

A Study on the Differences and Correlations Between Soybean Futures Markets in USA and China

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Abstract: Futures market in the United States has gone through more than 150 years and has the most developed grain futures market in the world. By selecting soybean, the most representative product in the futures market, in this work, the ADF test and Granger test are utilized to objectively distinguish between the soy bean futures markets of China and America. This article examines the effects of exceptional events on the soybean futures in two nations in light of the two typical special events of the Sino-US trade war and the COVID-19 epidemic. The findings are made by the author: there is a strong correlation between soybean futures and spot in China and the US. However, the association is not as prevalent in China as it is in the US. There is a cointegration link between the soy bean futures markets in China and the US, and there is a Granger guiding relationship for China on the USA's soy bean futures market. The impact of the Chinese and American markets on each other is long-term. The COVID-19 epidemic and the Sino-US trade dispute are investigated as well by the author, who discovers a negative link between the prices on the soybean futures markets of the two nations. The Chinese bean futures market is characterized by a lack of risk appetite and an overwhelming reliance on the US.

Keywords: Soybean futures market, Price transmission, China US trade war, Covid-19

1. Introduction

The establishment of Zhengzhou grain wholesale market in China in 1990 and the signing of the first wheat forward trading contract in the wholesale market in March 1991 all laid the foundation for the development of China's agricultural futures market. By 1994, China's agricultural futures trading grew rapidly. In 1995, the total turnover of China's futures market reached 636.12 million hands, with a total turnover of 10 trillion yuan, of which agricultural futures accounted for about half [1]. Since the beginning of reform and opening up, China has set up commodity futures exchanges, and then strengthened laws and regulations. It was not until 2006 that China entered World Futures Markets and began trading futures globally. At present, the organizational structure and variety pattern of China's agricultural futures market basically continue the state after the rectification and structural adjustment of the futures market by the State Council in 1998 [2]. The agricultural futures market in the United States has been developing since the 1840s, and after the civil war, the futures market in the United States has ushered in a period of stable development. And has been constantly optimizing equipment and rules.

The domestic futures market lacks pricing power and voice, and is affected by foreign markets. As the leader of the global futures market, the United States has brought rich experience in agricultural futures and spot price risk management for more than 100 years of development history. [3]. Soybean is one of the representative futures products, and China and the United States are the world's largest soybean importers and the second largest soybean exporters respectively. This paper can offer guidelines for the management and growth of the futures in China and USA, especially within China, by analyzing the soybean futures market between China and the United States and comparing their futures and spot markets. This is particularly useful in the era of globalization and closer ties among nations. Other than to having a significant impact on price transmission and correlation, the trade war and epidemic between China and USA have also had significant influence on the soy bean futures markets in China and the U.S.

2. Literature Review

2.1. Research on China's Soybean Spot and Futures Markets

One of the crucial economic purposes of the futures market is price discovery. The futures market, in contrast to the spot market, may establish a more developed and outstanding price mechanism, similar to the ideal competitive market. There are many research papers on the relationship between China's soybean market, mainly focusing on the relationship between the spot market. Liu Fengjun and Liu Yong studied the fluctuation relationship between soybean futures and spot prices, showing that soybean futures and spot prices have a cointegration connection. Futures and spot prices have a long-term equilibrium relationship, which influences short-term price swings and returns to a stable level. Futures and spot prices have a two-way Granger relationship. [4].

2.2. Research on Soybean Spot and Futures Markets in the United States

Yu Jianbin analyzed that from the price trend of soybean futures and spot market in the United States, compared with China, the change trend is more consistent, the peaks and valleys are more coincident, and the price fluctuation range of spot market and futures market is basically the same. The price connection between the spot and futures exchanges in the US is higher than that in China, with a correlation coefficient of 0.998. [5]. These data were, of course, compiled more than ten years ago. It needs to be confirmed whether the spot and futures markets in USA still have such a strong link after numerous financial market turbulences, natural disasters, political conflicts, and other occurrences.

