



Research article

Capital market and public health emergencies in Chinese sports industry based on a market model

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Abstract: The public health emergencies have had a significant impact on the world economy, and the sports industry has been no exception. This study employed StataMP-64 software and event study methodologies to examine the reaction of the Chinese sports industry's capital markets to the outbreak of public health emergencies. The event study method, which is becoming increasingly popular in the field of economics and management, is well-suited for evaluating the impact of specific events on stock returns in the capital market. This method has also garnered significant interest in the sports industry. In this study, the expected return is calculated using the classical market model, and the cumulative abnormal return and average cumulative abnormal return were calculated for each sports company during the period of the Wuhan “city closure” event and the inflection point event. The Wilcoxon non-parametric test has been used to examine the significance of the abnormal return. The results indicate that the event study method, applied to a procedural market model, is effective in analyzing the capital market's response to the public health emergencies outbreak in the Chinese sports industry.

Keywords: sports industry; capital market reaction; event study; public health emergencies; stock yield

JEL Codes: G14, C24, D53

1. Introduction

The public health emergencies have a widespread and significant negative impact on the global economy. After the outbreak of COVID-19, there has been a growing interest in research on the impact of pandemics (Wu and Ma, 2021). Since the outbreak of the pandemic, many stock markets around the world have experienced severe declines (Raéf and Assaf, 2020). The stock market is often referred to as the barometer of the economy, reflecting the impact of the epidemic on the economy (Xu and Pu, 2021). Numerous empirical studies have been conducted on the impact of the public health emergencies on the capital market, both domestically and internationally; however, few studies have specifically focused on the impact of the epidemic on the sports industry. The development of the sports industry has a positive impact on society, as shown by research from Jackson and Dawson (2021), who argued that sports can play a key role in understanding, managing and effectively responding to the public health emergencies. Additionally, Spriet (2021) noted that exercise and physical activity can play an important role in maintaining people's health and well-being, particularly during times of stress, such as during an outbreak. Moeijes et al. (2019) also found that participation in sports can have a positive impact on people's mental health. Li et al. (2020a) found that, if individuals spend more on products that match their personality, people report higher levels of happiness. Therefore, the healthy development of the sports industry is conducive to meeting the consumption needs of athletic people and improving their sense of well-being (Li, 2020a; Gao, 2022). The sports industry is a key pillar industry or a key industry for economic growth in many countries, with low resource consumption, high demand elasticity, broad coverage, high value-added product, a long industrial chain and strong driving effects. In 2019, the Chinese State Council released an Outline for the Construction of a Strong Sports Country, proposing that, by 2035, the sports industry would become a pillar industry of the national economy. Currently, the sports industry is a key industry for growth in China. We should not only focus on the total economic amount of the sports industry, but we should also pay attention to protecting the environment and achieving sustainable development. The capital market plays an important role in directly financing the sports industry, making it essential to study the sports industry's concept stocks in the capital market to ensure its stable development and control financial risk. This work involved using the event study method to analyze the impact of the COVID-19 epidemic on the stock prices of sports industry concept stocks listed on the Shanghai and Shenzhen stock exchanges in China. By using the stock returns of these listed stocks, the paper aims to provide theoretical and practical references for the healthy development of the sports industry capital market in the post-epidemic era.

The impact of significant emergencies on capital markets has been a topic of great interest for scholars both domestically and internationally. The COVID-19 pandemic has brought a significant negative impact on global economic development, and, based on the financial cycle, has entered a period of long-term and dramatic volatility (Li et al., 2020c), making it crucial to study the impact of the pandemic on the capital market. Studies have shown that the Shanghai and Shenzhen capital markets have been greatly affected by the short-term impact of COVID-19, with a clear heterogeneity among industries (Zhang et al., 2020). The COVID-19 outbreak casts a shadow over the world economy. Many uncertainties brought about by this cast a shadow over the stock market, which led to a sharp decline in investor sentiment (Li et al., 2022a). Research has also shown that investor sentiment has played a crucial role in transmitting the impact of the pandemic on the capital

market (Cheng and Liu, 2021; Li et al., 2021; Gao et al., 2022). Foreign studies have also reported that the COVID-19 outbreak has significantly impacted global stock markets. A 64-country study conducted by Ashraf (2020) showed strong negative market reactions in the early days of confirmed cases and 40 to 60 days after the initial confirmed cases. Matos et al. (2021) showed that the COVID-19 epidemic has passed between various sectors of the USA economy. Pandey and Kumari (2021) conducted a study of 49 developed and emerging markets around the world and found that the outbreak had a hard impact on global stock markets. However, early embargoes and restrictions implemented by countries had a positive impact on containing the spread of the epidemic, thereby rebuilding investor confidence and leading to sharp stock market recoveries. While most of the above studies have focused on the impact of the COVID-19 epidemic on capital markets, very few have looked at the capital markets of the sports industry. In this paper, we aim to fill this gap by conducting a comprehensive study on the response of the sports industry capital market to the COVID-19 epidemic.

