assets are negative during COVID-19. These can be seen as the top three sectors that were negatively impacted by the COVID-19 pandemic. The third type consists of information technology, industry, consumer staples, and financials, for which the average growth rates of net profit are positive, while those of return on assets are negative during COVID-19 and are moderately impacted by the pandemic.

To some extent, the financial performance of different sectors can interpret their reactions to different types of COVID-19 news (Tables 6 and 7). First, in the top three sectors (materials, healthcare, and energy) that were positively impacted by the COVID-19 pandemic, healthcare reacted most weakly to negative COVID-19 news and most strongly to positive COVID-19 news, which can

Table 8

Financial performance of Chinese companies before and after COVID-19.

	Pre-Covid	Post-Covid			Average Change Rate
	2019	2020	2021	2022	
Panel A: Net Profit (million)					
Market Level					
Overall	6280.80	6396.40	7443.65	7521.94	**13.37 %**
Sector level					
Materials (MA)	1912.06	2181.93	3969.02	2805.80	**56.15 %**
Health Care (HC)	1153.28	1604.76	1889.88	1860.88	**54.79 %**
Information Technology (IT)	1160.37	1350.98	1893.93	1830.68	**45.80 %**
Energy (EN)	14455.20	10372.24	21648.43	29424.54	**41.69 %**
Industrials (IN)	3406.47	3294.32	4782.79	4815.03	**26.15 %**
Consumer Staples (CS)	3312.86	4118.03	2932.08	4364.31	**14.85 %**
Financials (FI)	35580.19	35692.91	39139.50	39685.28	**7.29 %**
Consumer Discretionary (CD)	2405.68	2541.12	2444.71	2058.02	**−2.40 %**
Utilities (UT)	3172.15	4019.64	606.30	2709.04	**−22.92 %**
Real Estate (RE)	11090.46	11767.72	7092.97	1008.12	**−40.28 %**
Panel B: Return On Assets					
Market Level					
Overall	0.0618	0.0625	0.0628	0.0567	**−1.83 %**
Sector level					
Energy (EN)	0.0475	0.0418	0.072	0.0975	**48.28 %**
Materials (MA)	0.0482	0.0486	0.0826	0.0714	**40.11 %**
Health Care (HC)	0.1002	0.1217	0.1115	0.0936	**8.72 %**
Financials (FI)	0.017	0.0181	0.0184	0.0137	**−1.57 %**
Industrials (IN)	0.0526	0.0476	0.0489	0.0446	**−10.58 %**
Information Technology (IT)	0.0737	0.0701	0.0664	0.0588	**−11.67 %**
Consumer Staples (CS)	0.1064	0.1076	0.0724	0.0823	**−17.83 %**
Utilities (UT)	0.0341	0.0361	0.0187	0.0271	**−19.94 %**
Consumer Discretionary (CD)	0.0691	0.0635	0.0554	0.0454	**−20.74 %**
Real Estate (RE)	0.028	0.0263	0.0112	−0.0097	**−66.90 %**

Notes: This table reports financial performance of Chinese companies before and after COVID-19, covering 539 A-share listed companies in our sample. Panel A and B show the average amount of net profit and return on assets (ROA) of these firms on market and sector levels, respectively. The last column reports the average growth rates of the profitability variables, taking the year of 2019 as the benchmark.

be seen from the smallest CAARs in window [1,7] for negative news and the largest CAARs in window [1,7] for positive news reported in Table 7. This also explains why healthcare was the only sector that had a positive first reaction to the COVID-19 outbreak announcement (Table 6). Materials (MA) reacted strongly to both negative and positive COVID-19 news, and the first reaction to positive news was greater. Second, in the top three sectors (consumer discretionary, utilities, and real estate) negatively impacted by the COVID-19 pandemic, real estate reacts most strongly to negative COVID-19 news and most weakly to positive COVID-19 news, as can be seen from the largest CAARs in window [1,7] for negative news and the smallest CAARs in window [1,7] for positive news reported in Table 7. Interestingly, we also find that real estate (RE) reacts negatively to both good and bad news about COVID-19, implying that factors other than COVID-19 may lead to this downward trend.

