An Empirical Analysis of the Impact of the COVID-19 on China's Tertiary Industry Stock Price Yield—— Evidence from Event Study

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Abstract—The COVID-19 pandemic is one of the most significant public health events in recent years and poses a serious challenge to the global economy. Since the initial outbreak of the post-epidemic era, the stock market has experienced a relatively unstable period, and different industries have played different roles in the stock market volatility due to their particularities. With the introduction of policies and the development of COVID-19 vaccines, different industries show the same or different trends. In this background, in this paper, the development trend of the third industry as the research background, with 23 January, February 28, on July 16th for epidemic window node, in biological medicine, food and beverage industry, transportation, travel retail industry as the research object, respectively before the outbreak and five sectors covering of a particular disease index analysis, Select the data of each sector in "Great Wisdom 365" financial software, first establish the regression model of the relationship between returns and stock market portfolio investment returns, and then according to the sample data, estimate the parameters of each industry market model. The dummy variables were constructed according to the pre-event nodes, and the GARCH model was established after the conditional heteroscedastic ARCH test. Finally, the unit root test is performed. Analyze the impact of the epidemic on the above industries. The conclusion is that different tertiary industries vary greatly in their exposure to COVID-19 and other major events, but the overall trend shows large fluctuations. In the short term, the return rate of the tertiary industry is significantly affected, with a negative impact after a lag period and a positive impact after two lag periods. However, such a drastic change in yield will not affect the long-term development of the industry, and investors' long-term investment judgment based on raw data is still of reference significance.

Keywords-COVID-19, tertiary industry, financial market, Emergencies

1 INTRODUCTION

As a representative of major burst public health events, COVID-19 has a wide range of propagation characteristics, complicated, sudden, high-temperature, and a high degree of social panic.

After the explosion of COVID-19, countries actively respond to the prevention and control of the new crown COVID-19. In order to protect the lives and health of the people, the government

restricts population flow, restrict population gathering. The tertiary industry has increased the proportion of the country's economy in the industrial structure. The tertiary industry is related to personnel flow because of the special nature of the industry and under the prevention and control of the COVID-19[1]. Therefore, when studying the influence of the new crown COVID-19 on the economy, the tertiary industry will have a pivotal representation. On the other hand, the uncertainty of the spread of the new crown COVID-19, the length of the control time has caused some enterprises to be blocked, the company's production is not prosperous, the enterprise is closed, the unemployed personnel increase, the economic cycle is in a lack period.
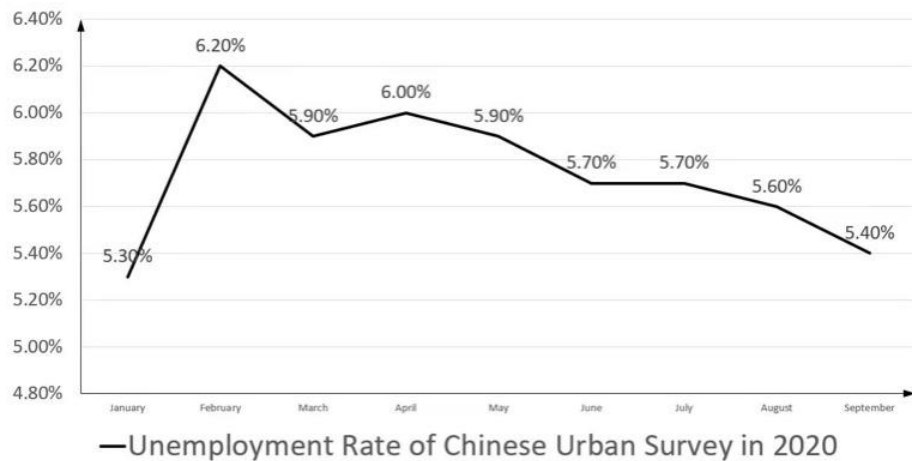

Figure 1 Unemployment Rate of Chinese Urban Survey in 2020

It can be seen from Figure 1 that the unemployment rate of the nationwide urban survey shows that at the end of 2019, after the outbreak of the COVID-19 in China, the unemployment rate of the Chinese population rose from 5.2 to 6.2.