2.3. Correlation Between Soybean Futures in China and American

When Liu Kai and Mu Yueying compared the pricing data for futures for soybeans in China and the US, they found that the price yields in both countries had "peak and thick tail" characteristics, with the price yield in the United States fluctuating more than that in China. When faced with the impact of market information, soybean futures prices in China will fluctuate more than those in the United States, and the volatility persistence is similar between China and USA, and the volatility persistence is strong [6]. This is in line with the basic understanding that as major soybean importers and exporters in the world.

2.4. Review

To sum up, the existing literature has studied the soybean futures, spot price transmission between China and the United States since 21st century and the correlation between the two countries, mainly reflected in the same trend of change, the same peaks and valleys, and the sensitivity of the Chinese market is not as sensitive as that of the United States. In the preceding five years, very few academics

have looked at the soybean futures markets of China and the United States, primarily after the postwar trade between the two countries. In this investigation, the price link between the futures and spot markets in both countries, as well as between China and the US, is investigated quantitatively under the two dissimilar settings of the Sino-US trade war and the era of the pandemic.

3. Empirical Evidence

3.1. Chinese and USA Soybean Futures Linked to Spot Markets

The author employing the monthly soybean futures data from January 2013 to prior to the Sino-US trade war in order minimize the impact of extremely uncommon events on the soybean futures marketplace between China and the U.S. Price information for these products comes from the biggest futures exchanges in China and the United States., DCE and CBOT. See Figure 1 for details.

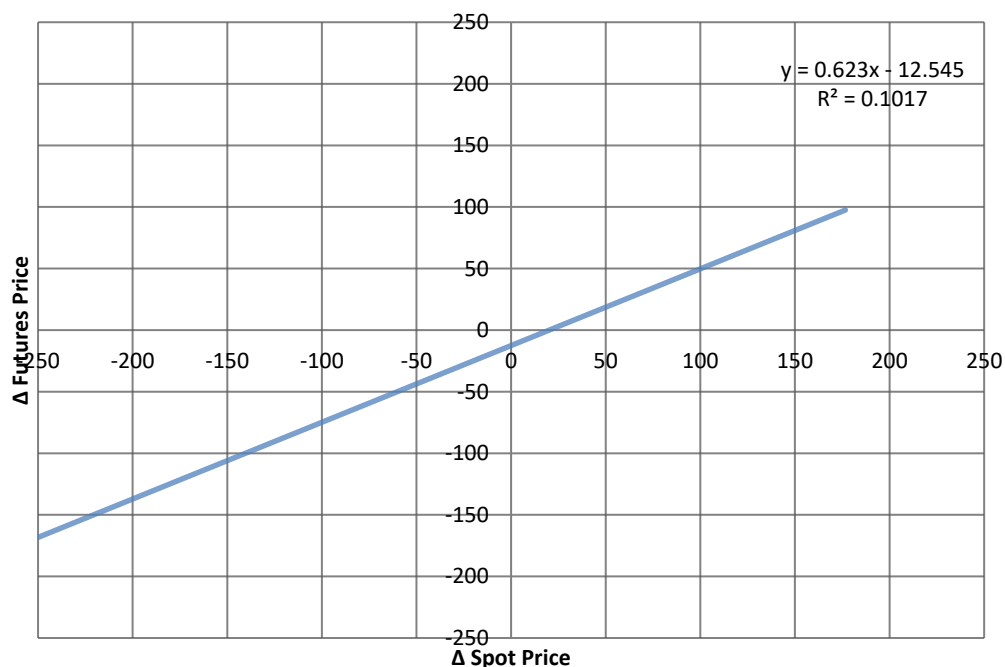


Figure 1: Correlation between spot price and futures price in China
Photo credit: Original

