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Does the Financialization of Agriculture Exist in China? Evidence from Sugar Industry

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Financialization refers to the growing importance of finance, financial markets, and financial institutions to the functioning of the economy. This paper thus examines the consequences of agricultural financialization in the Chinese sugar market. We use monthly data from January 2006 to June 2019 to build a series of econometric models to identify internal and external shocks and their transfer regimes through impulse response analysis, variance decomposition, and Granger causality test derived from a structural vector autoregression model. We conclude that the phenomenon of agricultural financialization does not exist in the Chinese sugar market.

Key words: agricultural finance, commodity prices, structural vector autoregressions

INTRODUCTION

In economic globalization and financial integration, agricultural systems have become increasingly complex. As an emerging economy, China has never been an exception since its agriculture industry has continued to expand and served as the underlying support for national economic growth over the past decades. Participants in agricultural activities have been increasingly involved in financial activities to reduce their own risk exposure or benefit from their predictions of future prices. Over the past few years, the prices of sugar, corn, garlic, ginger, and beans have risen abnormally, indicating that food prices are no longer solely dependent on supply and demand in the domestic market, and the presence of Chinese commodities is affected by financial factors. Epstein said, "Financialization means the increasing role of financial motives, financial markets, financial actors and financial institutions in the operation of the domestic and international economics (Epstein, 2005)." In this paper, we refer to the financialization of agriculture as the impact of the expansion of the use of financial instruments such as futures and derivatives on agricultural prices.

Sugar is indispensable in people's lives and an indispensable raw material for sugary foods such as snacks, drinks, sweets, and in the pharmaceutical industry. Sugar cultivation plays an important role in China's agricultural economy, with its output and value ranking fourth, following grains, oilseeds, and cotton. As a developing country with a huge population and great demand for the industry, China also has a great demand for sugar. At present, China is the third largest consumer of sugar. In international financial markets, sugar is an actively traded product. Sugar futures were listed and traded on the Zhengzhou Commodity Exchange in China on January 6, 2006. China's sugar market has been liberalized for nearly thirty years, with a high degree of sugar marketization. Sugar prices have been completely formed by the market.

Instability in sugar prices could cause serious social and economic problems for example, poverty, trade disputes, and so forth. Agricultural price volatility, especially for China, an agriculture–dependent developing country, could be more harmful. In this paper, we select the sugar industry as the subject of our study, considering the unique position of sugar among agricultural products with drastic price fluctuations.

The dramatic fluctuations in agricultural prices in recent years have sparked a series of intense discussions about the financialization of agriculture. Pindyck and Rotemberg (1990) argue that macroeconomic variables do not fully explain commodity price movements. They suggest that financial speculators may have influenced prices but do not provide further proof of the cause. Tang and Xiong (2012) showed that the prices of non–energy commodities are increasingly correlated with oil prices. They argue that this reflects a fundamental process of financialization of commodity markets, where the prices of individual commodities are no longer determined solely by their supply and demand but also by the overall risk appetite for financial assets and the investment behavior of investors in diversified commodity indices. Their study proves the existence of the financialization phenomenon. However, it does not target agricultural futures markets but only commodity market indices, and also limits the financialization indicators to oil prices without considering the financial markets in an integrated manner. Ruipeng *et al*. (2012) proposed the phenomenon of agricultural financialization in China's grain system. The development of financialization of agriculture in China is reflected in two aspects. One is the development of the agricultural futures market. The second is the increase in investment activities in agricultural products. Their study expresses some phenomena

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of agricultural financialization but does not study the relationship between financial activities and agricultural markets. Xueling *et al*. (2013) said that excess monetary liquidity and oil prices have had a significant impact on agricultural prices in China and that financialization of agriculture exists. Xingong (2012) added that the "value exploitation" function of bioenergy on agricultural products has led to an increasing detachment of agricultural price performance from the real commodity market supply and demand, with agricultural prices being influenced by financial markets. Clapp (2014) considered that new financial actors have entered the agri–food commodity chain and have gained significant power in it through the use of new and complex financial derivatives. Ouyang and Zhang (2020) believed that the phenomenon of agricultural financialization exists in China. They used the time–varying copula approach to explore the relationship between the Chinese agricultural and stock market. All of the above studies show that agricultural markets are influenced by financial markets. Because the Chinese agricultural futures market has been in its infancy in recent years and Chinese researchers have not used Chinese futures prices for data correlation analysis in this field, data from international commodity futures markets are used in this paper.

However, so far, there have been few other quantitative studies on the impact of financialization on the Chinese agricultural system except Ouyang and Zhang (2020), and the present study will explain the phenomenon of agricultural financialization in China from the perspective of the impact of international financial markets on China's agricultural markets. Accordingly, the objective of this study is to determine whether agricultural financialization exists in the Chinese sugar market using time series analysis. Our research strives to provide a better understanding of the impact of financial markets on agricultural price volatility, as well as ideas for the government regulation of market prices.

Focusing on changes in the impact of external commodity markets on agricultural prices, the model makes the following hypothesis:

Hypothesis: Changes in external commodity markets in which financial investors participate can lead to contemporaneous price changes in agricultural futures markets.