Capital markets have always been the focus of scholars' research. Capital markets are related to the efficiency of resource allocation and the stability of the financial market. It plays an important strategic role in promoting high-quality economic development and building a new pattern of development. The capital market is transforming into the inter-trading of domestic capital markets and inter-trading of countries (Vega, 2022). The significance of the capital market in the development of the sports industry cannot be overstated. Research on the impact of the COVID-19 epidemic on the capital market mainly involved employing the event study method and showed significant heterogeneity among industries. The global spread of the epidemic has shifted the development of China's sports industry into a new pattern of domestic and international double cycles. To achieve the goal of making the sports industry a pillar of the national economy and a strong sports nation, support from the capital market is imperative. As a platform for optimizing resource allocation, the capital market holds a critical position in the operation of the financial system and is crucial for promoting the formation of industrial capital, scientific and technological innovation and the real economy. Capital markets play a critical role in managing wealth and preserving residents' wealth, expanding residents' consumption and upgrading consumption. Capital markets are essential in building a strong sports country and developing a new pattern for the sports industry. They provide more funds for enterprise development, support government management capacity and offer a range of services that allow savers and investors to diversify their portfolios and reduce investment risk (Algaeed, 2021). Capital markets also play an important role in promoting the development of the sports industry by creating credit. Sports capital markets support the high-quality development of the sports industry by utilizing the inherent functions of capital markets. The development of the sports industry cannot occur without support from the capital market (Zhu et al., 2021). Considering the current state of domestic and international research on the impact of the epidemic on both the capital market and the sports industry, this paper proposes three research hypotheses to empirically study the response of the sports industry capital market to the COVID-19 epidemic. The aim of this study is to provide practical guidance for the healthy development of the sports industry capital market.

Our study has made significant contributions in several ways. First, we have applied event study methodology to the Chinese sports industry capital market in the context of the COVID-19 epidemic, providing innovative insights into this area. Second, our analysis of the impact of the COVID-19

outbreak on the stock prices of sports industry concept stocks in China's Shanghai and Shenzhen markets has revealed that the sports industry capital markets were severely affected by the pandemic. Finally, we offer practical suggestions for various stakeholders, including investors, the government, capital markets, sports enterprises and other interested parties, on how to promote the development of the sports industry in the post-epidemic era, based on our findings and insights. Overall, our study highlights the significant impact of the COVID-19 pandemic on the sports industry and its capital markets in China, and it emphasizes the need for proactive and coordinated efforts from various stakeholders to foster its recovery and future growth.

To provide a clear overview of the structure and contents of this paper, we include a brief outline of the following sections in this introduction. Section 2 offers a concise overview of relevant literature and studies. In Section 3, we describe the research methods employed in this study, while Section 4 presents our research findings. The subsequent section, Section 5, presents our discussions and analysis of the implications of our results. Finally, Section 6 provides a comprehensive conclusion of our main findings and their significance.

2. Related studies

2.1. The impact of the COVID-19 epidemic on the sports industry

The COVID-19 epidemic has caused significant harm to the global capital market, with varying impacts across different industries. Scholars have conducted several studies to analyze the impact of the epidemic on the sports industry. It has been found that the sports tourism, sports events, sports consumption and sports training industries have all been severely impacted by COVID-19. Cooper and Alderman (2020) found that the outbreak of COVID-19 brought restrictions on the movement of people, causing significant losses to sports tourism. Zhang (2021) argued that the perception that sports can enhance immunity will result in a transformation of the sports tourism industry, leading to a new consumer upgrading dynamic. Vitali et al. (2020) found that protective measures such as lockdowns, quarantines and social restrictions imposed during the COVID-19 epidemic created new difficulties and challenges for athletes participating in competitive team sports. Eime et al. (2022) noted that the number of participants in team sports saw the largest decline among all sports during the epidemic, with a higher decline in male participants compared to female. Mann et al. (2020) concluded that the cancellation or postponement of major sporting events due to the epidemic, including the Olympic Games, had a profound impact on the development of sports. Mastromartino et al. (2020) noted that the spread of the epidemic resulted in the closure of many sports venues, limiting the activities of sports organizations and reducing sports consumption. Bratland-Sanda et al. (2021) found that many sports training centers, such as gyms and sports clubs, were permanently closed due to reduced revenue, resulting in bankruptcy for sports-related industries and unemployment for many sports employees. Costello et al. (2021) argued that the epidemic seriously impacted people's physical and mental health, highlighting the importance of increased physical activity and an active lifestyle. Adams and Periard (2020) noted that the epidemic caused secondary school athletes to take prolonged leave, which had a significant impact on their future development. Cho et al. (2021) argued that, during the COVID-19 pandemic, sports consumers were deprived of many of their usual fitness activities due to social distancing measures. Overall, the studies of

various scholars have shown that the sports industry was significantly impacted by the COVID-19 epidemic. Liu (2020) found that the epidemic caused resistance to fundraising and project investment and increased the post-investment management pressure for venture capital institutions. Given the important role of the sports industry in economic development, it is crucial to strengthen the focus on the industry, analyze the factors influencing the development of the sports industry in the wake of the COVID-19 epidemic and actively mobilize all relevant factors to promote the industry's development.

2.2. Suggestions for sports industry development in the context of the epidemic

Event study is a statistical method that was first applied by James Dolley in 1933 to study the effect of stock splits on a company's stock price. In the late 1960s, scholars such as Ball and Brown (1968) and Fama et al. further refined the event study method and then studied the information content of surplus content and stock dividend effects. In the past 30 years, with the deep development of the world capital market, the method has been widely used in the study of financial capital securities markets. Even in the emerging Bitcoin market, the event study method is used to study the impact of related events on Bitcoin revenue (Li, 2021b). Previous studies have offered valuable insights for the enhancement of the sports industry through several means, such as enhancing government policy support, fostering a positive sports environment, optimizing network resources, seeking support from various societal forces, promoting a sense of independent innovation and actively collaborating with other industries. Ren and Huang (2021) proposed that the sports industry should receive support in the form of tax and financial incentives for sports enterprises. Lavallee et al. (2022) emphasized the importance of creating a supportive atmosphere for sports during the COVID-19 pandemic, promoting communication among individuals and inspiring them to actively participate in sports activities. Wang et al. (2021) stressed the significance of strengthening the use of online resources and promoting the integration of online and offline aspects of the sports industry, particularly in supporting emerging industries such as e-sports. Cui and Zhang (2020) suggested that, during the challenging circumstances of the pandemic, the survival of the sports industry can be ensured through a combination of self-help measures by sports enterprises, support from sports professionals and assistance from relevant government departments. Ratten (2020) argued that sports organizations should embrace innovation, leverage the latest technology, proactively adapt to changes and develop strategies that keep pace with current developments in order to overcome the impact of the pandemic. Murray et al. (2022) emphasized the importance of increased cooperation among sports organizations, the World Health Organization (WHO), governments and public health departments in order to assess risks and implement effective risk reduction measures for a safe return to sports. O'Grady and Jordan (2021) found that it is feasible to adhere to government policies and actively implement various measures to enhance the safety of sports activities. Although many studies have explored different aspects of the sports industry during the COVID-19 pandemic, there is a scarcity of research focusing on the capital market aspect. This paper aims to fill this gap by conducting empirical research on the response of the capital market of the sports industry to the pandemic, providing new insights and suggestions for the development of the sports industry and ultimately contributing to its growth and the recovery of the global economy.