5. Discussion

Our empirical findings at the market level are as follows. First, the Chinese stock market reacted negatively to bad news and positively to good news about COVID-19, and the intensity of bad news was stronger than that of good news. Some scholars find that good news on the Xiong'an New Area Strategy improves the performance of the Chinese stock market, while negative news impedes it, which is in line with our findings to some extent [45]. This finding is also partially consistent with previous studies that found that stock markets responded negatively to the outbreak of COVID-19 [5,8,12,13,43,46]. Some previous studies have found that most sectors in China will react positively to COVID-19 vaccine approvals in 2021, which is also in line with some of our conclusions. Second, the Chinese stock market reacts differently to various events, which is a novel finding obtained from our study. Specifically, the negative shock from the information that the WHO declared during the COVID-19 pandemic in March 2020 was stronger than that from the information that China announced the novel coronavirus to the public for the first time in January 2020. The positive shock from the information about China joining the COVID-19 Vaccines Global Access in October 2020 was stronger than the information about China authorizing the COVID-19 CoronaVac vaccine to begin Phase I–II trials in April 2020. The positive shock from China announcing the free emergency use of the Sinopharm BIBP vaccine in December 2020 is stronger than the information that the Sinopharm BIBP vaccine of China was approved for emergency use by the WHO in May 2021. The overall first reaction to the announcement of ending the dynamic zero-COVID strategy in December 2022 was more positive than the announcement of starting it after massive vaccination in December 2021. In addition, the Chinese stock market reacted more positively to the declaration of a plan to reopen borders in December 2022 than to the reopening of borders in January 2023. In addition, the first reaction for information to start the dynamic zero-COVID strategy after massive vaccination is positive on the event date, but this reaction becomes negative in the

long run.

Our main findings at different size levels are as follows: Except for two events, namely, the novel human-to-human coronavirus being introduced to the public for the first time (2020-01-21) and China declaring a dynamic zero-COVID strategy after massive vaccination (2021-12-13), small-size stocks react more positively to good news and more negatively to bad news on COVID-19, compared with middle- and big-sized firms. We also divided the nine events into negative and positive news to compare the average reactions of the different firms. Their empirical results show that small stocks react most strongly to both negative and positive news. This finding partially supports the view of a previous study [46] that larger hospitality firms fared better than smaller and weaker firms in the face of COVID-19 shock. One possible reason for this is that small firms have a weaker ability to face sudden exogenous events. Another reason small firms are affected more intensely is that they are generally riskier than large firms, consequently generating an expectation that their stocks will fluctuate more. Previous studies have found that firm size can be seen as a measure of risk, as large firms tend to have larger market values, rising expected returns, and lower riskiness [47–49].

Our main findings for the different sectors are as follows. First, there is heterogeneity in the reactions of different sectors to news about COVID-19; however, the main result that the Chinese stock market reacts negatively to bad news on COVID-19 and positively to good news is valid for most sectors. Second, real estate and consumer staples are the top two sectors exposed to bad news about COVID-19, followed by technology, consumer discretionary, industrials, financials, and materials. Third, technology, healthcare, and consumer discretionary are the top three sectors exposed to good news about COVID-19, followed by industrials, consumer staples, materials, utilities, and financials. Finally, regarding the financial performance of different sectors before and after COVID-19, the empirical results show that stock reactions to COVID-19 news are typically consistent with profitability during the COVID-19 pandemic. Consumer discretionary, utilities, and real estate are the most negatively affected by the pandemic in China, while materials, healthcare, and energy are the most positively affected. These findings are partially in line with a previous study on Tehran Stock Exchange revealing that the "Retail except for Vehicles" and "Real State and Housing" industries had the highest decrease, while the "Telecommunication and Technology" and "Pharmaceutical and Health" industries experienced the most considerable increase [18]. In addition, a previous study found that the information technology sector was the first to experience a reversal in returns after the outbreak of COVID-19 in Australia [43]. Another study found that the real estate and utilities sectors declined the most in the USA when the first local transmission case occurred on February 26, 2020 [46]. Thus, the results of previous studies are partially consistent with our results.