The remainder of this paper is organized as follows: Section one presents the conceptual framework and describes the empirical model and data used in this study. Subsequently, section three presents the results and discussion. Finally, Section four is the conclusion of this paper.

METHODOLOGY AND DATA

Conceptual Framework

To develop a conception of our empirical model and derive testable hypotheses, we adopted a simple conceptual framework that follows Janzen *et al*. (2014) and Janzen and Hdjemian (2017), which used structural vector autoregression (SVAR) models to investigate the effects of several factors on the phenomenon of extreme price volatility in wheat and cotton, respectively. We use a time–series analysis technology to analyze the volatility of time series data. This paper builds four variables of the SVAR model. Through the limitation on the model parameter space, it will separate the sugar price impact from the VAR model of composite impact the structure, analyzing the response of external commodity markets response to the impact of sugar price.

As previously mentioned, this research uses the SVAR econometric model to measure the relative contribution of four factors to observe sugar price fluctuations: (1) The Kilian index (Kilian, 2019) is used to represent global economic activity, and this method has been successfully applied in the studies by Kilian (2009) and Kilian and Murphy (2014). (2) Comovement with external commodity markets uses the value of the Standard & Poor's Goldman Sachs Commodity Index (S&P GSCI), which is a characteristic of financialization. (3) Calendar spread in the sugar futures market provides a good proxy for the precautionary demand of inventories by the competitive storage model (Fama and French,1988; Ng and Pirrong, 1994; Geman and Ohana, 2009) (4) Current supply and demand prices in the sugar industry.

SVAR is a multivariate, linear representation that captures the immediate structural relationships between variables within a model system. It is a model that studies the evolution of a set of interrelated, observable time series variables. The essence of SVAR is to obtain structural parameters and structural shocks based on the observed reduced–form VAR.

Ocean freight rates are not constrained by trade conditions and can be a better representation of economic activity in any part of the world. This paper used the Killian index to aggregate ocean freight rates to represent the level of global economic activity. This measure was used successfully in Kilian (2009) and Kilian and Murphy (2014), among others. Hamilton (2021) concludes that after 2015, global industrial production is a more accurate measure of the level of real economic activity than shipping costs. Then, Kilian corrected data after Hamilton's paper.

To measure financial market activity, the analysis uses the value of the S&P GSCI as a measure of external market price movement. The S&P GSCI is a composite index of commodity sector returns representing an unleveraged, long–only investment in commodity futures that is broadly diversified across the commodities' spectrum. People can approximate commodity price movements that may be associated with speculation–induced comovement using the prices of major commodities themselves. If the implications of the financialization hypothesis are correct, it should follow that nonagricultural commodity prices have driven sugar price changes.

In this study, we use the calendar spread of the furthest expiration date of futures contracts with the nearest expiration date of futures contracts as a measure of motivation for holding inventory. Data on physical sugar

inventories are the best intermediate variable; however, data are either not available at the frequency required by the model, or they only cover a limited number of locations, such as warehouses that are allowed to receive deliveries under various sugar futures contracts. Because of the working curve relationship between forward and near–term spreads and inventory levels, this calendar spread can represent the incentive to hold inventory between the current and forwarding periods as the precautionary demand for sugar.

Sugar spot market trading prices are represented by futures prices in the vicinity of each sugar futures contract. The observed sugar price changes are broken down into three structural shocks associated with the other variables. Any sugar price change unrelated to the first three factors represents a net supply and demand shock. This fourth structural shock is therefore interpreted as a structural shock caused by the specific supply and demand factors of sugar.

Empirical Model and Data

This section presents the empirical model and data.

Empirical Model

We examine the impact of financialization on agricultural markets by analyzing the impact of the S&P GSCI on futures prices in the vicinity of each sugar futures contract.

A SVAR model for y_t is

$$C_0\, y_t = \Gamma_0 + \Gamma_1\, y_{t-1} + u_t,\ t = 1, 2, \ldots, T, \tag{1}$$

$$\begin{pmatrix} 1 & -c_{12} & -c_{13} & -c_{14} \\ -c_{21} & 1 & -c_{23} & -c_{24} \\ -c_{31} & -c_{32} & 1 & -c_{34} \\ -c_{41} & -c_{42} & -c_{43} & 1 \end{pmatrix} \begin{pmatrix} y_{1,t} \\ y_{2,t} \\ y_{3,t} \\ y_{4,t} \end{pmatrix} = \begin{pmatrix} \gamma_{11}^{0} \\ \gamma_{21}^{0} \\ \gamma_{31}^{0} \\ \gamma_{41}^{0} \end{pmatrix} + \begin{pmatrix} \gamma_{11}^{1} & \gamma_{12}^{1} & \gamma_{13}^{1} & \gamma_{14}^{1} \\ \gamma_{21}^{1} & \gamma_{22}^{1} & \gamma_{23}^{1} & \gamma_{24}^{1} \\ \gamma_{31}^{1} & \gamma_{32}^{1} & \gamma_{33}^{1} & \gamma_{34}^{1} \\ \gamma_{41}^{1} & \gamma_{42}^{1} & \gamma_{43}^{1} & \gamma_{44}^{1} \end{pmatrix} \begin{pmatrix} y_{1,t-l} \\ y_{2,t-l} \\ y_{3,t-l} \\ y_{4,t-l} \end{pmatrix} + \begin{pmatrix} u_{1,t} \\ u_{2,t} \\ u_{3,t} \\ u_{4,t} \end{pmatrix}, \tag{2}$$