The simplest and most natural method for analyzing relationships between research variables is correlation analysis. Following fitting analysis, the correlation coefficient between the Chinese and United soya spot and futures markets is 0.925840899 and 0.318885003, respectively. The price of U.S. soybean futures is more predictable than that of Chinese soybean futures as there is a better price correlation between U.S. soybeans futures and spot than there is in China. It is worth mentioning that according to the price data analysis of China's soybean spot and futures market in past decade by Yu Jianbin scholars, the correlation coefficient is 0.955 [7], which is much higher than the experimental data of 0.3188 in this paper. Although the size of the correlation coefficient cannot fully represent the correlation between the two variables. It demonstrates to some extent how the interaction relationship between futures and spot is deteriorating as China's financial sector matures.

Using information on the yield of soybean futures between the People's Republic of China and the USA from 2013 to 2018, the researcher calculated the annual volatility yield for China in these years to be 0.115 and the annualized fluctuation yield for the U.S. futures market to be 0.207. This gap is rather wide. Less variation in prices results from less volatility. The fact that there is less danger involved despite the low likelihood of huge earnings shows that China's futures market is more reliable than the American one, and Chinese speculators will be more likely to make long-term investments.

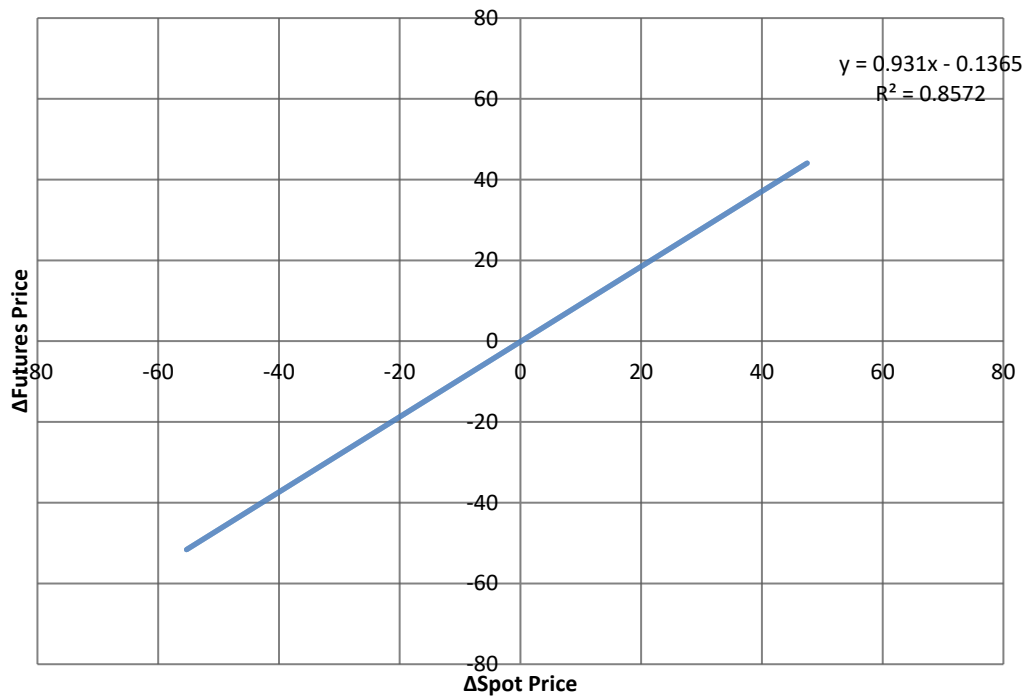


Figure 2: Correlation between Spot Price and Futures Price in USA
Photo credit: Original