6. Conclusions and suggestions for future research

In this study, we mainly use an event study methodology to examine Chinese stocks' reactions to the breaking news on COVID-19 from to 2020–2023, covering nine events from the first declaration of the novel coronavirus in January 2020 to the reopening of borders and classifying Covid-19 from top category A to category B in January 2023. To compare the reactions to different events, we uniformly take the sample data from January 1, 2019, to December 31, 2019 (before the COVID-19 pandemic) as the estimation window to calculate the abnormal returns (CAARs) of Chinese stocks, while listed firms in the CSI800 stock index are selected as the proxy for the Chinese stock market. Both daily average abnormal returns (AARs) and cumulative average abnormal returns (CAARs) are considered to analyze the effects of the events. In addition, the reactions at the market, size, and sector levels were considered.

Interesting findings were obtained from this study. First, the Chinese stock market reacts differently to various events. Overall, it reacts negatively to bad news and positively to good news on COVID-19, and the intensity of bad news is stronger than that of good news. Second, reactions differ for firms of different sizes. Compared with middle- and large-sized firms, small-sized stocks react more positively to good news and more negatively to bad news about COVID-19. Third, reactions differ in different sectors, and stock reactions to COVID-19 news are typically consistent with the profitability of different sectors during COVID-19. Materials, health care and energy are most positively affected, while consumer discretionary, utilities and real estate are most negatively affected by the COVID-19 pandemic in China.

Our study is the first to systematically investigate the Chinese stock market's reactions to a series of breaking news reports about COVID-19 from the beginning of January 2020 to the end of January 2023. This study contributes to the literature on the relationship between financial markets and the COVID-19 pandemic and has important implications for market participants in understanding the impact of the COVID-19 pandemic on the Chinese stock market by emphasizing the importance of announcements on stock market performance and suggesting that investors should consider such announcements.

For example, small-size firms should pay more attention on news about COVID-19, especially bad ones. It also suggests that stock investors could benefit from the sectors of materials, health care and energy which are most positively affected by the pandemic in China. Besides, we suggest stock investors should be more cautious about investing in real estate of China.

This study has some limitations. First, the event study methodology used has some issues. The empirical results may change when event windows and sample periods are used to estimate the coefficients for calculating benchmark expected stock returns. In the future, we could extend the event windows or our sample (beyond the Chinese CSI800 stock index) to investigate whether the main empirical results still hold. Second, this study only considers China. It would be interesting to conduct similar studies in other countries, estimating their stock reactions to a series of COVID-19 breaking news reports or their different stock reactions to the same events. Third, limited by data availability, we only summarize the average amount of profit and return on assets of Chinese firms in different sectors to analyze the relationship between stock reactions and the financial fundamentals of listed companies, assuming that firms' financial performance can only be affected by COVID-19. However, other factors deserved attention too. For example, in this study, we find that COVID-19 affects energy positively, while real estate is affected negatively, ignoring the shocks from the breakout of the Russia-Ukraine war in 2022 and the Chinese government's crackdown policy on real estate after 2017. Thus, examining why

different firms react differently to COVID-19 news might be informative and meaningful.

Data availability statement

Data associated with the study has not been deposited into a publicly available repository and data will be made available on request.

CRediT authorship contribution statement

Xiaoling Yu: Writing – review & editing, Writing – original draft, Visualization, Software, Methodology, Funding acquisition, Formal analysis, Data curation, Conceptualization. **Kaitian Xiao:** Writing – review & editing, Writing – original draft, Methodology, Data curation, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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