where y_t denotes a column vector that contains four endogenous variables, and t denotes time. y_1 is the global economic activity, y_2 is the external commodity markets, y_3 is the calendar spread in the sugar futures market, and y_4 is the real sugar price of nearby sugar futures. C_0 is the coefficient matrix of the corresponding endogenous variables. Γ_0 is the constant vector, and Γ_1 is the coefficient matrix of the corresponding hysteresis vector. u_t is the residual vector of the structure.

Without further well–founded economic assumptions, called restrictions, this would not be possible: The SVAR would not be identified. There is not enough information (estimable parameters) in the VAR to deduct all the parameters of the SVAR. The most common approach is to impose zero restrictions on selected elements of the coefficient matrix that links structural shocks to observable variables (Kilian, 2011).

We will make assumption as follows:

$$\begin{pmatrix} 1 & -c_{12} & -c_{13} & -c_{14} \\ -c_{21} & 1 & -c_{23} & -c_{24} \\ -c_{31} & -c_{32} & 1 & -c_{34} \\ -c_{41} & -c_{42} & -c_{43} & 1 \end{pmatrix} = \begin{pmatrix} 1 & 0 & 0 & 0 \\ -c_{21} & 1 & 0 & 0 \\ -c_{31} & -c_{32} & 1 & 0 \\ -c_{41} & -c_{42} & -c_{43} & 1 \end{pmatrix}, \tag{3}$$

$$\begin{pmatrix} 1 & 0 & 0 & 0 \\ -c_{21} & 1 & 0 & 0 \\ -c_{31} & -c_{32} & 1 & 0 \\ -c_{41} & -c_{42} & -c_{43} & 1 \end{pmatrix} \begin{pmatrix} y_{1,t} \\ y_{2,t} \\ y_{3,t} \\ y_{4,t} \end{pmatrix} = \begin{pmatrix} \gamma_{11}^{0} \\ \gamma_{21}^{0} \\ \gamma_{31}^{0} \\ \gamma_{41}^{0} \end{pmatrix} + \begin{pmatrix} \gamma_{11}^{1} & \gamma_{12}^{1} & \gamma_{13}^{1} & \gamma_{14}^{1} \\ \gamma_{21}^{1} & \gamma_{22}^{1} & \gamma_{23}^{1} & \gamma_{24}^{1} \\ \gamma_{31}^{1} & \gamma_{32}^{1} & \gamma_{33}^{1} & \gamma_{34}^{1} \\ \gamma_{41}^{1} & \gamma_{42}^{1} & \gamma_{43}^{1} & \gamma_{44}^{1} \end{pmatrix} \begin{pmatrix} y_{1,t-l} \\ y_{2,t-l} \\ y_{3,t-l} \\ y_{4,t-l} \end{pmatrix} + \begin{pmatrix} u_{1,t} \\ u_{2,t} \\ u_{3,t} \\ u_{4,t} \end{pmatrix}. \tag{4}$$

External commodity markets (y_2) have no impact on global economic activity (y_1). The calendar spread in the sugar futures market (y_3) has no impact on global economic activity (y_1). The real sugar price of nearby sugar futures (y_4) has no impact on global economic activity (y_1). The calendar spread in the sugar futures market (y_3) has no impact on the external commodity markets (y_2). The real sugar price of nearby sugar futures (y_4) has no impact on the external commodity markets (y_2).

Data

This paper examines data for the period January 2006– June 2019. The Kilian indicator is collected from Kilian's website. We collect data on sugar market prices from the Zhengzhou Commodity Exchange. External markets are represented by the S&P GSCI from the Bloomberg Database. All data are monthly data. We provide a detailed description of the data in Table 1.

Table 1. Data Construction and Sources

Variable	Construction and sources
Global economic activity	The Kilian index is used in this article to express the level of global economic activity. Kilian index aggregates ocean freight rates based on an empirically validated relationship between freight rates and economic activity. Source: Kilian's website https://sites.google.com/site/lkilian2019/research/data–sets
External commodity markets	Use unleveraged, long–only investment in global commodity futures S&P GSCI data. Source: Bloomberg Database
The calendar spread in the sugar futures market	A futures strategy that consists of buying/selling futures contracts that have different expiration months together as one position. In this paper, I decided to use the calendar spread of the furthest expiration date of futures contracts with the nearest expiration date of futures contracts as a measure. Source: Zhengzhou Commodity Exchange http://www.czce.com.cn/cn/sspz/bt/H770204index_1.htm
The real sugar price of nearby sugar futures	The price of the nearest expiration date of sugar futures contracts in China. Source: Zhengzhou Commodity Exchange http://www.czce.com.cn/cn/sspz/bt/H770204index_1.htm

Source: Made by author.