3. Methods

3.1. Market model

The event study method is a widely used approach in financial analysis, which involves selecting a specific event for study and analyzing the change in stock returns before and after the event to explain the impact of the event on the price change and return of the sample stocks. The method is primarily used to examine the price change before and after the event or the degree of price reaction to disclosed information. The event study methodology is commonly utilized to evaluate the impact of specific economic events on the market capitalization of publicly traded companies and the volatility of the stock market (Ding et al., 2018). The event study methodology evaluates the impact of a given event on a target variable. The methodology involves defining the moment of an unexpected event as the central point, designating a time window in which the target variable is influenced by the event, known as the event window, and, finally, determining the changes of the target variable before and after the event, along with its significance degree (Aithal et al., 2021). In order to effectively apply the event study methodology, the event must not be predictable, and there must be no interference from other events during the event's occurrence. The outbreak of the COVID-19 pandemic is certainly an unpredictable event, which could not have been foreseen by market investors, satisfying the fundamental requirements for this study. With these considerations in mind, the event study methodology was selected to quantify the Chinese sports industry capital market's reaction to the COVID-19 outbreak. The study is grounded in the following three fundamental assumptions. First, in accordance with the efficient market hypothesis, the Shanghai and Shenzhen financial markets can be considered efficient, and all publicly available information is reflected in stock prices. Second, the COVID-19 outbreak event analyzed in this paper was unforeseen by the market, and the use of abnormal returns allows us to gauge the extent to which stock prices of sports industry concept stocks react abnormally to the occurrence or disclosure of the event. Finally, there is no confounding effect from other events during the event window.

In this study, we aimed to quantify the impact of the COVID-19 outbreak on the stock prices of sports industry concept stocks. To achieve this goal, we followed the following steps:

(1) Estimation of expected return. The first step is to estimate the expected return, which represents the expected stock return of sports industry concept stocks if the COVID-19 outbreak had not occurred.

(2) Calculation of abnormal return. The second step is to calculate the abnormal return, which reflects the impact of the COVID-19 event on the return of sports industry concept stocks. This is achieved by subtracting the expected return from the actual return of each stock.

(3) Calculation of cumulative average abnormal return. In the third step, we will calculate the cumulative average abnormal return by summing up the abnormal returns of each and each group of stocks during the event window.

(4) Significance testing. Finally, we will test the significance of the cumulative average abnormal returns obtained in the previous step. This will help us determine whether the impact of the COVID-19 outbreak on the stock prices of sports industry concept stocks is statistically significant.

The sudden outbreak of COVID-19 resulted in a shift in the value of sports industry concept stocks in the Shanghai and Shenzhen financial markets. In order to study this impact, this study

adopted the classical market model to estimate the expected return of these stocks. The abnormal return is then calculated by subtracting the estimated expected return from the actual return of the sports industry concept stocks. The market model has theoretical implications for the sports industry because it examines the relationship between the stock returns of sports companies and market portfolio returns. This model assumes a linear relationship between expected returns on sports industry company stocks and market returns during the event window of the COVID-19 pandemic. To apply this model, the Ordinary Least Squares (OLS) regressions were performed for each sports industry company stock separately.

The market model is defined as

$$R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it} \quad (1)$$

The expected return can be expressed as

$$ER_{it} = \alpha_i + \beta_i R_{mt} \quad (2)$$

The abnormal return can be expressed as

$$AR_{it} = R_{it} - ER_{it} \quad (3)$$

where R_{it} denotes the stock's real return, which is the return of stock i on day t . ER_{it} is the expected return, determined by excess return; the marketability risk is β_i , and the market return is R_{mt} . AR_{it} is the abnormal return of stock i on day t .

Next, we can calculate the average abnormal return and sum up the abnormal returns. In order to study the impact of the COVID-19 epidemic on the pricing of sports industry concept stocks, it is necessary to calculate the average abnormal return AAR_{it} and the cumulative abnormal return CAR_{it} . Usually, the average abnormal return is averaged over all sports industry concept stock companies for a point in time, and the formula is expressed as follows.

$$AAR_{it} = \frac{1}{N} \sum_i^N AR_{it} \quad (4)$$

According to the above formula, t is a time in the event window and N is the number of companies. The cumulative abnormal return is calculated as the sum of the abnormal returns of firm i during a certain period from t_1 to t_2 , and it is calculated as shown below.

$$CAR_i(t_1, t_2) = \sum_{t=t_1}^{t_2} AR_{it} \quad (5)$$

On this basis, the cumulative average abnormal return is calculated at a specific time point t . The cumulative average abnormal return for all sports industry concept stock companies is calculated in the following way.

$$CAAR_i(t_1, t_2) = \sum_{t=t_1}^{t_2} AAR_{it} \quad (6)$$

where t_1 and t_2 are the left and right ends of the event window, respectively, that have been defined before.

