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Grain Price Transmission from International Markets to Chinese Domestic Markets

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After joining WTO, Chinese agricultural commodities linked more and more with the international markets. This study evaluated the grain price translation from the international grain markets to Chinese grain markets. The result of ADF test for grain prices in China and the US, which reports that all of the weekly grain prices in these two markets belong to I (1) and a long–run integration between the Chinese grain prices and the US grain prices are found in this study. We use the VECM model to find that the estimated error correction term coefficients are –0.04749, –0.002187, –0.0009480, –0.005806 and –0.004652 for soybeans, wheat, corn, indica rice and japonica rice, respectively. In addition, the volatility for the US' soybeans prices can Granger–cause the Chinese soybeans prices fluctuated. And the impulse response function Chinese grain prices response immediately to its own standard deviation innovation and the impact from the international markets is more significant for soybeans. The US's soybeans and corn prices show significant effect to its own innovation.

Key words: grains, price transmission, Johansen co–integration test, VECM model

INTRODUCTION

After joining the World Trade Organization (WTO), Chinese agricultural commodities linked with the international markets to a certain extent. Therefore fluctuations of international grain prices started influencing Chinese domestic grain markets, which indicated that the volatility of international grain prices brought new challenges to Chinese grains price stabilization. Weekly prices of milled rice, wheat, corn and soybeans showed that Chinese grain prices are more stable than the international grain prices from February 25, 2007 to February 24, 2013 (Fig. 1). On the other hand, Chinese domestic grain prices were rather moderate compared to the US market. However, the fluctuations of the two grain markets happen simultaneously, which suggests that there is consistency between the domestic grain prices in China and the US future grain prices. This is due to the Chicago Board of Trade (CBOT) prices playing a decisive role in announcing price information, by which Chinese domestic grain prices are influenced. For example, soybean prices in China fluctuated in a style rather similar to US soybean prices.

Chinese grain prices increased rapidly during the past 6 years (Table 1). Chinese wholesale grain prices increased by 69.75%, 66.10%, and 60.04% for japonica rice, soybeans and corn, respectively. In addition, domestic wholesale prices of wheat and indica rice also increased by more than half compared to the in prices during the beginning of 2007. We excluded the influence from the inflation by calculating grains real prices. After depreciating, the Chinese grain prices were double, compared to their prices on February 25, 2007. The prices of japonica rice and soybeans accounted for the highest two increase rates. There are many reasons for the rapid growth of grain prices in China, including government policies which encourage farmer's benefits, such as the Chinese grain minimum procurement prices. Other factors also raised the Chinese domestic grain prices. These factors included the Chinese high economic development and population growth, rising costs of agricultural production, inflation expectations, excess monetary supply and natural disasters in recent years (Wang and Xie, 2012). The impact from the fluctuations in the international grain markets also play an especially important role in increasing the domestic Chinese grain prices.

A significant evidence for China to play an increasingly important role in the world grain markets was that the trade shares for grains after China joined WTO (Fig. 2). Especially, import shares for Chinese grains increased while its export shares reduced in the recent

Table 1. Increase rates of Chinese wholesale grain prices (%)

Grains	RMB–denominated	Dollar–denominated
Soybeans	66.10	104.7
Wheat	55.04	91.1
Corn	60.04	97.3
Indica Rice	54.48	90.4
Japonica Rice	69.75	109.2

Source: Authors' calculation.

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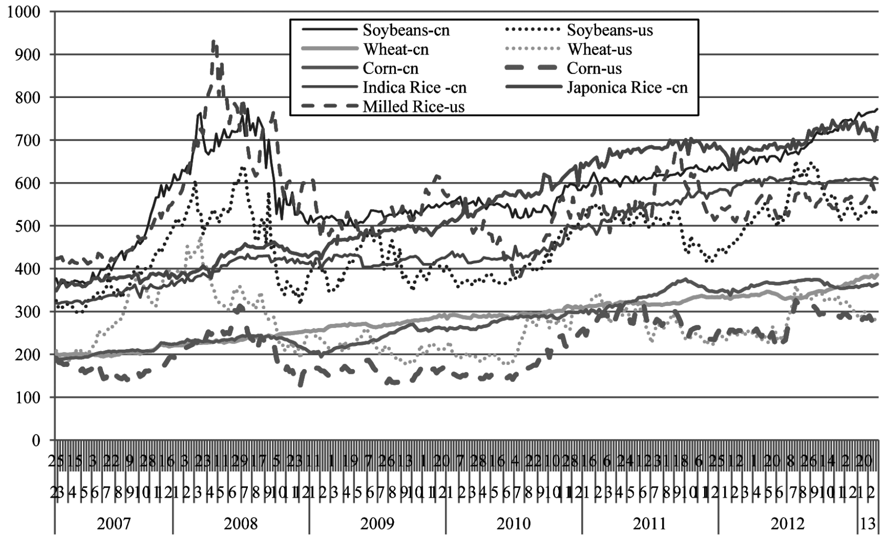

Fig. 1. Weekly prices of rice, wheat, corn and soybeans in China and the US markets.
Source: Price data, China Grain Data Center, http://datacenter.cngrain.com
GFT – Online Futures Trading, http://futures.tradingcharts.com
The Central Parity of RMB, State Administration of Foreign Exchange, http://www.safe.gov.cn
Bureau of Labor Statistics, United States Department of Labor, http://www.bls.gov