RESULTS AND DISCUSSION

Trend analysis of data

Descriptive statistical analysis

Table 2 shows the descriptive statistical analysis. Global Economic Activity values fluctuate from –161.643 to 189.220 with an average value of 2.635. External Commodity Markets' values fluctuate from $289.974 to $832.309 with an average value of $511.978. Calendar Spread had a minimum value of –853.261 RMB, a maximum value of 943.050 RMB, and an average value of 30.244 RMB. Sugar Prices fluctuated from a minimum of 3236.400 RMB per ton to 7713.217 RMB per ton with an average price of 5174.346 RMB per ton. It can be seen from the standard deviations of the four variables that sugar price has the largest standard deviation, indicating a high degree of data dispersion. From kurtosis and skewness, it can be seen that kurtosis of all variables is < 3 and skewness is > 0, so it can be considered that the data of all variables are different from the normal distribution. To test the hypothesis of the normality of variable data, it can be seen from the Jarque– Bera test that, at a significance level of 10%, the *p*–values of all variables are less than the significance level, so the null hypothesis of normality can be rejected, that is, all variables are significantly different from the normal distribution.

Table 2. Descriptive statistical analysis

	Global Economic Activity	External Commodity Markets	Calendar Spread	Sugar Price
Observations	162	162	162	162
Mean	2.635	511.978	30.244	5174.346
Median	–15.043	484.797	–10.496	5163.827
Maximum	189.220	832.309	943.050	7713.217
Minimum	–161.643	289.974	–853.261	3236.400
Std. Dev.	78.008	122.320	348.180	1072.791
Skewness	0.645	0.330	0.361	0.194
Kurtosis	2.718	2.076	2.624	2.254
Jarque–Bera	11.755	8.702	4.472	4.770
(probability)	(0.003)	(0.013)	(0.013)	(0.092)

Note: This table shows the mean, median, maximum, minimum, standard deviation, skewness, kurtosis, and Jarque–Bera probability of the Kilian index, GSCI, calendar spread, and sugar price. The sample period is January 2006–June 2019.
Source: Calculated by author.

Time series trend analysis

Figure 1 shows the time–series diagram of the four variables, all of which have a large fluctuation range. The fluctuation range of global economic activity is between –170 and 200, reaching a peak in 2008 and gradually rising after the bottom in 2016. External commodity markets range from 300 to 850, and calendar spread ranges from –800 to 1,000, both of which also peaked in 2008. It is worth noting that the sugar price has the most obvious fluctuation range, starting to gradually pull up after bottoming out at 3,200 in 2008, rising nearly 8,000 in 2011 or so, then gradually falling and hovering around 6,000.

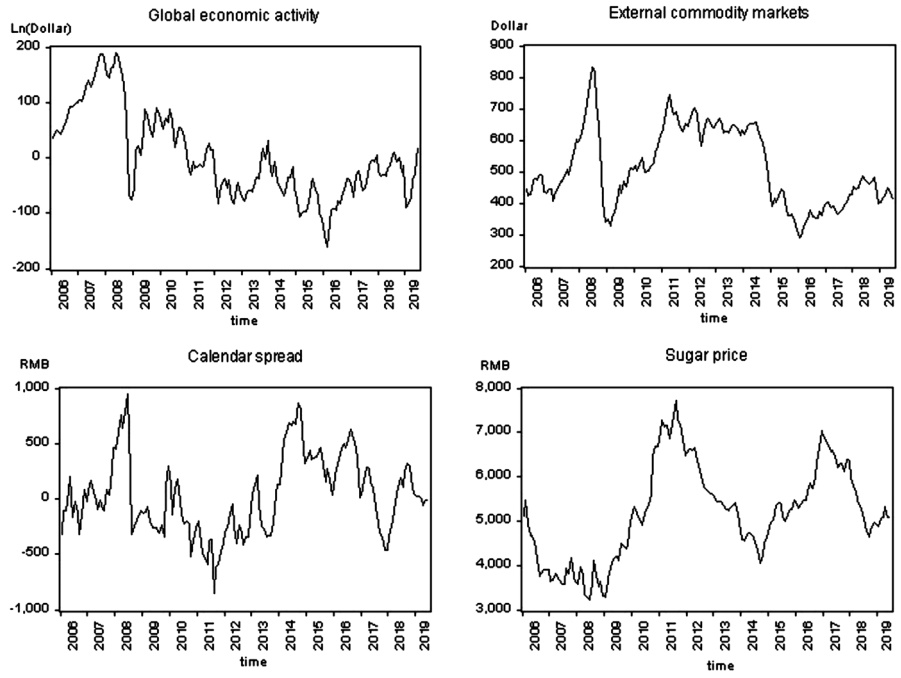

Fig. 1. Time–Series Diagram
Source: Calculated by author.