The final step is to assess the significance of the cumulative average abnormal return. This involves evaluating whether the COVID-19 outbreak has a statistically significant impact on the

stock prices of the sports industry concept stocks. The cumulative average abnormal return of each stock is compared to determine if it is statistically different from zero, indicating the presence of a significant effect of the outbreak on stock prices.

3.2. Source and processing of data

This study aims to examine the impact of the COVID-19 outbreak on the capital market of the sports industry by using a sample of companies listed on the Shanghai and Shenzhen stock exchanges in China as the sports industry concept stocks. The daily stock trading data were sourced from the RESSET Financial Research Database (www.resset.com), while the COVID-19 epidemic data were obtained from the official website of the National Health Commission. The study employed a market capitalization-weighted approach to analyze the daily stock returns of the studied companies and the average daily market returns of the stock market in which they are located.

According to the event study methodology, three dates were selected as event dates: January 23, 2020, when the city of Wuhan announced its closure, February 20, 2020, when the inflection point of confirmed diagnoses was reached, and April 8, 2020, when Wuhan was unsealed. The date of April 8, 2020 was selected as the event date, with the closure and unsealing of Wuhan serving as illustrative event dates for the government's measures to prevent and control the COVID-19 epidemic, and the inflection point of confirmed cases served as an event for the mitigation of the epidemic.

In this study, the event window period was established in accordance with the methods applied by some scholars (Pandey and Kumari, 2021; Zhang et al., 2020). The event window period spans from 12 days prior to the event and extends for 12 days post-event, which is used to evaluate the impact of the event on the stock prices involved. Additionally, an estimation window period of 120 trading days, ranging from 132 trading days prior to the event to 13 trading days prior, was used to determine the expected return through the market model. By examining the cumulative abnormal return and cumulative average abnormal return of different event window periods and evaluating their significance, this study aimed to determine the impact of the COVID-19 epidemic on the value of various sports industry concept stocks, thus reflecting the effect of the COVID-19 outbreak on the capital market of the sports industry.

3.3. Data processing

In this paper, we make use of StataMP 16 software for data processing and Stata external order restudy, a procedure for event study estimation contributed by three authors from LIUC Università Carlo Cattaneo, to examine the impact of the COVID-19 epidemic on the stock prices of sports industry companies listed on the Shanghai and Shenzhen stock exchanges in China. The expected returns were estimated through the application of a market model, and the cumulative abnormal returns and cumulative average abnormal returns were calculated for each sports company during the window of the "city closure" event in Wuhan. The significance of the abnormal returns was tested by means of a non-parametric test, the Wilcoxon test, for the events of the confirmed inflection point and the unsealing of Wuhan.

This study utilized the StataMP 16 software for data processing and employed the Stata external order study, a procedure for event study estimation developed by three authors from LIUC Università

Carlo Cattaneo, to examine the impact of the COVID-19 outbreak on the stock prices of sports industry companies listed on the Shanghai and Shenzhen stock exchanges. In order to accurately reflect the impact of the epidemic on sports industry concept stocks, the study employed the respective market indices of Shanghai and Shenzhen. The sample companies were divided into two parts, depending on the stock exchange where they are listed. Within each part, the sample companies were further divided into two groups based on their main engagement in the sports industry. The first group comprises stocks with a focus on the sports industry, totaling nine stocks, while the second group comprises stocks with non-main focus on the sports industry, totaling 21 stocks. The selected companies are recognized as sports industry concept stock companies by financial media such as Sina Finance and Finance, and they were normally traded in the stock market during the study period. Through a detailed review of listed companies on the Shanghai and Shenzhen stock exchanges, the selected sample companies were found to be deeply related to the sports industry and have significant influence in the field. As a result, the selected samples can effectively represent the sports industry sector in the Shanghai and Shenzhen stock exchanges. The statistics of the Shanghai and Shenzhen sports industry concept stock research samples can be seen in Table 1.

Table 1. Statistics of Shanghai and Shenzhen sports industry concept stock research samples.

Stock Market	Stock Type	Quantity	Names of sports industry concept stocks
Shanghai Stock Exchange	Major operating sports industry concept stocks	2	China Sports Industry, Comefly Outdoor
	Non-major operating sports industry concept stocks	7	Shanghai International Port, Zhejiang Dongwang Times Technology, Wuhan Ddmc Culture & Sports, Jiangsu Sainty, Hangzhou Jiebai, Jilin Yatai, Shandong Linglong Tyre
Shenzhen Stock Exchange	Major operating sports industry concept stocks	7	Lander Sports Development, Tread Holdings, Impulse (Qingdao) Health Tech, China Dive Company Limited, Beijing Sanfo Outdoor Products, Lisheng Sports (Shanghai), Jiangsu Jinling Sports Equipment
	Non-major operating sports industry concept stocks	14	Caissa Tosun Development, Focus Media Information Technology, HL Corp (Shenzhen), Citic Guoan Information Industry, Suning.Com, Suzhou Gold Mantis Construction Decoration, Guangdong Guangzhou Daily Media, Xiamen Anne Corporation Limited, Guangdong Advertising Group, Shenzhen Aoto Electronics, Rastar Group, Ledman Optoelectronic, Fujian Snowman, Shanghai Yaoji Technology

4. Empirical results and analysis

4.1. Analysis of the impact of sports industry concept stocks on the announcement of “city closure” in Wuhan

Tables 2 and 3 illustrate the average abnormal returns of sports industry concept stocks in Shanghai and Shenzhen during the 43-day window of the Wuhan city closure event. The results of the study demonstrate that both the Shanghai and Shenzhen markets had nine negative average abnormal returns in the 12 days prior to the city closure, and 18 negative average abnormal returns in

the 30 days following the event. On the day of the city closure event, both Shanghai and Shenzhen sports industry concept stocks showed significant negative impacts, as indicated by significant p-values at the 1% significance level. However, their market reactions differ, with Shanghai exhibiting a positive average abnormal return and Shenzhen exhibiting a negative average abnormal return. During the city sealing event window, the average abnormal returns in the Shanghai market showed negative significance seven times before the event and 17 times after the event, while the average abnormal returns in the Shenzhen market showed negative significance nine times before the event and 18 times after the event. The significant negative impact of the COVID-19 outbreak event on the average abnormal returns of sports industry concept stocks in both the Shanghai and Shenzhen markets highlights the serious effect of the event on the sports industry.