3.2. Price Transmission Between Spot and Futures

The price of soybeans on both the futures and spot markets is impacted by a number of elements, including the supply and demand connection for spot soybeans, national macro control policies, the global political and financial environment, market monopolies and competition, psychological characteristics, and many others. The trend of futures prices and spot prices, as well as the volatility, are essentially the same under the ideal market system over the long term and for a substantial portion of time over the same market cycle. There may be a guiding relationship. Price discovery is one of the futures market's most important economic goals. In contrast to the spot market, the futures market has a more sophisticated price mechanism. Due to many participants: commodity producers, speculators, processors, importers and exporters, the futures market is similar to a perfect competitive market. In addition, the futures market does not allow private trading, open and fair competition transparent trading platform, which also makes the price found in futures trading highly authoritative. The author runs a Granger test on the prices of the spot futures in China and the USA in order to gain insight into the price conductivity of spot and futures markets. 49 sets of data representing monthly futures and spot market prices from January 2014 to January 2018 were chosen. The specific data sources are on display in the following table.

Table 1: Data source

Nation	Type	Data resource	Data set
China	Spot price	CSMAR	Shipping price of domestic soybeans futures contract
	Future price	CSMAR	Closing price of DCE soybean
U. S	Spot price	WinD	Spot market prices
	Future price	CBOT	Closing price of CBOT soybean futures contract

The moving average multiplier is used in this phase to take the seasonal impact out of the seasonality of soybean production and consumption, which causes seasonal fluctuations in soybean prices.

Table 2: The seasonal index of China and USA

	Quarter	1	2	3	4
Seasonal index	China	0.9879	0.9863	1.0296	0.9963
	Us	0.9832	1.0392	0.9832	0.9944

The Granger test of soya spot and futures in China and the United States is shown in Table 3 as results.

Table 3: Granger test results of soybean futures and spot prices in China and the United States

Nation	Null hypothesis	Lags	F-value	P-value	Con
China	Futures do not guide spot	5	3.323	0.0027	Futures guide spot
	Spot does not guide futures	5	2.813	0.0067	Spot guides futures
U. S	Futures do not guide spot	5	4.035	0.0012	Futures guide spot
	Spot does not guide futures	5	3.614	0.0018	Spot guides futures

The significance level of P value is less than 5%, which can be said that there are Granger reasons between the indicators of this study.

It is evident that the spot and futures markets for soybeans in China, like those in the United States, are influenced by one another. Furthermore, the U.S. futures market's p value for transmission efficiency is higher than the Chinese futures markets. Overall, the statistical findings indicate that there is greater significance and effectiveness in the price transmission between the two markets in the United States.

3.3. Correlation Between Soy bean Futures Market Prices in China and the United States

Grain crops, including soybean, go through a growth cycle, which accounts for the cyclical volatility in grain futures prices. In the northern hemisphere, soybeans are sown in April and collected in September, as seen by soybean futures. The growth cycle of soybeans determines that the supply is in short supply from July to August every year, and the price of soybean futures is high, while the supply is often oversupplied in November every year, and the price pair is at a low ebb. Figure 3 displays the ten-year closing price trend for Chinese and American soybean futures.



Figure 3: The prices of soybean future in the past ten years

Note: the data have been processed uniformly, and the price of one cent/bushel has been converted to \$0.36744/ton at the market rate, and then the average exchange rate of RMB against the US dollar in the past ten years has been selected to obtain an average exchange rate of \$100 - 650.7788 yuan for comparison.

Photo credit: Original

From the above chart, it can be concluded that over the past decade, there has been a very close correlation between soybean futures prices in China and USA, and the trend is basically the same. In some periods, such as around 2022 and 2017, it shows the opposite trend. In order to ensure the correctness of the conclusion, we use ADF test and Johansen cointegration test.

The data source of this study is Guotai Junan research service center(<http://www.gtarsc.com/Login.aspx>). In view of the difference between the availability of data and the listing and trading time of Chinese futures varieties, after dealing with the differences of main contracts, holidays, and contract design. The soybean futures price series, which covers the period from January 4, 2013 to December 30, 2022, includes 2429 pairs of closing soy bean futures prices between China and the USA as the final sample for quantitative analysis. Finally, the author obtained the following sample information:

3.3.1.ADF Test and Johansen Cointegration Test

The stability of time series serves as the foundation for time series analysis. First, the original time series of our variables were tested by ADF. At the critical value of 1%, each time series is unstable and has unit roots since the T value of all sequences is higher than the critical value.