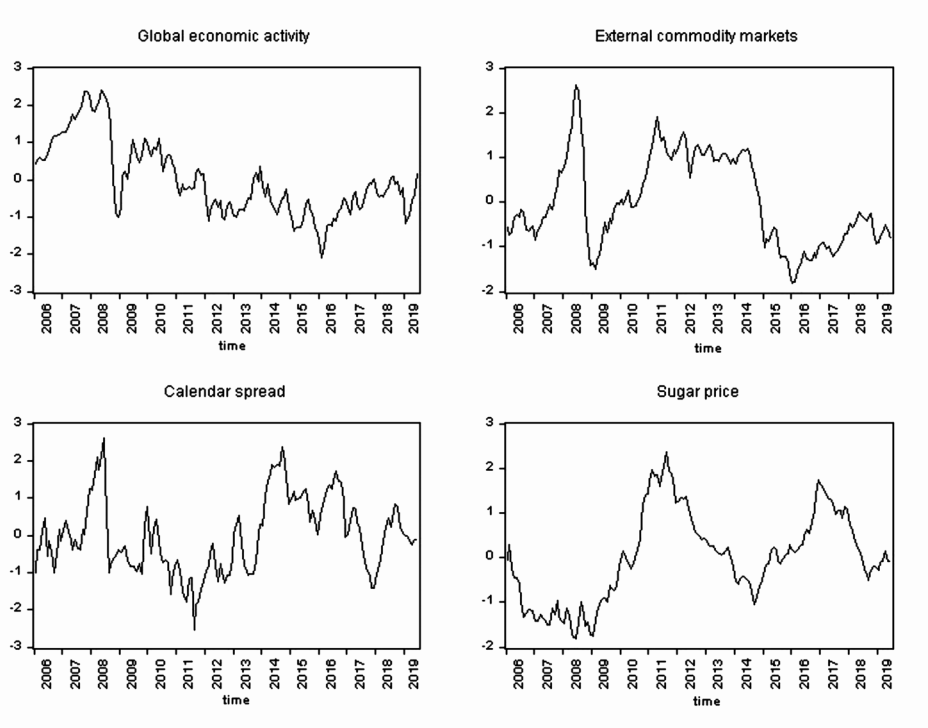

Fig. 2. Adjusted Time–Series Diagram
Source: Calculated by author.

Determining the SVAR model

The first step is to standardize the data to eliminate the influence of the magnitude on the analysis process. Referring to Janzen and Hdjemian (2017), we consider the effect of dimension and further standardize the data; the time series of processed data is shown in Figure 2.

Second, the Augmented Dickey–Fuller (ADF) unit root test was used to test the stability of the variables. As can be seen from Table 3, the *p*–value for the three raw data stability tests is greater than 5%, so the original data were considered unstable. If the data are differentiated, the *p*–value of the stationarity test of the data after the difference is less than the significance level of 5%, the null hypothesis that the difference sequence is not stationary can be rejected. Therefore, the post–differential sequence can be used for modeling. The trend graph of the processed data is shown in Figure 3.

Table 3. Augmented Dickey–Fuller (ADF) Unit Root Test

Variables	Statistic	*p*–values	Conclusion
KILIAN	–2.503	0.117	unstable
D_KILIAN	–9.641	0.000	stable
GSCI	–2.586	0.098	unstable
D_GSCI	–7.700	0.000	stable
CALENDAR_SPREAD	–3.298	0.017	stable
D_CALENDAR_SPREAD	–10.164	0.000	stable
SUGAR_PRICE	–1.668	0.446	unstable
D_SUGAR_PRICE	–9.863	0.000	stable

Note: The sample period is January 2006–June 2019.
Source: Calculated by author.

According to the selection results of lag order, order one was selected as the lag order of the SVAR model, considering the number of lag items and complexity of the model.

As can be seen from Figure 4, no root lies outside the unit circle; SVAR satisfies the stability condition, the model is stable, and the output of the model has strong explanatory power.

SVAR model analysis

Impulse response analysis

Impulse response analysis is to yield an inference of the dynamic pattern and time path of the international financial market shock to the Chinese sugar market. In addition, the impulse response analysis indicates the duration of the shock impact.

Based on the excellent fitting effect of the model, the output impulse response function chart (see Figure 5) shows that all variables are most affected by their own impact, and external commodity markets are positively impacted by global economic activity, indicating that it plays a positive role in boosting external commodity markets. Neither calendar spread nor sugar prices had a significant impact on global economic activity. The strength of the influence of external commodity markets on other variables is almost similar, with global economic activity having a positive effect before the fourth period and a negative effect after the fourth period after being influenced by external commodity markets, indicating that global commodity markets have an influence on global economic activity. The external commodity markets also have an impact on sugar stocks and sugar