Table 2. Average abnormal returns (AAR) and p-values of Shenzhen-Shanghai sports industry concept stocks before lockdown event. (***) p-value < 0.01, (**) p-value < 0.05, (*) p-value < 0.1).

t	Shenzhen Stock Exchange		Shanghai Stock Exchange	
	AAR	p-value	AAR	p-value
t ₁₂	0.2424%***	0	1.5274%***	0
t ₁₁	-0.7823%***	0	-0.5945%***	0
t ₁₀	-0.2679%***	0	-0.3056%***	0
t ₉	0.4331%***	0	0.4109%***	0
t ₈	-0.2853%***	0	-0.00857	-0.8595
t ₇	0.4468%***	0	-0.3357%***	0
t ₆	-0.9695%***	0	-0.2550%***	0
t ₅	-0.3191%***	0	-0.6031%***	0
t ₄	-0.7976%***	0	0.7071%***	0
t ₃	-0.3580%***	0	-1.4041%***	0
t ₂	-1.3081%***	0	-0.1151%***	0
t ₁	-0.9920%***	0	-0.015916	-0.3142
T	-0.0218%***	0	0.5810%***	0

In order to better understand the impact of the Wuhan city closure event on sports industry concept stocks in the capital market, we plotted the trend graph of average abnormal returns for a total of 43 days, spanning 12 days before and 30 days after the event (as shown in Figure 1). The trend line indicates that, on the day after the announcement of the city closure, sports industry concept stocks in both the Shanghai and Shenzhen markets experienced a sharp decline, but then there was a general upward trend observed. This significant downward market reaction supports the evidence that the COVID-19 outbreak had a profound negative impact on sports industry concept stocks in the short term. However, as time progressed, the market appeared to be moving in a positive direction.

Table 3. AAR and p-values of Shenzhen-Shanghai sports industry concept stocks after lockdown event. (***) p-value < 0.01, (**) p-value < 0.05, (*) p-value < 0.1).

t	Shenzhen Stock Exchange		Shanghai Stock Exchange	
	AAR	p-value	AAR	p-value
T	-0.0218%***	0	0.5810%***	0
t+1	-0.0556%***	0	-1.6746%***	0
t+2	-4.1522%***	0	-2.7565%***	0
t+3	0.0227%***	0	0.0296%***	0
t+4	-0.6078%***	0	-0.4126%***	0
t+5	2.0112%***	0	1.4797%***	0
t+6	0.2239%***	0	-0.1309%***	0
t+7	-0.5683%***	0	-0.3336%***	0
t+8	-0.4858%***	0	-0.3432%***	0
t+9	-0.5657%***	0	-1.0899%***	-0.0077
t+10	-0.5297%***	0	0.1120%***	0
t+11	-0.7112%***	0	0.2846%***	0
t+12	0.8157%***	0	0.5617%***	0
t+13	-0.5308%***	0	0.1398%***	0
t+14	0.4636%***	0	-0.2525%***	0
t+15	-0.5558%***	0	-0.9181%***	0
t+16	-1.2654%***	0	-0.020939	-0.1098
t+17	-1.9892%***	0	-2.5104%***	-0.0077
t+18	1.7878%***	0	3.0197%***	0
t+19	0.1572%***	0	-0.5282%***	0
t+20	-0.5709%***	0	0.0596%***	0
t+21	-0.8504%***	0	0.1898%***	0
t+22	-0.0351%***	0	-0.5424%***	0
t+23	0.6704%***	0	0.9132%***	0
t+24	-0.7104%***	-0.0007	-0.2089%***	0
t+25	0.4076%***	0	-0.2514%***	0
t+26	0.7143%***	0	1.7853%***	0
t+27	-0.5918%***	0	-1.1661%***	0
t+28	1.8345%***	0	0.8822%***	0
t+29	0.8307%***	0	-0.1626%***	0
t+30	-0.4535%***	0	-0.2205%***	0

Figures 1 and Figure 2, in comparison with the trend chart of the study by Pandey and Kumari (2021), demonstrate that COVID-19 had a substantial impact on the global capital market. However, the Chinese sports industry sector in Shanghai and Shenzhen appeared to be bucking the trend. The average abnormal return showed a general upward trend as the epidemic developed, which suggests that the city closure restrictions in China initially had a negative effect on the capital market in the short term. Nevertheless, as the COVID-19 situation became more controlled, investor confidence in the capital market sports industry sector increased, and the capital market sports industry stocks showed a positive reaction to the epidemic.