Table 4: The result of ADF test

Variables	Test Statistic	1%	5%	10%
China, raw	-0.921	-3.430	-2.860	-2.570
China, difference	-26.267	-3.430	-2.860	-2.570
US, raw	-0141	-3.430	-2.860	-2.570
US, difference	-20.102	-3.430	-2.860	-2.570

Then the first order difference processing needs to be carried out, and then carry out ADF test on the first order difference sequence. The T value of each first order difference sequence is significantly smaller than the corresponding critical value at 1% critical value, indicating that the first order difference sequence of each variable has no unit root and is first order stable.

Johansen cointegration test results show that at the 5% confidence level, China and the US agricultural commodity futures market have a cointegration relationship. In other words, although soybean futures on the futures exchanges of China and the USA may diverge in the short run, they will eventually be adjusted to a relationship that works in harmony and is characterized by long-term equilibrium.

Table 5: The Johansen cointegration test results

Rank	Params	LL	Eigenvalue	Trace statistic	Critical value 5%
0	2	-36085.296	\	5177.3381	15.41
1	5	-34769.087	0.51422	2544.9191	3.76
2	6	-33496.627	0.50242	\	\

3.3.2. VEC Test and IRF results

The price of China's soybean futures is negatively adjusted by the error repair term. The Chinese soybean futures price exhibits the Granger guiding relationship between the U.S. soybean futures price and the Chinese soybean futures price at the significant level of 5%. Statistics also indicate that the price of Chinese soybean futures is not zero and instead has a lagging guiding effect on itself.

The error correction factor for U.S. soybean futures is at a respectable 5% level. It shows a Granger guiding link between the price of soybeans on the Chinese market and the price of soybeans in China in addition is considerable and smaller than zero. It also shows how the error correction period affects the price of soybeans in the United States negatively. Since statistics are significant and not zero, the price of soybean futures in the USA has a lagging guiding influence on itself.

The soybean markets in two nations have a long-lasting effect on each other's shocks, as seen in Figures 4, 5, 6, and 7.

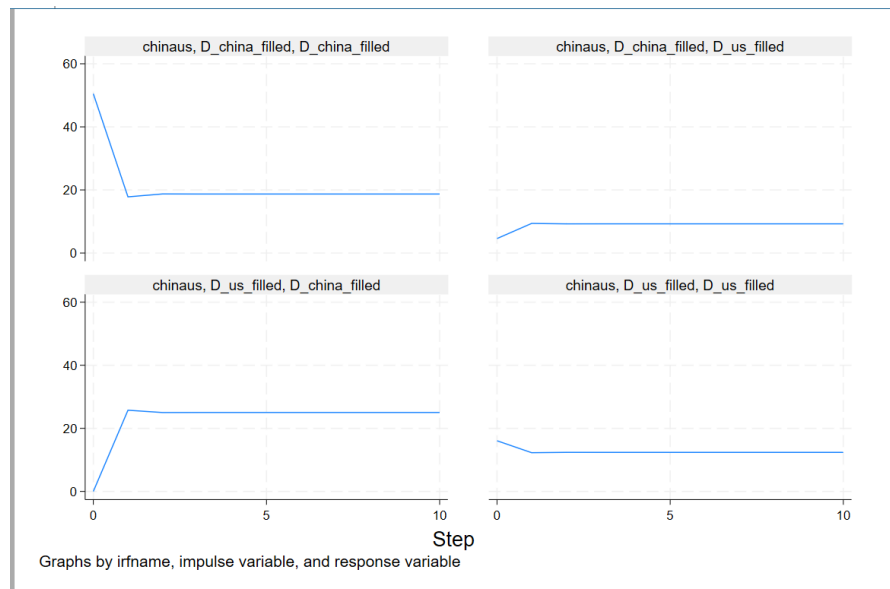


Figure 4: Impulse response
Photo credit: Original

The author found that, contrary to our test results, soy bean futures prices in two countries had completely different trajectories for a while. For example, during the Sino US trade war and during the epidemic.

