

An empirical analysis on the price discovery function of iron ore futures market in China

Fangqun Zhang *, Yangfu Li

Guangdong Peizheng College, Guangzhou, Guangdong Province, China

*Corresponding author (Zhang Fangqun) Email: 304697043@qq.com

Abstract: The role of the iron ore futures market in price discovery is crucial when studying the future trend of China's iron ore market. To promote the healthy and sustainable development of China's iron ore futures market, this study collected data on the closing prices of the main chain of iron ore and China's iron ore spot price index from December 2019 to December 2023 in the Dalian Commodity Futures Exchange. This paper aims to empirically analyze research methods and explore the mechanism behind price discovery in China's iron ore futures market. Through detailed empirical research and in-depth analysis, this study reveals a close relationship between the volatility of iron ore futures and iron ore spot market prices, forming a long-term economic balance between them.

Key words: Iron ore spot price; Iron ore futures prices; Price discovery

1. Literature Review

In a study conducted by Liu Xin (2020), techniques such as impulse response function and variance decomposition were applied to identify a long-term cointegration characteristic between the futures and spot prices of iron ore. Hu Zhenhua, Zhong, and Wang Huanfang (2018) found through an empirical study centered on the VEC-SVAR model that there exists a close correlation and long-term equilibrium between China's iron ore futures price and domestic and foreign spot prices. Additionally, Wang and Fan (2019) demonstrated that market sentiment may have a negative effect on both futures and spot prices of iron ore. Furthermore, Wang Xingfen and Liu Changhao (2020) concluded from their research analysis that the sentiment index serves as the Granger cause for fluctuations in iron ore futures price. They also highlighted how combining the sentiment index with technical characteristics can enhance trend accuracy in predicting iron ore futures price movements.

2. Empirical analysis on the price discovery function of iron ore futures in China

2.1 Data selection and processing

2.1.1 Selection of sample data of iron ore futures

This paper selects daily data from December 2, 2019 to December 29, 2023 to analyze the price discovery function of iron ore futures.

2.1.2 Correlation analysis

Firstly, the correlation between China's iron ore futures price and spot price is studied to determine whether there is an equilibrium relationship. Figure 1 below shows the trend of China's iron ore spot price from December 2, 2019 to December 29, 2023. From the data, it can be observed in this paper that the trend of iron ore spot price and futures price is generally similar, with the overall rise first. The spot price and futures price of iron ore reached the highest value of 1326 yuan/ton on May 10, 2021, and then gradually declined, reaching the lowest value of 609 yuan/ton on December 2, 2021, and then the price gradually tended to fluctuate around 1000 yuan/ton. Therefore, it can be seen from Figure 1 that there is a long-term equilibrium relationship between the spot price and the futures price of iron ore. At the same time, as shown in the correlation analysis results in Table 1 below, the

correlation coefficients between the two groups of variables of iron ore futures price and spot price are all higher than 0.9, and there is a very significant positive correlation between the futures market and spot market, which indicates that they are closely related, and there is a price interaction and influence effect. Figure 1 shows the trend of iron ore futures price and spot price. Table 1 shows the correlation analysis results between iron ore spot price and futures price.



Figure 1 Chart of iron ore futures price and spot price

(The blue curve in the graph shows the spot price of iron ore and the orange curve shows the iron ore futures price.)

Note: The figure shows the trend of iron ore futures and spot prices. The blue curve in the figure is the spot price of iron ore, and the orange curve is the iron ore futures price. Data source: iFund Flush database (self-drawn)

Table 1 Correlation analysis results of iron ore spot price and futures price

	LNCSI	LNDCE
LNCSI	1	0.9297
LNDCE	0.9297	1

Data source: empirical analysis results

2.2 Empirical test on the price discovery function of China's iron ore futures market

2.2.1 Descriptive statistics

It can be seen from Table 2 that the mean values (LNCSI is 6.80, LNDCE is 6.70), maximum values (LNCSI is 7.42, LNDCE is 7.20) and minimum values (LNCSI is 6.38, LNDCE is 6.24) of the two groups of variables are relatively close. It indicates that the price difference between the futures market and the spot market of iron ore is very small. The skewness coefficients of LNCSI and LNDCE both exceed 0 and are right-skewed, which means that they do not follow the normal distribution law. As shown in Figure 1, the time series volatility trends of the two groups of variables are very similar, showing extremely high convergence.

