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The Study on the Pricing of Commodity Futures and the Direction of Development in China

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Abstract

China's futures market, a vital component of the modern market economy, has undergone a challenging and delayed evolution since its inception during the reform and opening up era. Despite its significance in constructing China's market system, in-depth theoretical research on the country's futures market remains limited. Given that it has an overwhelming role in constructing China's market, an objective assessment of its operational efficiency becomes imperative. A well-regulated and mature futures market should exhibit a sustained equilibrium relationship between futures and spot prices. Therefore, this paper takes this as the object of research, firstly, it discusses the importance of the long-term equilibrium relationship between the two. Secondly, it proposes four research methods for the equilibrium relationship between the two. Thirdly, it takes copper, a futures product, as the object of research, and conducts an empirical study on the long-term equilibrium relationship between spot prices and futures prices, finally, it puts forward three suggestions for the development and improvement of China's futures market, in order to provide a reference for the development and improvement of the futures market.

Keywords

Futures price, Spot price, Long-run equilibrium relationship

1. Introduction

The futures market holds a vital position in the modern market economy, serving as an indispensable element of the national economy for price discovery and risk management. China's transition from a planned to a market economy has fueled the gradual development of its futures market. Integration into the global market system following WTO accession has presented unprecedented opportunities and challenges.

Recognizing its significance, the Communist Party of China (CPC) and the government have prioritized the steady development of the futures market since the 17th National Congress. However, this journey has been marked by obstacles and mixed evaluations. In-depth research remains limited, with a prevalence of qualitative theoretical studies rather than quantitative empirical analyses.

Price patterns play a pivotal role in a well-functioning futures market, accurately reflecting supply and demand dynamics in the spot market and providing a proactive mechanism for regulating spot prices. However, an immature and non-standardized futures variety may deviate significantly from spot prices, transforming into a speculative symbol controlled solely by market forces. Such deviations hinder the market's ability to fulfill its role in price discovery and risk management, posing additional risks to participants and the broader economy.

2. The importance of a long-term equilibrium relationship between futures prices and spot prices

2.1 The formation mechanism of futures price

Futures trading involves buying and selling standardized contracts on an exchange, representing the future delivery of a specific quantity and quality of a commodity. The futures price is the trading price of the contract, inclusive of VAT, for the standard product to be delivered at a designated warehouse.

2.2 Importance of the existence of a long-term equilibrium relationship between futures prices and spot prices

The futures market and the underlying spot market are highly correlated, yet drawing definitive conclusions regarding the impact of information on both markets remains challenging. This study aims to establish a long-term stable equilibrium relationship between the trading prices of the two markets and investigate the leading-lagging relationships between them. It seeks to determine whether futures lead spot, spot leads futures, or if they are causally or independently related. Additionally, the analysis examines the extent to which information generated in one market influences the other. By verifying the correlation and studying the leading-lagging relationships under equilibrium conditions, this research aims to comprehensively demonstrate the characteristics of the long-term equilibrium relationship between the futures and spot markets.

2.2.1 Helps to test the impact of different trading regimes on the realization of the price discovery function in futures markets

In mature futures and spot markets, the relative transaction costs and trading restrictions of futures and spots are key factors in determining price discovery in both markets. As for any futures market, its own trading system directly affects the cost of futures market transactions while imposing restrictions on futures trading. Examples include the margin system, the setting of trading fees, the capital gains tax levied on futures trading, and the rules governing the types and maximum limits of futures trading by individuals and legal entities. Emerging futures markets differ significantly from mature futures markets in terms of trading systems, and both market regulations and trading mechanisms have distinct regional characteristics. In this context, studying the performance of futures markets in terms of price discovery under the role of different trading regimes can be used to analyze the strengths and weaknesses of different trading regimes based on the results of the study, and provide empirical references for market management to improve and adjust the trading system.