During this period, on April 13, 2016, China imposed 25% tariffs on soybeans, corn and other products exported by the United States in accordance with relevant principles of international law. The imposition of tariffs on grain by China and the United States has significantly affected the normal grain trade between the two countries, resulting in a supply gap for some grain products that China depends on imports, sharp fluctuations in grain futures prices in large commercial exchanges, and rising soybean prices. The United States is also unable to export a large number of grains normally, grain is unsalable in a large area, and grain futures prices on the Chicago Board of trade have also changed sharply. In addition to objective reasons such as national policies. Investors' investment habits have shifted as a result of the trade battle between China and the United States.

When investor sentiment is high, investors have a tendency to follow the trend to do more; When investors are depressed, investors have a tendency to follow the trend of short selling. This leads to an inverse relationship between futures market yields and investor sentiment. Therefore, the news of Sino US trade war has a reverse effect on soybean futures yields [8].

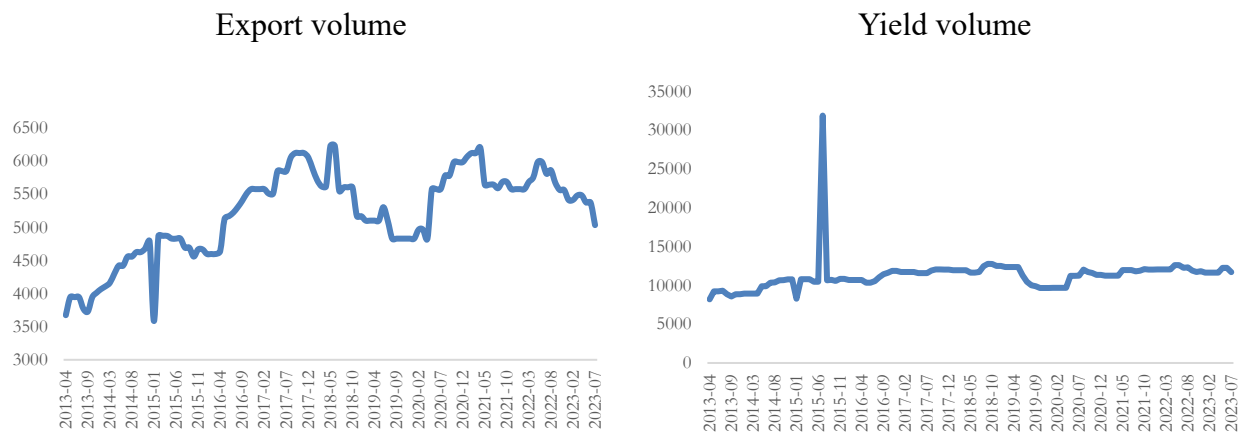


Figure 5: Export and yield volume of China and USA
Photo credit: Original

The graph above shows statistics on soybean imports from China and exports from the United States over the last ten years, and it is obvious that there is a significant inverse relationship between the two. The volume of imports and exports directly adds to the opposing trend of price increases on the futures markets, based on the principle of supply and demand. The CBOT soybean futures market is closely followed by the soybean future market in China, and price changes in the CBOT soya futures have a big impact on the price trend in China. A healthy development of the Chinese soybean spot market can be facilitated by keeping a watch on the CBOT soybean futures market, which can be used to assess and predict the price trend of the Chinese futures market for soybeans [9].