Residents' income fluctuates strongly, combating residents' consumption enthusiasm, making residents more inclined to keep spending. Influence residents' consumption structure, with an obvious impact on tourism, logistics and medicine, for tourism, people are for security consideration, will reduce this aspect, and many places before the new crown COVID-19, the development of tourism is dominated, to create a new tourism industry chain, and more in front of the previous period, since 2019, the tourism industry has stagnated, with the local part Industry with tourism-oriented enterprises, airlines, etc., and tourism as complementary relationships. The new championship latency is longer. There is no way to eliminate the threat of the incubation period. People are unwilling to take a certain risk to choose from. When the mining industry is facing the COVID-19, the suspension rectification seems to be a kind of industry norm, but reopen notice It is also far away[2]. The virus can survive longer in a low-temperature environment, and the refrigerated chain found that the news of the new crown virus also allows the logistics industry to fall into a dilemma. People have no trust in contact records in the process of logistics transportation, spraying alcohol disinfection. With the increase in the COVID-19 situation and related reports, society today pays more attention to the 3rd industrial share price index's volatility to understand how the relevant information is spread on the market. This paper hopes to analyze the outlying of the COVID-19 situation and official information disclosure,

study the third industry stocks' volatility characteristics, and provide investors with some rational investment decision-making reference [3].

After the outbreak of the COVID-19, most studies focused on the stock market fluctuations of the primary and secondary industries under the COVID-19 and explored how to select the investment portfolio with the highest yield under acceptable risks under the impact of the COVID-19[4]. Or, the industry of the tertiary industry is chosen to be an industry that is less negatively affected by the COVID-19 and has good development prospects, using theoretical knowledge to conduct an empirical analysis on several selected industries and give a meaningful investment portfolio. Our research has begun on the tertiary industry under the COVID-19. There are catering industries that are more negatively affected by the COVID-19. However, we do not rule out the potential for the development of the catering industry after the COVID-19 is controlled. Some pharmaceuticals show greater vitality under the COVID-19 Biological industry, etc. The disclosure of information sometimes also affects the judgment of investors. The fluctuation of the financial market is also the fluctuation of the decision made by investors on the information after the disclosure of information. Based on this, our research considers the impact of information disclosure, selects the tertiary industry with both positive and negative impacts under the COVID-19, is relatively representative of the tertiary industry, and uses data for empirical analysis to give clearer and more rational Portfolio recommendations [5].

According to the stock market volatility path diagram of the five tertiary industries that we have selected, it can be found that the stock prices of the catering industry that are not optimistic have fallen rapidly after the outbreak of the COVID-19. After the COVID-19 is controlled, the catering industry has regained vitality and the stock price up [6]. As for the pharmaceutical and biological industry, which is clearly favored in the COVID-19, stock prices rose sharply immediately after the outbreak but then slowly declined and tended to an initial stable state. We use a single root test to test the obtained stock index. We use the Jacque-Bear statistic method to test the positivity to obtain the descriptive statistical results of the daily return rate to do serial autocorrelation. Finally, we can make a GARCH model and finally find that, combined with the data and model results, under the COVID-19 situation, the impact of the new crown pneumonia COVID-19 on the stock market is not obvious, and the Chinese stock market is resilient.

2 METHOD

Our data is first reflected in the changes in the abnormal return trends of various industries. From then on, we can see the fluctuations in the stocks of various industries under the COVID-19. Later, we will do the ADF unit root test to get the stock market return rate. The thesis mainly uses three research methods:

Literature research. Check the literature and study the new crown pneumonia COVID-19 and the trend of the stock price of the tertiary industry.

Theoretical research method. We have used portfolio theory. We have found multiple sets of prospective tertiary industry stock volatility data from February 2019 to September 2020[6]. We intend to rely on these data to establish a model that is instructive for future investment. Choose a combination with lower risk while getting the highest possible return.

Empirical analysis method. We do empirical analysis related to numerical analysis, that is, balanced analysis and dynamic analysis. We selected biomedicine, catering, transportation, tourism, and retail as the data sources for our model construction. In the process of building the model, it is first determined that the autoregressive conditional heteroscedasticity model is selected for testing. The result of the unit root test shows that the rate of return series is stable. Then consider the establishment of model variables, and use the Jaeque-Bera statistics method to carry out the positive test. From the results of various conditions, the ARCH effect test shows that the sequence has a significant ARCH effect.