2.2.2 Helps to examine and analyze the differences in the speed of transmission of new information in futures markets under different market structures, and thus analyze the cons and pros of different futures market structures

The futures market structure has a more direct impact on price discovery than the trading system. The market structure of the futures market includes a number of factors such as short-selling restrictions, financial leverage ratios (margin ratios), minimum charge amounts, market maker systems, trader conditions, and market liquidity, in addition to the relative transaction costs of futures and spot and trading restrictions mentioned above. The many factors of market structure play a very significant role in the rapid transmission of information in the futures market. Differences in market structure in futures markets with different levels of development may be the main reason for the different speeds of response and adjustment of prices in futures markets and spot markets in different regions. By studying the long-term equilibrium relationship between futures markets and spot markets, the findings can be used to compare the usefulness of different market structure factors for price discovery and provide input for the continued improvement of mature futures markets and the promotion of emerging futures markets.

2.2.3 Helps to test the market price correction effect of arbitrage and to analyze the extent of the impact of trading behavior on price discovery

Arbitrage behavior is an important mechanism for maintaining consistent price discovery between the two markets. The stable relationship between futures and spot prices can be accurately described by a mathematical model with transaction costs. In the absence of market frictions, when the prices of the two markets deviate from the relationship described by the model, arbitrageurs in the market trade the two markets in opposite directions, thereby earning risk-free profits. The impact of arbitrage behavior on the market is reflected in the correction of market price deviations, so that when the price of one market fluctuates by the appearance of information, arbitrage behavior quickly transmits the information to the other market, causing its original price to change, and eventually prompting the price of the two markets to fall back to equilibrium. If arbitrage is not carried out in a timely manner, price changes in the dominant market cannot be transmitted to the satellite market in a timely manner, resulting in a significant price lead-lag relationship between the two markets. Therefore, by studying the long-term equilibrium relationship between the futures market and the spot market, it is possible to analyze the role of arbitrage behavior between the two markets and the extent of its impact on price corrections.

3. Methodology for studying the long-term equilibrium relationship between futures prices and spot prices

3.1 Co-integration test

An effective method to study the relationship between variables is regression analysis. Before the co-integration theory was proposed and refined, two main types of methods were used to conduct regression analysis studies: the traditional econometric method of joint cubic or single equation, which regresses several variables of interest through least squares regression; and the auto-regressive moving average model (ARMA) proposed by Boxer-Jenkins in time series analysis, which extends the regression analysis of variables of interest to their variable lagged terms and residual lagged terms. A prerequisite assumption for regression analysis in traditional econometrics is that the data of the variables to be regressed are stable; however, scholars in this period did not pay attention to whether economic and financial data were stable in their analysis but assumed that economic and financial data obeyed the stability process of normal distribution, which was reasonable from the point of view of the time.

3.2 Error Correction Model (ECM)

The existence of a cointegrating relationship among variables indicates the existence of a stable equilibrium relationship among these variables in the long run, which is maintained by the continuous adjustment of the short-run dynamic process. This is possible because a moderating process, the error correction mechanism, is at work, preventing deviations in the long-run relationship from increasing in size or quantity. Thus, any two sets of mutually cointegrating time series variables have an error correction mechanism that reflects short-term adjustment behavior. This is the famous "Granger causality test" (Qin Jieye, Green Christopher J., & Sirichand Kavita, 2021).

$$\mathrm{d}(\mathrm{f}_t) = \alpha_1 + \sum_{i=0}^{m} \beta_{1i}\mathrm{d}(\mathrm{p}_{t-i}) + \sum_{i=0}^{m} \gamma_{1i}\mathrm{d}(\mathrm{f}_{t-i-1}) + \lambda_1 e_{t-1} + u_{it}$$

$$\mathrm{d}(\mathrm{p}_t) = \alpha_2 + \sum_{i=0}^{m} \beta_{2i}\mathrm{d}(\mathrm{p}_{t-i}) + \sum_{i=0}^{m} \gamma_{2i}\mathrm{d}(\mathrm{f}_{t-i-1}) + \lambda_2 e_{t-1} + u_{2t}$$