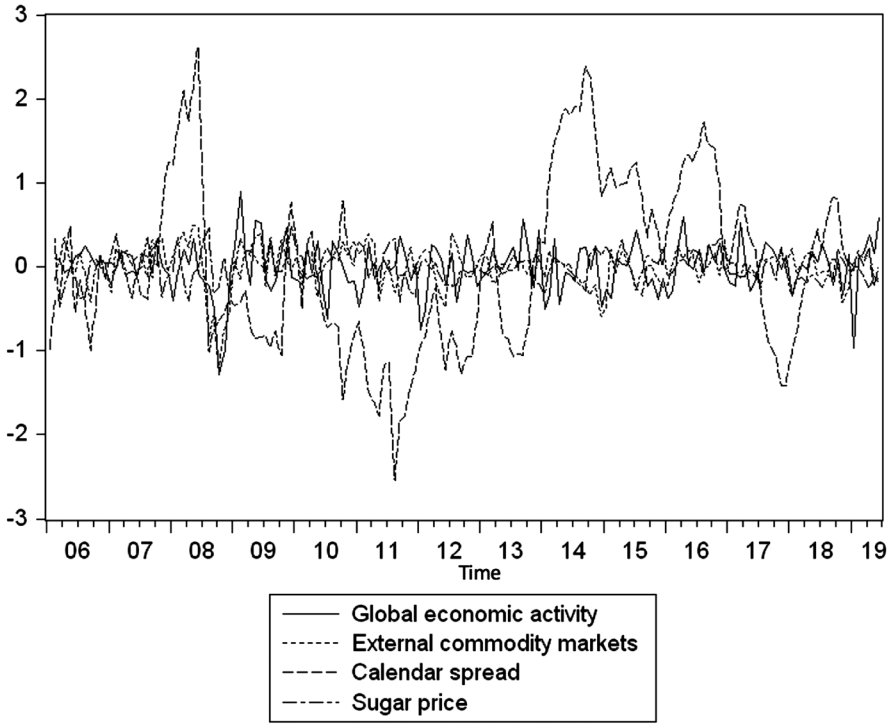

Fig. 3. Standardized and Differenced Data
Source: Calculated by author.

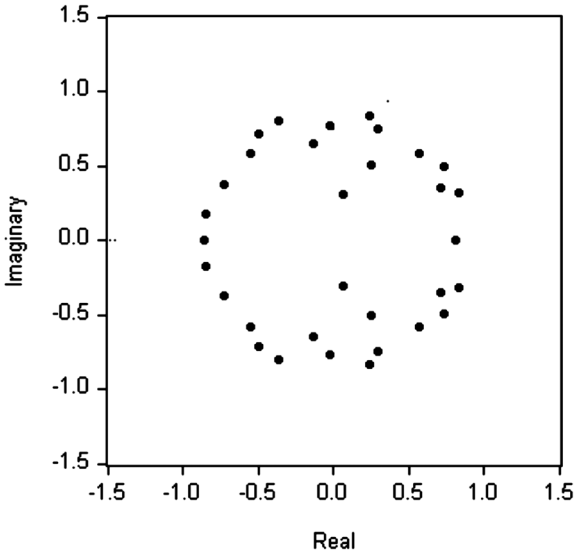

Fig. 4. SVAR Stability Condition
Notes: No root lies outside the unit circle; SVAR satisfies the stability condition.
Source: Calculated by author.

prices, with the maximum intensity of the impact around 2. Sugar inventories have no significant impact on global economic activity and external commodity markets, and they have a negative impact on sugar prices. Sugar prices have little impact on global economic activity and external commodity markets, but it has a great impact on sugar inventories.

Variance decomposition

The variance decomposition technique is used to further examine the importance of the financial market to the sugar price variance.

Figure 6 shows the variance decomposition results of the four variables.

Apart from the variance contribution of the variables themselves, external commodity markets contributed the most to global economic activity, with a variance contribution of 12.624 in the ninth period. Global economic activity to external commodity markets makes the largest contribution to the variance, reaching a maximum of 8.136 in Period 9 and stabilizing at 7.966 in Period 10. The variance contribution of sugar price to the calendar spread is the largest. It has experienced a rapid rise, with the sugar price contributing 0.682 to the calendar spread in Period 2 and then rising sharply, finally reaching 14.673 in period 10, indicating that changes in sugar prices affect changes in sugar stocks. The calendar spread contributed the most to the variance of the sugar price, which finally stabilized at 11.946. This indicates that the change in sugar stocks is the main reason for the change in sugar prices.

Granger causality test

To further corroborate the results of the impulse response function, a Granger causality test was next performed to track the short–term dynamics and direction of causality between the two groups of variables: Endogenous and exogenous. We focus on the Granger causality of international financial markets and Chinese sugar prices.