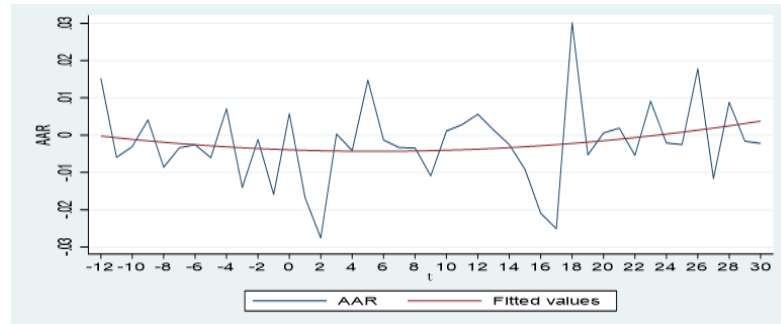


Figure 1. AAR trend chart of Shanghai sports industry concept stocks during the event window period (t-12 to t30).



Figure 2. AAR trend chart of Shenzhen sports industry concept stocks during the event window period (t-12 to t30).

To gain further insight, this study also investigated the cumulative average abnormal returns in the vicinity of the event day over a short time period. Table 4 presents the results of employing the market model to estimate the expected returns and the cumulative average abnormal returns of sports industry concept stock companies in Shanghai and Shenzhen, using a six-window approach around the Wuhan “lockdown” event; it also assesses their significance.

In the sports industry concept stock companies listed on the Shanghai Exchange, the cumulative average abnormal returns of the primary sports industry stocks during the event window period were all negative. The cumulative average abnormal returns were significant at a 1% level of significance in the event window periods of $(-1, +5)$ and $(-1, +6)$. Over the six windows of the study, the cumulative average abnormal returns of non-primary sports industry concept stocks in Shanghai were significant at a 1% level of significance. In particular, the event window periods of $(-1, +2)$, $(-1, +3)$, $(-1, +4)$ and $(-1, +5)$ showed negative significance. These results indicate that the Wuhan city closure event had a significant and negative impact on all Shanghai sports industry concept stocks, but that the non-primary sports industry group exhibited an earlier market reaction than the primary sports industry group.

Table 4 reveals that the cumulative average abnormal returns of both groups of sports industry concept stock companies listed on the Shenzhen Stock Exchange were negative. The cumulative average abnormal returns of companies in both groups were significant at a 1% level of significance during the event windows $(-1, +1)$, $(-1, +2)$, $(-1, +5)$ and $(-1, +6)$. These results indicate that the

Wuhan city closure event had a significant negative impact on the sports industry concept stock companies in Shenzhen. The primary sports industry concept stock group in Shenzhen showed a negative and significant impact from the city closure event in all six window periods, while the non-primary sports industry concept stock group showed a negative and significant impact from the city closure event in five window periods.

Table 4. Significance test (non-parametric test) of “lockdown event” of sports industry concept stocks in Shanghai and Shenzhen stock exchanges. CAAR: cumulative average abnormal return (***) p-value < 0.01 ** p-value < 0.05, * p-value < 0.1).

SECURITY	CAAR[-1,1]	CAAR[-1,2]	CAAR[-1,3]	CAAR[-1,4]	CAAR[-1,5]	CAAR[-1,6]
Shanghai main sports industry concept stocks	-5.0122% (-0.1797)	-10.3600% (-0.1797)	-9.0554% (-0.1797)	-7.8079% (-0.1797)	-2.5843%*** (0.0000)	-2.3189%*** (0.0000)
Shanghai non-core sports industry concept stocks	0.4379%*** (0.0000)	-1.6810%*** (0.0000)	-0.9504%*** (0.0000)	-0.9655%*** (0.0000)	-0.3445%*** (0.0000)	0.0315%*** (0.0000)
Shenzhen main sports industry concept stocks	-2.0898%*** (0.0000)	-5.4582%*** (0.0000)	-4.9454%*** (0.0000)	-4.7063%*** (0.0000)	-2.2642%*** (0.0000)	-1.3089%*** (0.0000)
Shenzhen non-core sports industry concept stocks	-0.4742%*** (0.0000)	-5.0836%*** (-0.0004)	-5.3467%** (-0.0339)	-6.4485% (-0.8152)	-4.6886%*** (0.0000)	-4.8914%*** (-0.0022)

Based on the findings, it appears that the “city closure” event in Wuhan has had a considerable impact on the cumulative average abnormal returns of concept stocks in the sports industry in both Shanghai and Shenzhen stock exchanges. This shows that the capital market promptly received information about the intensification of the epidemic prevention and control measures and reacted accordingly. Furthermore, the analysis suggests that the Wuhan city closure event had a noticeable negative effect on the share prices of concept stocks in the sports industry in both Shanghai and Shenzhen in the short term. However, the negative impact of the city closure event was more rapid in the Shenzhen Stock Exchange compared to the Shanghai Stock Exchange.

4.2. Analysis of the capital market impact of the “inflection point of existing diagnoses” event

The event of the “inflection point of confirmed cases” is seen as a sign of easing of the epidemic and the emergence of a turning point. As shown in Table 5, from the second to the fourth day after the inflection point event, the cumulative average abnormal returns were all less than zero and significant at the 1% level of significance. However, currently, the mean value of cumulative average abnormal returns for sports industry concept stocks in Shanghai and Shenzhen is higher than the mean value of the cumulative average abnormal returns for the Wuhan lockdown event. This suggests that the epidemic situation had improved. In the short term, the negative effect of the epidemic on sports industry concept stocks has been mitigated, but it is still significant and the overall investor reaction to the sports industry capital market was still negatively and significantly

affected. This differs from the findings of Zhang et al. (2020), who found that the cumulative average excess returns for the capital market in the 12 days following the confirmed inflection point event were all greater than zero and showed a continuous trend of higher returns, indicating a significantly positive market reaction to the improvement of the epidemic. By comparing these results, we can conclude that, after the “inflection point of confirmed cases” event, the overall negative impact on Shanghai and Shenzhen sports industry concept stocks was alleviated, but the negative impact of the epidemic on the sports industry in the capital market was still significantly greater than the average level of the entire capital market.