Finally, we concluded that combining the variance equation and the coefficient regression results, a few months after the outbreak, the stock market had a great impact on the stock market's volatility. The market is in a downturn, but with the release of the information, the stock market has gradually recovered.

3 RESULTS AND DISCUSS

3.1 The impact of the COVID-19 epidemic on the development of China's tertiary industry (based on the event research method)

In order to study the impact of the COVID-19 epidemic incident on the stock price return rate of the tertiary industry, this article uses the event research method to define the incident as the occurrence of the COVID-19 epidemic, using A-share bio-medicine, catering, transportation, trade and retail stock price data as the basis, excluding other factors The stock price rate of return has an impact on the normal, and the abnormal return is analyzed.

The stock market model of the prior window is mainly suitable for the regression model that measures the relationship between the normal investment income of the stock index of a specific industry and the investment income of the stock market portfolio. Its model is:

$$R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it} \tag{1}$$

Among them, R_{it} is the normal return of a certain industry stock index at time t, R_{mt} is the combined return of the Shanghai and Shenzhen 300 index at time t, α_i and βi is the parameter to be estimated, is a random interference item, and $E(\varepsilon_{it}) = 0$, $Var(\varepsilon_{it}) = \sigma_{\varepsilon i}^2$, and at the same time, assume that each The normal returns of industry stock indexes all obey the independent and identical distribution of the joint normal.

The abnormal return model of the event window and the post-event window can be expressed as:

$$AR_{it} = R_{it} - \alpha_i - \beta_i R_{mt} \tag{2}$$

Among them, AR_{it} is the estimated value of abnormal investment income that appeared in a time window of some tertiary industry stock index i. The empirical data comes from the daily K-line chart of A-share biomedicine, catering, transportation, trade and retail stock prices. R_{mt} is the Shenzhen 300 Index. The empirical data is from September 2, 2019, to September 2, 2020, with 1 year.

According to the sample data, the parameter estimation of the market model of each industry is carried out according to formula (1), and the average return rate of the event window and the post-event window is calculated. The regression results are shown in Table 1:

Table 1 Model Results

Variables	(1)	(2)	(3)	(4)	(5)
	0.03	-0.02	-0.05	0.01	-0.06
	(0.09)	(0.11)	(0.04)	(0.06)	(0.04)
	0.88***	0.68***	0.94***	0.97***	0.83***
	(0.13)	(0.16)	(0.06)	(0.09)	(0.06)
Adj-Rsq	0.33	0.15	0.72	0.54	0.64
N of Obs.			96		

Note:

1. Five Variables:

(1) Biomedicine, (2) Catering, (3) Transportation, (4) Trading, (5) Retail.

2. The data in this article's average estimation analysis results are rounded up and finally retained to the fourth decimal place. Among them, the number in parentheses is the standard error of the coefficient, * represents the significance level, ***, ** and * Indicates that the significance level is 1%, 5%, and 10%, respectively.

Based on the analysis of the window of major events this year and the trend of the number of patients diagnosed with the COVID-19 epidemic this year, starting from January 23, the "closure of the city" in Wuhan, Hubei, means that the outbreak of the COVID-19 epidemic has begun to have an impact on the Chinese economy. The serious negative impact, so this article regards it as the beginning of the window of major events. On February 12, the COVID-19 epidemic showed an inflection point for the first time, and this event can be regarded as the deadline for the event window [7]. The aftermath window is divided into the following nodes: 1) On February 28, the National Health Care Commission of China made a judgment on effective control of the local COVID-19 epidemic situation in China, indicating that the local COVID-19 epidemic will affect China as a whole. The impact of the economy has begun to decline, and the focus of work has shifted from strengthening epidemic prevention and control to vigorously supporting the resumption of work and production of small and medium-sized enterprises; 2) On April 8, Wuhan announced its unblocking; 3) On July 16, The GDP growth rate of China in the second quarter turned from negative to positive.

Therefore, our research sets Period 1 for the COVID-19 epidemic event to be from January 23 to February 28, 2020, the pre-event window is set to September 2, 2019-January 22, 2020, and the post-event window are set for: 1) Afterwards window 1 (Period 2): February 12 to February 28; 2) Afterwards window 2 (Period 3): February 28 to April 8; 3) Afterwards window 3 (Period 4): April 8th-July 16th; 4) After the event window 4 (Timepoint 5): July 16th-September 2nd. The time is 1 year.