Table 2 Descriptive statistics of iron ore futures price and spot price in China

	LNCSI	LNDCE
Mean	6.798326	6.698215
Median	6.787907	6.697651
Maximum	7.416577	7.198184
Minimum	6.375587	6.237348
Std. Dev.	0.204903	0.182225
Skewness	0.614603	0.314728
Kurtosis	3.331244	2.685669
Jarque-Bera	66.98774	20.46077
Probability	0.000000	0.000036
Sum	6743.939	6644.629
Sum Sq. Dev.	41.60724	32.90719
Observations	992	992

Data source: empirical analysis results

2.2.2 ADF stationarity test

Spurious regression means that even though there is no direct correlation between the variables, the results of the regression analysis falsely confirm that there is some form of correlation between them. This phenomenon, called spurious regression, is mainly caused by the instability of time series variables. In order to verify the stability of the time series data, this paper uses Eviews7.2 to conduct a stationarity test on the data. The test objects are the logarithm-based China Iron ore spot price Index (LNCSI) and iron ore futures price (LNDCE), and the results are shown in Table 3 below:

Table 3 ADF test results

	ADF	1%	5%	10%	P	Conclusion
LNCSI	-1.989588	-3.436736	-2.864248	-2.568264	0.2916	unsteady
LNDCE	-2.457757	-3.436729	-2.864245	-2.568262	0.1264	unsteady
D (LNCSI)	-26.99437	-3.436736	-2.864248	-2.568264	0.0000	steady
D (LNDCE)	-33.11949	-3.436736	-2.864248	-2.568264	0.0000	steady

Data source: empirical analysis results

According to the ADF detection data in Table 3, it is observed in this paper that the ADF values of LNCSI and LNDCE time series data both exceed the critical values at the significance levels of 1%, 5% and 10%, which indicates that the time series data of LNCSI and LNDCE are at the confidence level of 99%. These two sets of data both follow the previous hypothesis, and the p-value exceeds 0.05, which means that they have unit roots, so LNCSI and LNDCE are a pair of non-stationary time series data when the logarithm of the two data is taken.

Subsequently, we need to conduct a detailed first-order difference test on LNCSI and LNDCE. This point can be clearly reflected from the analysis results that the ADF values of D(LNCSI) and D(LNDCE) time series are lower than their critical values at the significance levels of 1%, 5% and 10%. That is to say, the time series of D(LNCSI) and D(LNDCE) reject the null hypothesis at the 99% confidence level, and the P values of the two data are less than 0.05 at this time, that is, there is no unit root, so the null hypothesis cannot be accepted. At this time, the time series data of LNCSI and LNDCE are a set of stationary time series. Through the application of ADF unit root test in Table 3 above, this paper observes that there is a close relationship between the price fluctuation range of iron ore futures price and spot price. Iron ore spot and futures prices in China have shown a steady trend.

2.2.3 Johansen cointegration test model

Next, Johansen cointegration test method will be used to deeply explore the long-term balance relationship between the iron ore futures and spot market price fluctuations. The test results are shown in Table 4 and Table 5:

Table 4 Johansen cointegration test results

Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.319730	604.9901	15.49471	0.0001
At most 1 *	0.203137	224.3481	3.841466	0.0000

Data source: empirical analysis results

Table 5 Johansen cointegration test results

Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.319730	380.6420	14.26460	0.0001
At most 1 *	0.203137	224.3481	3.841466	0.0000

Data source: empirical analysis results

It can be seen from Table 4 that there is a cointegration relationship between the two variables of iron ore futures price and spot price. After research, this paper finds that the trace statistics cover the statistical data of the largest eigenvalue, and their values exceed the critical value at the 5% confidence level, which indicates that there is a durable and stable balance relationship between spot price and futures price. In the Johansen cointegration test, it is found in Table 4 and Table 5 above that there is a long-term equilibrium between the futures market and the spot market, and after a long time of evolution, there is significant consistency and synergy between them.