Table 5. Significance test (non-parametric test) of CAAR for “inflection point of existing confirmed number” events in Shenzhen Stock Exchange.

SECURITY	CAAR[-1,1]	CAAR[-1,2]	CAAR[-1,3]	CAAR[-1,4]	CAAR[-1,5]	CAAR[-1,6]
Shenzhen main sports industry concept stocks	0.0397%*** (0.0000)	-0.8309%*** (0.0000)	-1.8456%*** (0.0000)	-0.2864%*** (0.0000)	1.2499%*** (0.0000)	0.7519%*** (0.0000)
Shenzhen non-core sports industry concept stocks	-0.7992%*** (0.0000)	-2.2235%*** (0.0000)	-4.7121%*** (0.0000)	-2.7315%*** (0.0000)	-3.3107%*** (0.0000)	-3.8715%*** (0.0000)
Shanghai main sports industry concept stocks	-2.0911% (-0.1797)	-1.9853%*** (0.0000)	-3.3945%*** (0.0000)	-3.5048%*** (0.0000)	-2.6091%*** (0.0000)	-3.9915%*** (0.0000)
Shanghai non-core sports industry concept stocks	-0.4668%*** (0.0000)	-0.8922%*** (0.0000)	-2.1065%*** (0.0000)	-0.5876%*** (0.0000)	-1.5411%*** (0.0000)	-1.5683%*** (0.0000)

4.3. Analysis of capital market impact of Wuhan’s announcement of “unsealing” event

On April 8, 2020, the Wuhan “unsealing” event marked a key step in the containment of the COVID-19 outbreak in China. As shown in Table 6, in the period surrounding the Wuhan unsealing event (-1, +1), the cumulative average abnormal return of sports industry concept stocks in Shanghai and Shenzhen had a significant positive impact at the 1% significance level. However, the cumulative average abnormal return of the Shanghai stock market was only positive in the (-1, +1) period, while the cumulative average abnormal return of sports industry concept stocks in the Shenzhen stock market was positive and significant at the 1% significance level in all six windows surrounding the Wuhan unsealing event. These results suggest that investors in the Shanghai stock market did not react positively to sports industry concept stocks after the epidemic was contained. On the other hand, the impact of the sports industry in the Shenzhen stock market was alleviating, and investors in the Shenzhen stock market had a significantly positive reaction to sports industry concept stocks after the epidemic was contained.

5. Discussion

5.1. Influence of investor sentiment

Table 6. Significance test (non-parametric test) of CAAR for Wuhan’s announcement of “unsealing” event. During the unsealing window in Wuhan, there were abnormal extreme values of the mid-term latent share CAAR. In order to reduce the estimation error, it was not included in the analysis of this table. (***) p-value < 0.01, (**) p-value < 0.05, (*) p-value < 0.1).

SECURITY	CAAR[-1,1]	CAAR[-1,2]	CAAR[-1,3]	CAAR[-1,4]	CAAR[-1,5]	CAAR[-1,6]
Shanghai main sports industry concept stocks	0.5514%*** (0.0000)	-1.1744% (-0.1797)	-2.2049% (-0.1797)	-2.4466% (-0.1797)	-1.4479%*** (0.0000)	-1.3947% (-0.1797)
Shanghai non-core sports industry concept stocks	0.4460%*** (0.0000)	-0.3686%*** (0.0000)	-0.4492%*** (0.0000)	-0.3886%*** (0.0000)	-0.9418%*** (0.0000)	-1.7603%*** (0.0000)
Shanghai main sports industry concept stocks	3.0071%*** (0.0000)	1.7893%*** (0.0000)	1.3725%*** (0.0000)	0.6988%*** (0.0000)	0.5670%*** (0.0000)	1.0078%*** (0.0000)
Shanghai non-core sports industry concept stocks	4.0739%*** (0.0000)	4.4306%*** (0.0000)	3.2125%*** (0.0000)	3.6343%*** (0.0000)	3.9079%*** (0.0000)	4.6036%*** (0.0000)

Table 6 shows that investors in the Shanghai stock market did not react positively to sports industry concept stocks after the epidemic was contained. On the other hand, investors in the Shenzhen stock market had a significantly positive reaction to sports industry concept stocks after the epidemic was contained. According to behavioral finance theory, investor sentiment is a significant factor that influences stock prices (Xu and Green, 2013). It affects investors’ judgments of asset valuations and investment risks, as well as their attitudes toward stocks, ultimately affecting a company’s stock returns (Xu and Green, 2013; Shi, 2018). The literature suggests that investor sentiment can be influenced by various factors, including market returns, market volatility, market movements, stock returns, policies, economic cycle fluctuations, epidemic dynamics and company fundamentals (Xu and Green, 2013; Shi, 2018; Cevik, 2022; Cheema, 2020). By examining the literature and the results of our empirical study, we analyzed the mechanism by which the COVID-19 epidemic affects the stock returns of sports industry concept stocks in the capital market.

5.2. Changes in business activities in the sports industry

The empirical results in Tables 2 and 3 show that the COVID-19 outbreak event has seriously affected the sports industry concept stocks in both markets. Therefore, the study concluded that the sports industry was greatly impacted by the COVID-19 outbreak. Large-scale sporting events were postponed or canceled, stadium operations were suspended, offline fitness training was hindered and sports marketing was severely restricted. The epidemic resulted in significant market returns and substantial fluctuations in the overall financial market. Due to the unique characteristics of the sports

industry, its development was severely impacted, leading to increased uncertainty in the future returns and risks of sports companies and affecting investor sentiment. However, with the implementation of national epidemic prevention measures and other policies, the epidemic has been contained, and investor sentiment has gradually improved. Confidence in the market and the sports industry has been strengthened and investors' expectations for sports companies in the stock market have increased. As a result, the stock returns of sports industry concept companies have improved.