In order to examine in detail, the fluctuations of the tertiary industry's stock prices during the epidemic period, the article selects five path diagrams of the tertiary industry's stock prices affected by the epidemic and draws them as shown in Figure 1:
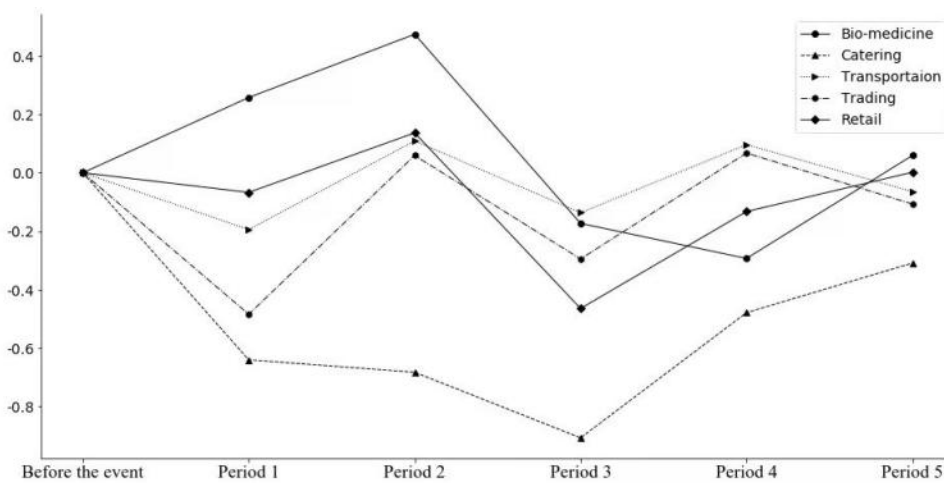
Figure 2 Trends of Abnormal Returns in Various Industries

It can be found from Figure 2 that when the COVID-19 epidemic occurs, except for the bio-medical industry, other industries are negatively affected, showing a trend of lower yields. However, after the inflection point of the COVID-19 epidemic, except for the catering industry that has not been opened due to national policy restrictions, the rest of the industries have shown a rebound trend after receiving this good news. When the country announced the resumption of work and production, the stock market experienced a brief decline, inconsistent with common sense. After Wuhan announced the release, it also means that the national epidemic has been brought under control [8]. Except for the bio-medical industry, other industries have seen an upward trend, consistent with common sense. After the country announced that the GDP in the second quarter turned from negative to positive, it received major gains, the stock market was further stimulated, and all industries showed an increase.

3.2 The impact of the new crown epidemic on Chinese financial market volatility (GARCH model)

Based on the research on the impact of the COVID-19 epidemic on China's tertiary industry stock market, this article further studies the impact on my country's financial market volatility. The purpose is to measure the impact of the new crown epidemic on my country's macroeconomic development from the economic and financial negative aspects.
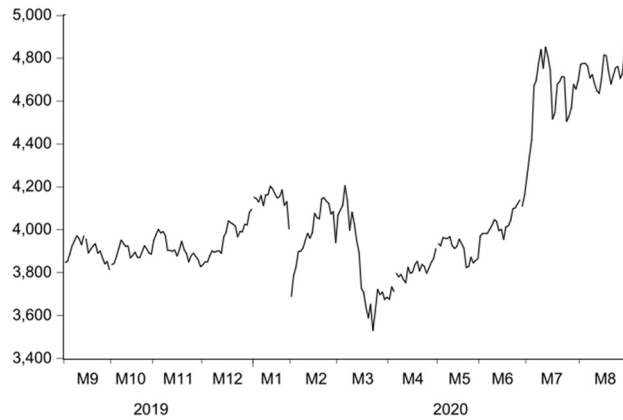
Figure 3 The Closing Price of the Shanghai and Shenzhen 300 Index

Because the financial market is easily affected by fiscal policy, monetary policy, and some major emergencies, the conditional variance of the error term often changes with events and depends on the size of the past error for a long time. Therefore, the disturbance variance in the time series model of the financial market Stability is usually worse than expected [9]. Time series tend to fluctuate in groups. The fluctuations are small in some periods and large in others, indicating that the error term is likely to have conditional heteroscedasticity [10]. This article chose the ARCH model for testing and added a time dummy variable to the variance equation. The time window is consistent with the period of the event analysis method, which lasts 1 year from September 2, 2019, to September 2, 2020; the sample data comes from the daily closing prices of the Shanghai and Shenzhen 300 Index during the year. As can be seen from the Shanghai and Shenzhen 300 Index chart in Figure 3, during the COVID-19 pandemic, especially during the January-March and June-July 2020 periods, the stock market has significantly increased volatility.