3.3 Granger causality test

The existence of a cointegrating relationship between futures and spot prices indicates that futures prices are unbiased estimates of spot prices, but this only indicates the existence of a long-run equilibrium relationship between the two variables. The existence of a long-run equilibrium relationship between the two variables does not indicate who among the two variables plays a leading role in price discovery. To do this requires an analysis of Granger causality between futures prices and spot prices.

$$\mathrm{p}_t = \sum_{i=1}^{m} a_{1i} p_{t-i} + \sum_{j=1}^{n} b_{ij}\mathrm{f}_{t-j} + e_{1t}$$

$$\mathrm{f}_t = \sum_{i=1}^{m} a_{2i} \mathrm{p}_{t-i} + \sum_{j=1}^{n} b_{ij}\mathrm{f}_{t-j} + e_{2t}$$

It is important to note that when performing the Granger causality test, separate tests are usually performed for different lag lengths to ensure that the random error terms in the causality test are not serially correlated.

3.4 Methods for constructing futures price series

It is easy to construct a spot price series based on the trading records in the spot market, but not in the futures market. A futures trading species generally trades several contracts for delivery in different months at the same time, and the prices of each month's contract are further divided into opening price, high price, low price, closing price, and settlement price. It is worthwhile to carefully consider what data is selected as representative of the futures price of the day, thus constituting a continuous price series.

Since the opening price, the highest price and the lowest price are susceptible to chance factors. In contrast, the closing price is the last traded price of the day, this data can best reflect the impact of the latest information on the price on the trading day, so the daily closing price has been selected as the representative of the futures price in the past literature.

The daily settlement price of a particular month's contract is the volume-weighted average of the day's traded prices. The futures market has a large trading volume and high liquidity, and the prices traded within the day often have a relatively wide distribution range. Although the closing price is the last trading price of the day, reflecting the impact of the latest information on the price of the day of trading, after all, it is only a specific trading price, from the perspective of reflecting the overall transaction situation of the day, only the settlement price is the most representative. The settlement price is not only the basis for calculating the floating win and loss of the day's settlement but also the base point for determining the next day's trading price halt and stop, which also shows the importance of the settlement price. Therefore, some people choose the settlement price as the representative of futures prices. This article agrees with this selection method.

$$\mathrm{f}_t = \sum_{i=1}^{m} a_{2i}\mathrm{p}_{t-i} + \sum_{j=1}^{n} b_{ij}\mathrm{f}_{t-j} + e_{2t}$$

4. An empirical study on the equilibrium relationship between futures prices and spot prices—with copper as the object of study

4.1 Variety Profile

Copper is one of the first ancient metals discovered by mankind and was used by humans more than 3,000 years ago. In modern society, copper has a wide range of applications: its high thermal and electrical conductivity makes it a pivotal material in the electrical and electronics industry; it is chemically stable and corrosion resistant, and can be widely used in the energy and petrochemical industries and the light industry; it has high tensile strength, is easy to fuse, and is malleable and ductile.

4.2 Data description

This paper constructs the copper futures price series based on the daily quotation data of Shanghai Futures Exchange, according to the method and formula (6) described in section 3.4 of this paper; the trading of copper metal in the Yangtze River non-ferrous metals spot market is relatively active, and the quality standard of copper metal for spot trading is consistent with the quality standard of copper metal contract in the Shanghai Futures Exchange, and the resulting spot price is very representative, so the Yangtze River The spot price of copper metal in the Yangtze River non-ferrous metal spot market is selected as the representative spot price, which is denoted as {Pt}. The sample period is from October 10, 2006, to September 28, 2008. Considering the correspondence of the two time series data, only the futures price but not the spot price, or only the spot price but not the futures price are excluded, and 485 pairs of valid data are obtained.