5.3. Effect of government sports industry support policy

As shown in Table 6, in the period surrounding the Wuhan unsealing event (-1, +1), the cumulative average abnormal return of sports industry concept stocks in Shanghai and Shenzhen had a significant positive impact at the 1% significance level. It can be seen that policy changes will have a huge impact on the development of the sports industry. Under the impact of the COVID-19 pandemic, it is important for the government to implement policies to support the sports industry. To stabilize the development of the capital market, both at a macro level and for the sports industry, the government should take proactive fiscal measures, such as tax cuts and increased fiscal expenditures, to mitigate the short-term impact of the pandemic. Additionally, the government can implement prudent monetary policies and support commercial bank loans to help sports enterprises overcome difficulties and increase stability in the sports industry investment environment in the capital market. The government should also support and guide the integration of the sports industry with other industries, promoting deeper and broader industrial integration and strengthening the source and driving force for growth in the value of the sports industry.

5.4. Governance role of capital market

Figures 1 and 2 clearly show that the lockdown event had a huge impact on the capital market of China's sports industry. It is necessary to further improve the capital market and enhance its ability to resist external risks. The capital market in the sports industry sector must take several steps to enhance investor protection. First, market rules should be clearly defined and communicated, and the information disclosure system should be strengthened to promote transparency and guide investors. Additionally, education and awareness about investment should be emphasized to empower investors to make informed decisions and protect their interests. Second, effective supervision of enterprises is crucial in detecting any fraudulent financial activities and unethical practices. The delisting system of enterprises should also be improved to prevent speculation and the abuse of resources. Third, increasing the dividend system of listed companies is an important step in ensuring returns for investors. This will also guide individual and institutional investors toward the goal of achieving medium- and long-term returns and ensuring stable growth in returns. Finally, the development of financial technology, including the application of the internet, big data and artificial intelligence, must be accelerated. This will improve the analysis and research of investment trends and behaviors, such as trading behavior, psychological expectations and emotional factors, ultimately enhancing the effectiveness of investor protection in the capital market of the sports industry. By taking these measures, the general public can preserve and grow their wealth through investments in the rapidly developing sports industry.

5.5. Effect of coping strategies of sports enterprises

Table 5 shows that an improvement in the epidemic will not immediately lead to a full recovery in the sports industry. Sports companies must take proactive measures to prevent and control the spread of epidemics on a regular basis and undertake necessary transformations and upgrades. First, the epidemic situation should be closely monitored, and companies should adjust their strategies accordingly to adapt to the changing competitive market environment. They should leverage their strengths to overcome challenges and stimulate demand in the sports industry. Second, it is imperative to improve the business model by integrating online and offline sales channels and undergoing digital transformation. This will enable companies to better respond to changing market conditions and customer needs. Third, companies should conduct thorough research on the external environment and identify new opportunities for growth. This could involve expanding into new industries, leveraging resources and promoting business upgrades. Fourth, it is essential to secure multiple sources of financing and to effectively manage available funds. Companies should regularly analyze their stock prices and investor behavior to minimize financing risks and protect investor interests. Finally, companies should actively support the government's development strategy of promoting a healthy China and a strong sports nation. They should collaborate with governments at all levels and market players to drive the growth of sports and sports industries.

5.6. Investors' ability to analyze and evaluate

Figures 1 and 2 show that, between the second and 18th day after the Wuhan closure event. The average abnormal return of sports industry concept stocks in the capital market had experienced sharp declines and large increases, indicating that investors' investment behavior is very volatile in the face of unexpected events. During an epidemic, investors must exercise caution and avoid making impulsive investments. They should stay informed about relevant policies and announcements from the government and other agencies. To make informed investment decisions, investors can analyze the strengths and opportunities of sports market players, screen relevant information and make rational investments. Institutional investors should conduct thorough research and analysis of investment information to ensure objective assessments and minimize any deviation in investment behavior. On the other hand, individual investors should take initiative to educate themselves on investment knowledge, improve their ability to evaluate investment opportunities and manage the impact of emotions on investment decisions.

6. Conclusions

The impact of COVID-19 on the Chinese sports industry capital market was analyzed using event study methodology. The results indicate that the sports industry capital market was more severely impacted by the epidemic in the short term compared to the overall capital market in Shanghai and Shenzhen. Furthermore, the reaction of concept stocks in the sports industry was positive following the lifting of restrictions. Compared to the trends observed in global developed and emerging capital markets, the Shanghai and Shenzhen sports industry capital markets demonstrated a positive response to the epidemic. As the situation improved and the epidemic was

controlled, the negative impact on sports industry concept stocks reduced and investors' confidence increased. The study also revealed that the Shenzhen market showed a faster and stronger reaction to the COVID-19 epidemic compared to the Shanghai market.

The impact of the COVID-19 pandemic on the sports industry has been significant and challenging. Although this study brings some innovative insights into the analysis of the capital market in the sports industry, it has several limitations. First, there is a lack of a clear definition of what constitutes sports industry concept stocks in academic circles. The data collection and analysis in this study therefore focused on a sample of companies that have a significant impact in the sports industry. Second, the sample size of this study was small, which limits its ability to fully analyze the characteristics of the capital market in each sector of the sports industry. To address these limitations, future research should track the capital market performance of listed companies in the sports industry by collecting data from their annual reports and other relevant sources to gain a deeper understanding of the sports industry capital market.

Acknowledgments

This study was supported by the Humanities and Social Science Fund of the Ministry of Education of China (Grant No. 21YJC890046) and National Natural Science Foundation of China (Grant No. 61906110).

Conflict of interest

The authors declare that there is no conflict of interest.

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