- Unit root test

Table 2 ADF Inspection Results

		0 Derivative ADF-TEST		1 Derivative ADF TEST	
		t-Statistic	Prob.*	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-0.4464	0.8976	-14.6856	0.0000
Test critical values	1% level	-3.4572		-3.4573	
	5% level	-2.8732		-2.8733	
	10% level	-2.5731		-2.5731	

In order to prevent the phenomenon of "false regression", the ADF unit root test was performed on the daily closing price of the Shanghai and Shenzhen 300 stock indexes. The test results are shown in Table 3. It is not stable, but after the first-order difference, the daily closing price is stable.
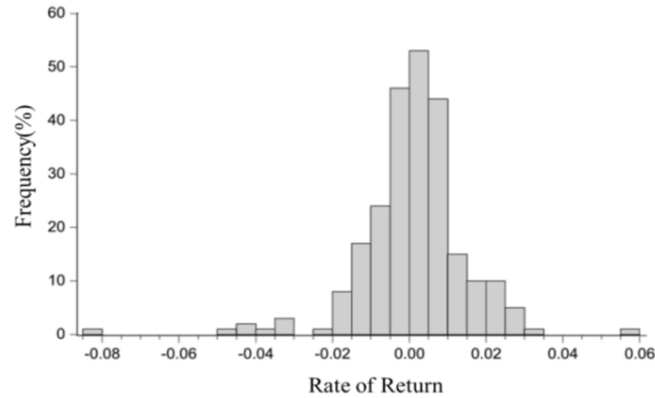
3.3 Normality test of Jaeque-Bera statistic method

Figure 4 Probability Distribution of Daily Return Rate

Table 3 Descriptive Statistical Results of Daily Return

Mean	0.0001	Std.	0.0138
Median	0.0014	Skewness	-1.1270
Max	0.0551	Kurtosis	9.7500
Min	-0.0821	Jarque-Bera	512.7575
Probability	0.0000		

Based on the relevant data of the Shanghai and Shenzhen 300 stock indexes, we conducted descriptive statistics on the daily yield of the Chinese stock market. The statistical results are shown in Table 5. The study found that in the months before and after the outbreak of the COVID-19 epidemic, The average market rate of return is 0.094684, and the average rate of return does not show a significant negative value. Judging from the probability distribution diagram of the return rate, the kurtosis value, and the Jarque-Bera statistics, it can be seen that the return rate of the Chinese stock market presents the characteristics of high peaks and thick tails, which is suitable for the ARCH model.

Consider the time node in the previous article, and construct dummy variables based on the event node in the previous article. Period 1 and later refers to the day of the outbreak and later, take 1, otherwise, take 0; Period 2 and later refers to the inflection point of the epidemic, take 1, otherwise, take 0; Period 3 and later refers to the national resumption of work and production, take 1, otherwise take 0; Period 4 and later is 1 after Wuhan is unblocked. Otherwise, it is 0; Period 5 and later is China's second-quarter GDP growth rate from negative to positive and then 1, otherwise it is 0.

- Sequential autocorrelation and partial autocorrelation test

Table 4 The Results of Sequence Autocorrelation and Partial Autocorrelation

	AIC	PACF	Q-Stat	Prob
1	0.0370	0.0370	0.3392	0.5600
2	0.0210	0.0200	0.4531	0.7970
3	0.0580	0.0560	1.2750	0.7350
4	-0.1020	-0.1070	3.8568	0.4260
5	0.0660	0.0730	4.9417	0.4230
6	-0.0260	-0.0320	5.1065	0.5300
7	-0.0280	-0.0160	5.3032	0.6230
8	-0.0410	-0.0580	5.7270	0.6780
9	-0.0340	-0.0110	6.0231	0.7380
10	-0.0100	-0.0150	6.0475	0.8110
11	0.0300	0.0380	6.2814	0.8540
12	-0.0710	-0.0820	7.5722	0.8180

In order to determine whether it is necessary to add a lag term, this paper does a series of autocorrelation and partial autocorrelation tests on the empirical data. The results show that the P-value is greater than 0.5, and the autocorrelation value and the partial autocorrelation value both fall into the double estimation standard. Within the range of the difference, and the P-value is greater than the confidence level of 0.05, set the mean value equation to a constant.

