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Correlation between agricultural markets in dynamic perspective—Evidence from China and the US futures markets

Rui-Lin Jia [a], Dong-Hua Wang [a,b,*], Jing-Qing Tu [a], Sai-Ping Li [c]

[a] School of Business, East China University of Science and Technology, Shanghai 200237, China
[b] Research Center for Econophysics, East China University of Science and Technology, Shanghai 200237, China
[c] Institute of Physics, Academia Sinica, Nankang, Taipei 115, Taiwan

HIGHLIGHTS

- We study the correlation between China and US agricultural futures markets in both returns and volatilities.
- We use thermal optimal path (TOP) method to examine the lead–lag relationship.
- We analyze the change of lead–lag order based on three partitioned stages.
- We contrast the lead–lag function of three different agricultural commodities varieties.

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ABSTRACT

Emerging as the earliest futures markets, agricultural futures markets play an important role in risk aversion and price discovery. With the integration of global economy, the linkage between domestic and international futures markets becomes closer than ever. By using the thermal optimal path (TOP) method, this paper selects soybean, corn and wheat as the representatives to study the dynamic lead–lag relationship between the Chinese and American markets in both returns and volatility. The results indicate that: (1) For the futures return, different kinds of agricultural futures lead–lag relationship between China and the US varied before 2014 both in direction and order in different time periods. However, China leads the US for all the three kinds we study after 2014. (2) Agricultural commodities subject to less import restrictions and government regulations in China such as soybean are more susceptible to the fluctuations from the international markets. On the other hand, lower foreign trade openness and more government regulation species such as wheat are less affected by fluctuations from outside. (3) The volatility transmission from the US to China wheat futures market takes longer time than soybean, which suggests that China's soybean futures market is more closely linked to the international agricultural futures market than wheat.

1. Introduction

In recent years, China's agricultural markets have been growing rapidly, mainly due to the expanding trade with other countries. In 2011, China replaced the United States and became the world's largest importer of agricultural products. The

* Correspondence to: 130 Meilong Road, P.O. Box 114, School of Business, East China University of Science and Technology, Shanghai 200237, China.
E-mail address: dhwang@ecust.edu.cn (D.-H. Wang).

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total value of China's agricultural imports has increased dramatically to more than 1.1 trillion dollars in 2014. Despite the fact that the trading volume of China's agricultural products keeps growing, its trade position is not optimistic, meaning that the prices of China's most important agricultural products can only passively follow the international markets and do not have strong international pricing power. For example, wheat and corn as well as many others from China cannot compete with those from the US, Canada and other countries due to quality problems, resulted in an inferior international trade position. Traditional agricultural products such as soybeans and cotton have lost their advantages after China joined the World Trade Organization since they are no longer protected by domestic high tariffs. As a result, China has to import large quantities of agricultural products passively every year.

Under the planned economy system, the commodity futures market cannot perform its role of price discovery and hedging as the government controls the price of almost all commodities. Since the reform and open-up policy in 1970s, China began to release the price control and to reduce direct government intervention to allow the market to gradually build a socialist market economy. Since then the commodity prices began to fluctuate dramatically. Yet, a valid hedging market mechanism did not exist at that time and a large number of market participants suffered great loss from huge price fluctuations. For example, the Chinese "soybean crisis" in 2004 brought huge market risks for the operation and production of the whole soybean-related industrial chain. In recent years, with the integration of the global economy, the linkage between markets in China and other countries has become closer. In particular since 2007–2008, the prices of international agricultural commodities fluctuated significantly and brought new challenges for Chinas domestic agricultural markets that threatened peoples livelihood.

Accordingly, the study on the linkage and transmission effects between domestic and foreign markets is essential in the trend of economic integration. The present work will not only help us understand the current situation of China's agricultural futures market deeper, but will also help us carry out proper strategies to compete in the international market, and to further improve Chinas pricing power of agricultural products among the international markets.

2. Literature review

A perfect market system is a prerequisite for the healthy smooth operation of the market economy. Futures market, as an extension of stock market, is becoming an integral part in the contemporary financial markets due to its function of risk aversion and price discovery. A highly developed commodity futures market can provide hedging tools for market participants.

In recent years, researchers have conducted research on futures markets from different perspectives including spot-futures price relationship, volume–price relationship and the linkage between different futures markets [1–6]. Early studies e.g., Garbade and Silber [1] presented a model to examine the price discovery mechanism of futures market and the effect of arbitrage on price changes in commodities spot-futures markets, extending the existing methodology to this area. Chan et al. [3] employed a bivariate GARCH model to study the intraday return relationship between Standard and Poor's stock index and its futures, and suggested that the volatility of the spot and futures returns has a strong inter-market dependence. On the contrary, other studies reported conflicting conclusions that there are no significant volatility spillovers from the spot market to the futures market [4]. Using the intraday five-minute interval data, Lihara [2]also proved that the information flow observed in the spot and futures market is unidirectional, which is different from the results given in Chan et al. [3].

The "instantaneous adjustment" property of an efficient market was put forward by Fama [7], which suggests that the history of the series cannot effectively predict its future. According to the efficient market hypothesis, the transmission effect does not theoretically exist across different financial markets since any useful information will be digested by the financial markets promptly. Yet, the spillover effect and inter-market information transmission has been observed and discussed in rich literatures and researchers began to pay more attention to the research of the linkage between different financial markets in recent years. The early works in this field mainly focus on the stock markets [8–11]. For example, Hamao et al. [8] examined the spillover effect between stock markets in the US, the UK and Japan, and the spillover effect shows an intriguing asymmetry. Similar evidence was observed by Susmel and Engle [9]. Contrary to the results in Refs. [8–11], Lin et al. [10] showed that cross-market interdependence in returns and volatility between the US and the Japanese stock markets was bi-directional. Based on the conception of stock-markets integration, evidence has been found that some international stock markets share the same volatility process [11].

In the trend of global economy integration, the linkage between China and the world markets is becoming closer. China is more vulnerable to the fluctuations of the international markets in recent years. Previous studies [12–21] provide abundant resources to investigate the linkage between different financial markets in the world. These studies suggest that the US plays a predominant role in information flow across international financial markets. For example, Xu and Fung [17] found that the US market played a more important role than the Japanese market by examining the cross-market price spillover effect of gold, silver and platinum futures. After the large swings of agricultural commodity prices between 2007 and 2008, Beckmann and Czudaj [20] found that a short-run volatility transmission process existed between the US and China agricultural futures markets, but the impacts died out in the long-run. Zhang and Qu [21] studied the effect of global oil price shocks on six kinds of agricultural commodities in China, and found that the oil price shocks had different effects on different agricultural commodities.

One should be aware that most of the previous studies on futures markets employed linear parameter methods [22–24]. For example, based on the Johansen's co-integration approach, Wang and Ke [23] studied the efficiency of Chinese wheat and