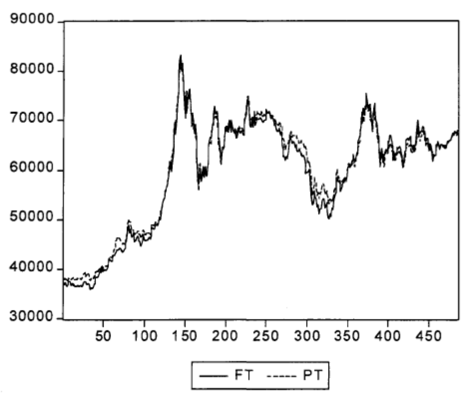

Figure 1. Copper futures price (FT) and spot price (PT) chart.

The trend of the futures price data series (hereinafter referred to as futures price) and the spot price data series (hereinafter referred to as spot price) are first depicted graphically to make a judgment on the correlation between the two series intuitively, as shown in Figure 1. As can be seen from the graph, there is a strong correlation between copper futures prices and spot prices.

4.3 Co-integration relationship test

The data stationarity analysis shows that both copper futures price and spot price are first-order single integer time series, which are eligible for cointegration analysis. Whether for 1%, 5%, or 10% confidence level, the ADF value is less than the critical value, so the null hypothesis is denied, indicating that the series is smooth and the cointegration relationship holds. This indicates that there is a long-run equilibrium relationship between copper futures prices and spot prices. The regression relationship between them is meaningful and the inference depending on the t-test and F-test is not problematic.

According to the cointegration equation of copper futures and spot prices, the goodness of fit $R^2 = 0.990$ and the t-test value of the coefficient of spot price p_t is 219.249, which is a good model fit, indicating that the spot price p_t has strong explanatory power for the futures price f_t; the proportional relationship between futures price swallow and spot price p_t is 1.044, which is close to 1, indicating that the futures price and spot price move in the same direction in long-run equilibrium, and the changes The magnitude of the movements is approximately equal, indicating that external information affects the movements of both markets to almost the same extent.

4.4 Granger causality test

The Granger causality between futures and spot prices is analyzed below using Eviews 5.0 to show which of the two variables plays a leading role in the discovery of prices. The tests were conducted separately for different lag lengths to be confident that the random error terms in the causality test are not serially correlated. The results of the tests were organized as shown in the following table (Bin Gao, Jun Xie, & Yun Jia, 2019).

The following table of copper futures price and spot price Granger causality test table significance level a=0.05.

Table 1. Copper futures price and spot price Granger causality test table (significance level a=0.05)

Number of lag periods	Granger causality	F-value	Conclusion
3	Spot prices do not guide futures prices	2.11268	Rejection
	The futures price does not guide the spot price	11.4389	Rejection
4	Spot prices do not guide futures prices	2.5129	Rejection
	The futures price does not guide the spot price	7.34326	Rejection
5	Spot prices do not guide futures prices	2.82088	Rejection
	The futures price does not guide the spot price	6.59556	Rejection
6	Spot prices do not guide futures prices	2.51543	Rejection
	The futures price does not guide the spot price	5.53866	Rejection

From the Granger causality test, it is clear that there is a significant two-way causal relationship between the futures price and the spot price of copper. This conclusion can be interpreted that for copper, investors can predict the spot price based on the futures price and also predict the futures price based on the spot price, and the futures price and the spot price influence and guide each other. This is consistent with the conclusion of the previous analysis based on the error correction model.

5. Conclusion

This study underscores the maturation of China's futures market, as evidenced by the establishment of a long-term equilibrium relationship between commodity futures and spot prices. The market's effective price discovery mechanism offers valuable guidance to producers and consumers while providing a platform to manage price risks. The implementation of revised regulations in 2007 further solidified the market's legal foundation, fostering its growth and development.

However, challenges persist, as the current futures market in China falls short of meeting the hedging and risk-aversion needs of many enterprises. With only 19 traded varieties compared to over 260 globally, there is room for improvement. To address these limitations and enhance the market's contribution to the national economy, it is crucial to prioritize the development of the futures market. Accelerating economic transformation, improving the socialist market economy system, optimizing resource allocation, and fostering market scale and efficiency are essential steps to fulfill the market's potential. By doing so, the futures market can better serve the needs of enterprises, promote risk mitigation, and facilitate optimal resource allocation for overall market growth and efficiency.

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