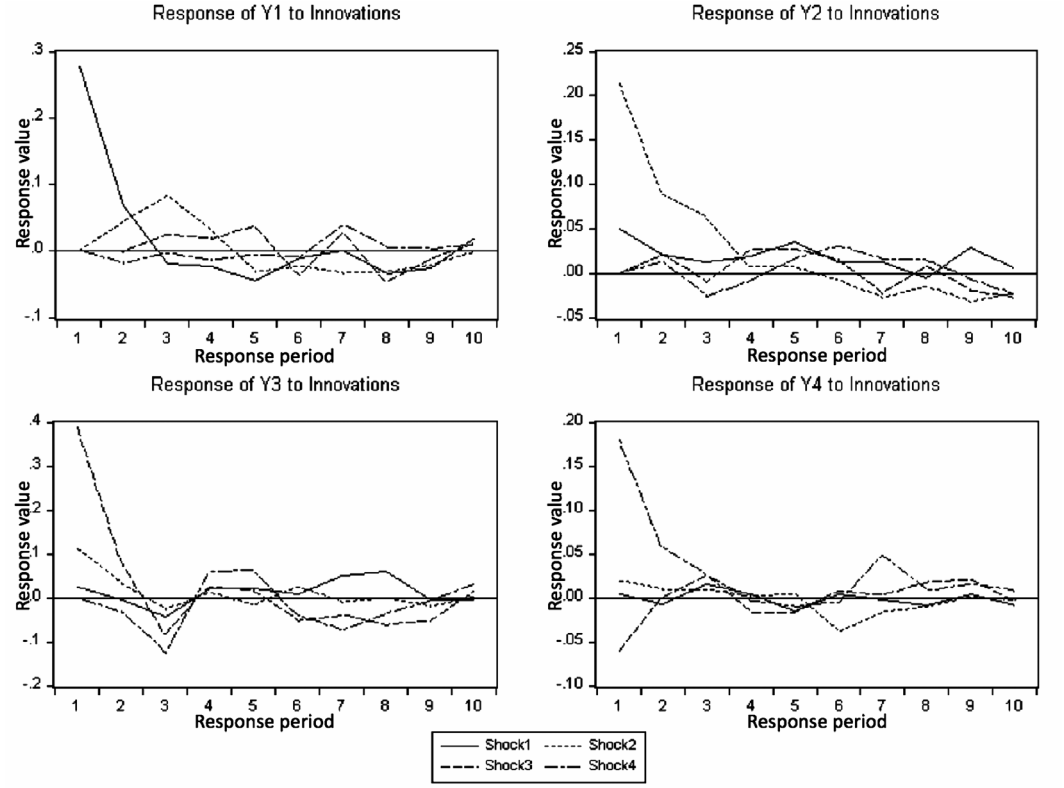

Fig. 5. Impulse Response Function Diagram
Notes: Response–standard–errors bands (dashed lines) are generated by Monte Carlo simulation technique based on 100 repetitions
Source: Calculated by author.

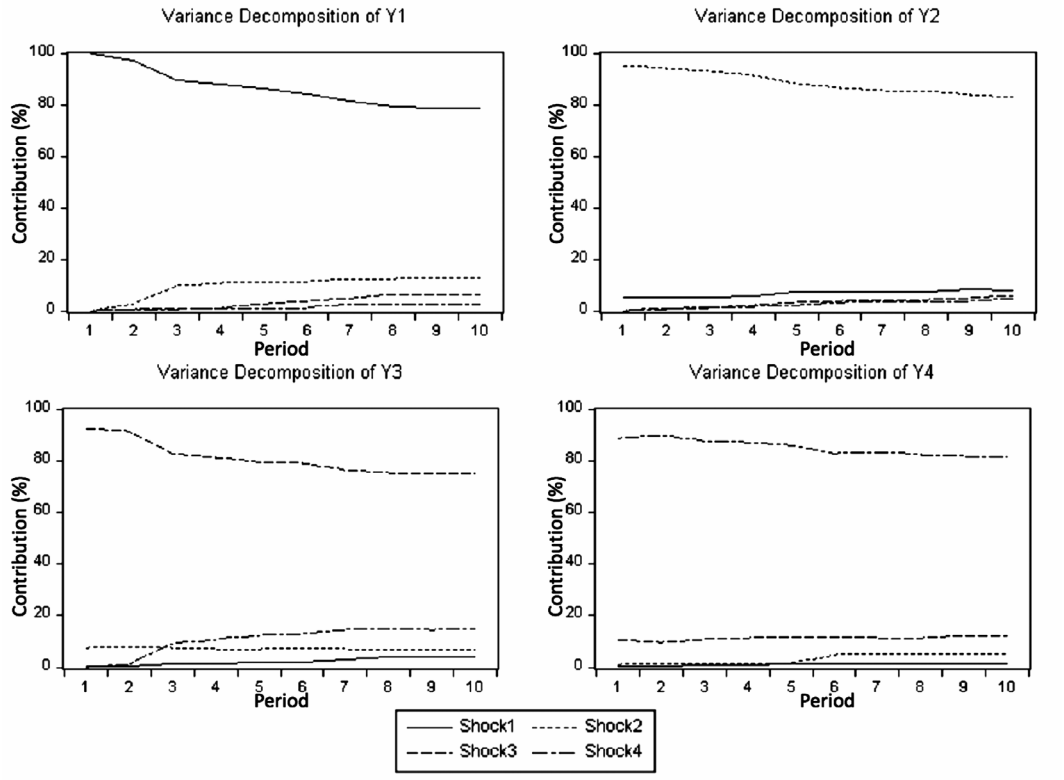

Fig. 6. Variance Decomposition Diagram
Notes: The data in the table represent the percentage of forecast error variance. Each period represents one month.
Source: Calculated by author.