● Conditional heteroscedasticity ARCH test

Table 5 ARCH Test Results

F-statistic	4.8862	P-value	0.0280
Obs*R-squared	4.8286	P-value	0.0280

After the ARCH test of the model, it is found that when the ARCH order is 1, there is an ARCH effect in the sequence, and the GARCH model can be established.

The GARCH (1,1) model is the most widely used, reflecting the conditional heteroscedasticity in the financial market, so the GRACH (1,1) model is selected.

● Establish GARCH model

Table 6 GARCH（1，1）Model Results

Variance Equation				
Variable	Coefficient	Std.Error	z-Statistic	Prob.
C	0.0001	0.0000	2.3375	0.0194
Time point 1 and later	-0.0011	0.0007	-1.5896	0.1119
Time point 2 and later	0.0010	0.0006	1.5337	0.1251
Time point 3 and later	-0.0004	0.0003	-1.4612	0.1440
Time point 4 and later	0.0004	0.0003	1.3894	0.1647
Time point 5 and later	-0.0001	0.0001	-1.3105	0.1900
GED PARAMETER	1.3955	0.1686	8.2771	0.0000

In summary, from a long-term perspective, the impact of the COVID-19 epidemic on the volatility of China's stock market is not obvious. The fundamentals of the long-term improvement of China's economy have not changed, and the economy has continued to recover and maintain a stable development trend.

4 CONCLUSION

This paper analyzes the average rate of return to four windows periods for the five biomedicine sectors, catering, transportation, tourism, and retail, and constructs a GARCH model. The study found that when COVID-19 occurred, other industries were negatively affected by the biological medicine industry, showing a trend of decreasing returns. However, after the turning point of COVID-19, except that the national policy restrictions did not open the catering industry, the rest of the industry showed a rebound trend after receiving this favorable interest rate. After the state announced the resumption of production and work, due to market distrust and concerns about the epidemic, various industries made a temporary adjustment, but after the GDP changed from negative to positive, various industries resumed a sharp rise. The novel coronavirus pneumonia has a significant impact on the third industry's yield, and the lag one is negative, but it has a positive effect after two lags periods. In this epidemic stage, the market return to the tertiary industry fluctuates greatly and shows instability. For different fields, there are also obvious differences in impact effects. Catering and trade had been purely negatively affected. The biomedicine and retail industry sectors have been shaken due to some positive stages, while the transport industry has little impact.

The impact on the epidemic will lead to sharp fluctuations in the yield of the tertiary industry, which will exert great psychological pressure on investors. Novel coronavirus pneumonia is not a significant factor in China's market fluctuation, but it will not change the overall macroeconomic growth trend and the market's opening up. Therefore, for investors aiming at long-term investment, the short-term impact will not make the long-term investment index data lose reliability, and investors can still refer to the corresponding indicators to make decisions. For short-term investors, they can pay attention to major window nodes and event information for investment. Based on the literature review, we found that there are still differences in the performance of specific companies affected by the epidemic of different sections, which may be affected by many factors such as internal adjustment, product performance, industry particularity, economic environment and so on. Therefore, the research results of this paper can only be used as a reference index, and investors can not completely rely on it to invest blindly.

The contribution to this paper is to make up for the blank of the research on the third industry under the epidemic situation. By calculating the average yield of the event window and post window and building the GRACH model, the influence of COVID-19 on the financial market is analyzed and studied. Comparing the data to the model can provide some rational investment decision-making reference from investors to restore a stable stock market. At the same time, there are few analytical studies on different time windows of the epidemic. The research finds that different window nodes have different properties, and short-term investors should analyze information data and make decisions. Although major short-term events will cause a significant shock to the yield for long-term investment, they will not change the long-term reference index. Investors can still invest according to the original index.

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