Similar to this, soya futures costs in China and the USA have been impacted by the covid-19 epidemic in early 2020. The epidemic's spread presents a significant challenge to the world food economy. First of all, in terms of agricultural production, the epidemic has made farmers unable to farm normally because of the ban at home and the risk of epidemic infection, and the harvesting efficiency of grain crops has been significantly reduced. There have been frequent incidents of grain crops rotting in farmland because they cannot be picked on time. Secondly, in terms of grain transportation, due to the restrictions on the flow of people between countries in the world, major grain producing countries are unable to transport grain to grain consuming countries, resulting in the hoarding of grain production Treasuries and the impact of farmers' enthusiasm for growing grain. Quantitative easing policies launched by European and American countries have flooded global liquidity. It has also prompted the grain futures market to start driving prices upward. Despite the fact that the epidemic era and the trade war are the same, Between the Chinese mainland and the USA, the number of soybeans imported and exported is decreasing. The impact of the parallel rise in soybean futures prices between China and that of the US is nevertheless demonstrated. This is as a consequence of the sharp decline in overall soybean production, but concisely, the price increase for soybean futures in the US is much smaller than that in China, demonstrating that China's soybean futures market still has less capacity for managing risk than the US market does. Additionally, a pulse response function analysis of the growth rate of soybean futures returns revealed that, following the start of a trade war, the amplitude of soybean futures' responses to shocks rose in both nations, suggesting that market fluctuations have a stronger impact on soybean prices. The outlook for the futures market is uncertain, and price swings could get worse. [10]. Futures market is a form of market organization based on modern market mechanism. The healthy development of futures market is inseparable from the sound foundation of spot market. It is necessary to effectively promote the marketization process of spot market and lay the foundation for the good development of futures market [11].

4. Conclusion

Both China and the United States have high correlations between soybean futures and spot prices, however China's correlation coefficient is lower than that of the United States. The Granger test results show that there is more significant and effective price transmission between the two marketplaces in the United States. It implies that American soybean futures prices are more stable than Chinese ones. The correlation between spot and spot in China has been declining this year as a result of the growth of the country's financial market, which is also a result of the growing interference factors, frequent government macro interventions in China's free trading market, and the country's increasing distance from the United States in terms of soybean price transmission. Over time, China's annualized volatility yield was 0.115, whereas the U.S. futures markets was 0.207. This gap is rather wide. Less price volatility results from less volatility. The fact that there is less danger involved despite the low likelihood of huge profits shows that China's futures market is more reliable than the American one, and Chinese speculators will be more likely to make long-term investments.

The results of the Johansen cointegration test show that, at the 5% level of confidence, there is a cointegration link between China as well as the US agricultural commodity futures market. Soybean futures on the Chinese and American agricultural futures markets may diverge in the short run, but they will eventually be adjusted to a synergistic relationship, which will be apparent as a long-term equilibrium relationship. The price of futures for soybeans in China and the price of soybean futures in the United States have a Granger guiding relationship, and the error correction term has a negative modification effect on the price of soybean futures in the People's Republic if the error correction term is positive, the price of soybean futures in China will decrease moving forward. Statistics also indicate that the price of Chinese soybean futures is not zero and instead has a lagging guiding effect on itself. The IRF's findings demonstrate how long-lasting the effects of the Chinese and US markets are on one another.

During the trade dispute between the Chinese and US and the epidemic period, the soy bean futures markets in two countries exhibited an unstable price trend. During the trade war, there was a negative link between the price of soya futures in the US and China. Investor sentiment has an inverse relationship with futures market yields. According to the premise of the Sino-US trade war, investors on the futures markets have different local investment tendencies, which, along with changes in the objective economic conditions, like tariffs, causes soybean futures prices in the two countries to move in the opposite direction. During the epidemic period, soybean futures prices in China continued to rise, while those in the United States fluctuated little. This is not only the impact of the epidemic on the reduction of global grain production and farmers' agricultural conditions and enthusiasm, but also reflects China's dependence on the United States in the soybean industry and the insufficient and incomplete ability of soybean futures risk prevention and control.

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