After the above variance decomposition analysis of the two chart data of LNDCE and LNCSI, it can be concluded that the spot price of iron ore has a greater impact on its futures price, but in contrast, the impact of iron ore futures price on spot price is relatively small.

3. Conclusions and prospects

3.1 Research conclusion

Taking the daily transaction price data of iron ore futures and spot in China from December 2, 2019 to December 29, 2023 as the research object, this study uses descriptive statistics, ADF unit root test and other research methods to conduct a detailed empirical analysis of iron ore futures price and iron ore spot price. These analyses further reveal the price correlation between China's iron ore futures price and its spot price, explore the internal connection, and draw the following conclusions:

3.2 Policy suggestions

According to the empirical analysis in this paper, the iron ore futures market can provide assistance for the discovery of domestic spot prices in the initial stage. But in China, there is room for the maturity of the iron ore futures market to increase, and to ensure the health of the market and maximize its price discovery power, further promoting its sound development is crucial. In view of the actual situation in China, this article gives several specific suggestions:

3.2.1 Strengthen and improve the development of domestic iron ore resource supply system and reduce domestic iron ore prices

The problems encountered by China's iron ore include insufficient iron content, difficulty in mining and high cost. These factors make China's iron ore supply rely on external imports for a long period of time, making China's iron ore supply and iron ore pricing subject to others. If such a situation continues, from a long-term perspective, This situation may have a negative impact on the development of China's iron ore market and steel smelting industry. Considering this problem, it is particularly important to optimize China's iron ore supply strategy. The state should continue to attach great importance to this matter, establish a more perfect and effective iron ore supply system mechanism, and promote the long-term development of China's iron ore futures market.

3.2.2 Promote the internationalization of iron ore futures market and realize the pricing power of international iron ore market

Strengthening the connection between China's iron ore futures and the international version of iron ore futures, especially in order to accelerate the internationalization process of China's iron ore futures has become particularly important. Doing so can not only help China's iron ore industry to adjust and improve the structure, but also continue to enhance the competitive strength of China's iron ore futures in the global iron ore market, bringing new opportunities and breakthroughs. In order to fully realize the potential of China's iron ore futures market in price identification, the construction and improvement of the domestic market becomes an indispensable step. In order to further strengthen the infrastructure construction of China's iron ore market, this paper aims to promote the transformation of domestic iron ore futures to the international market. By continuously improving the pricing ability of China's iron ore futures, we expect to gradually occupy the core position in the pricing strategy of the global market.

3.2.3 Strengthen the external supervision mechanism of iron ore trading market and improve the transparency of market transaction information

In order to conduct more refined management and monitoring of iron ore trading, the government must strengthen external guidance and monitoring, and constantly use the influence of the government to optimize its regulatory structure. For example, the use of external mandatory regulatory measures, or the government's use of legal procedures to ensure the stability of iron ore trading, and the establishment of an information sharing platform for iron ore futures trading, etc. When disclosing the monitoring data of the iron ore market, national and local governments at all levels must ensure that the latest relevant information is transmitted to investors in a timely, accurate and rapid manner, so that they can quickly make appropriate investment choices based on the latest data.

3.2.4 Continuously develop and improve the product structure in China's iron ore futures market

Due to differences in the accuracy and composition of iron ore, as well as the wide variety of different types of iron ore, currently, in China's iron ore market, there are multiple categories of spot products, but there is no clear division of the futures market, which brings no small challenge to investors in the delivery. Therefore, it is crucial to make a clear distinction between Chinese iron ore futures products for the price setting of Chinese iron ore futures. By strengthening and improving the product price adjustment mechanism of China's iron ore market, this paper has the ability to influence the effect of iron ore futures price on China's iron ore spot price more efficiently, which will help further promote the realization of the function of China's iron ore futures market in price discovery.

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