Table 4. Granger Causality Test

Null hypothesis:	*F*–statistic	probit
External commodity markets do not Granger cause global economic activity.	6.162	0.003
Global economic activity does not Granger cause external commodity markets.	0.263	0.769
Calendar spread does not Granger cause global economic activity.	1.803	0.168
Global economic activity does not Granger cause calendar spread.	0.860	0.425
Sugar price does not Granger cause global economic activity.	0.115	0.892
Global economic activity does not Granger cause sugar price.	1.216	0.299
Calendar spread does not Granger cause external commodity markets.	1.038	0.357
External commodity markets do not Granger cause calendar spread.	0.171	0.843
Sugar price does not Granger cause external commodity markets.	0.015	0.985
External commodity markets do not Granger cause sugar price.	0.328	0.721
Sugar price does not Granger cause the calendar spread.	1.269	0.284
Calendar spread does not Granger cause sugar price.	1.819	0.166

Source: Calculated by author.

F statistics based on OLS estimation is

$$F = \frac{(RSSR–RSSU)/4}{RSSU/(n–3)}, \quad (5)$$

where RSSU is the sum of square residuals of the unconstrained model. The RSSR is the sum of squares of residuals of the constraint model.

If external commodity markets are Granger reasons for the real sugar price of nearby sugar futures, the real sugar price of nearby sugar futures is the Granger reason for external commodity markets, and this paper will conclude that there is a financialization phenomenon in the Chinese sugar market.

According to Table 4, at a significance level of 5%, in the Granger causality test containing the maximum lag order of 2, only external commodity markets are responsible for changes in data on global economic activity; there is no Granger causality between the other variables. The phenomenon of agricultural financialization does not exist in the Chinese sugar market.

First, financial speculators trade commodities to diversify their portfolios and earn the expected risk premiums. Components of sugar prices driven by comovement represent the impact of this part of financial speculation. Based on the SVAR model, in the lag order of 1, this study uses the Granger causality test and obtains that at a significance level of 5%, the preliminary information of comovement with external commodity markets cannot explain the change in sugar price. However, the preliminary information on calendar spread in the sugar futures market can explain the change in sugar prices. Although we did not find any obvious effect of financial speculation on sugar prices, we did find the effect of precautionary demand on sugar prices, which can be explained by the existence of basic speculation on sugar for the purpose of preventing market price changes.

Second, based on the excellent fitting effect of the model, the output impulse response function shows that all variables are most affected by their own impact. The impact of external forces on sugar prices is relatively small relative to the impact of supply and demand in the sugar industry itself. The shocks to global economic activity, external markets, and precautionary inventory demand are small but long–lasting. It could also show that financial speculation in commodity markets does not affect sugar prices. The results show that the sugar price has the most obvious response to the demand and supply shock, which is reasonable. Sugar price is mainly affected by the impact of the current sugar market of supply and demand factors, and it is not affected by financial speculator behavior.

After model analysis and three types of tests, our results reject the original hypothesis. Changes in external commodity markets in which financial investors participate cannot lead to contemporaneous price changes in agricultural futures markets.

CONCLUSIONS

In this paper, we study the relationship between the sugar and financial market by building an SVAR metric model through time series analysis. The S&P GSCI was chosen as the algebra for the financial markets. In addition, the Kilian index has been selected as a proxy for global economic levels, and the calendar spreads in the sugar China futures market have been selected to represent trends in sugar stocks.

By analyzing monthly data for the period January 2006– June 2019, our analysis presents the following conclusions: Financialization of agriculture does not exist in the Chinese sugar market.

The financialization of agriculture is not the cause of the abnormal and violent price fluctuations in the sugar market. Commodity financial markets are not as risky as some belief, and the financialization of agriculture has not brought drastic price swings to the Chinese sugar market.

Based on the findings, there are policy recommendations for addressing commodity price volatility; legisla-

tion and regulations restricting financial speculation in commodity futures will not affect future changes in sugar prices. Governments should not control sugar prices by suppressing their activities in financial markets. Instead, the Chinese government should guide agricultural participants to actively use financial markets to control risk and even profit from them by forecasting market prices. Nevertheless, the government can guide sugar producers to store a reasonable amount of sugar to stabilize the sugar market price.

However, since the data analyzed are limited to the sugar market and also only take into account changes in the international financial market and not the Chinese financial market, we are unable to determine whether the phenomenon of agricultural financialization is widespread in the Chinese agricultural market, or to demonstrate the impact of the Chinese financial sector on the agricultural market. To answer these two questions, data from other agricultural product markets need to be collected and integrated, and variables from the Chinese financial market need to be introduced. Future research will further analyze the Chinese agricultural market in more detail.

AUTHOR CONTRIBUTIONS

All listed authors discussed the results and contributed to the final manuscript. Peiran Su was the designer of the study and performer of the data calculations, completed the data analysis, and wrote the manuscript of the paper. Teruaki Nanseki participated in the study design and analysis of the data results and directed the study design, data analysis, and writing and revision of the paper. Yosuke Chomei contributed to the editing and revision of the manuscript. All authors read and agreed to the final text.

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