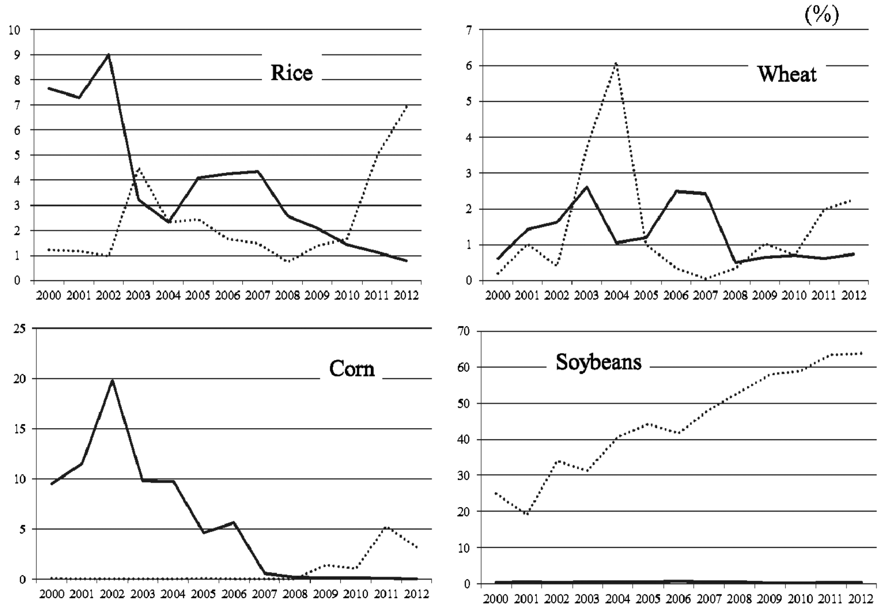

Fig. 2. Trade shares of Chinese grains among the world markets after China joined WTO.
Source: US Department of Agriculture: PS&D Online.
Note: Real line – export share, dotted line – import share

years, which suggested that the China turned to increase its grain demands from the world markets. China grew a great volume of grains to feed the largest number of population in the world. However it began importing more grains from the world grain market, especially for corn and soybeans. As a result, the international grain prices might influence the Chinese domestic grain markets. In addition, prices of rice and wheat as the staple foods in China may be influenced by the fluctuation imported grain prices due to the substitutions among the domestic grains.

There were a number of existed studies which discussed and proposed the grain price transmission from the world markets into the Chinese domestic markets. In previous research, correlation between the Chinese domestic grain prices and the world grain prices was not significant before China joined WTO. Zhang (1999) showed that integration of the domestic and international grain markets was not high. Studies focusing on the grain prices after China joined WTO suggested that

Table 2. Description of data and source in this study

Data	Variable	Desecription	Souree
Chinese soybean prices	SC	weekly, wholesale	Price data, Zhengzhou Hualiang Technology Co., Ltd
Chinese corn prices	CC	weekly, wholesale	Price data, Zhengzhou Hualiang Technology Co., Ltd
Chinese wheat prices	WC	weekly, wholesale	Price data, Zhengzhou Hualiang Technology Co., Ltd
Chinese indica rice prices	IC	weekly, wholesale	Price data, Zhengzhou Hualiang Technology Co., Ltd
Chinese japonica rice prices	JC	weekly, wholesale	Price data, Zhengzhou Hualiang Technology Co., Ltd
Soybean prices in US	SU	weekly, future prices	GFT–Online Futures Trading CBOT
Corn prices in US	CU	weekly, future prices	GFT–Online Futures Trading CBOT
Wheat prices in US	WU	weekly, future prices	GFT–Online Futures Trading CBOT
Millded rice prices in US	RU	weekly, future prices	GFT–Online Futures Trading CBOT
Exchange rate	EX	daily	State Adninistration of Foreign Exchange, China
CPI in the United States	CPI–U	monthly	Bureau of Labor Statistics, United States Department of Labor
Import shares of Chinese grains	I	anural (from 2000 to 2012)	US Department of Agriculture: PS&D Online
Export shares of Chinese grains	E	anural (from 2000 to 2012)	US Department of Agriculture: PS&D Online

Note 1: Time period: February 25, 2007 -- February 24, 2013;
Note 2: Samples numbers of each prices: 314.

price transmission from the international grain markets to Chinese domestic grain markets became significant. However, researchers have not see agreed that there in an interactive relationship between Chinese and international grain prices. Luo (2009) reported that changes in international grain prices affecting Chinese domestic grain prices becoming is becoming significant. Cao, *et al.* (2012) found that Chine and U.S. soybean prices had a strong relationship, while those for indica rice, wheat and corn show a weak relationship. Miao, *et al.* (2012) found a long–term relationship between the international and Chinese domestic rice prices.

The purpose of this study is to explore whether the international grain prices have an impact on Chinese grain prices in recent years, using the latest weekly time series data and econometric analysis, to verify the causality of the domestic and international grain prices and check whether or not long–run equilibrium or short–run equilibrium relationships exist between the Chinese and international grain prices.

MATERIALS AND METHODS

Weekly grain prices in China were collected from the China grain data center, where authoritative average grain prices are published every Monday. Ito (1991) found that the US and Thai rice export prices are highly competiv. We there fore regarded the US rice prices as the world rice prices. And we used wheat, corn and soybeans prices in the US as the world prices because of its great trade share, because the United States is located as the first largest exporting country for wheat and corn, the second largest for soybeans, and the fifth for rice in the world grain export share. In addition, weekly grain future prices were collected from CBOT, whose prices played a decisive role in announcing price information to other countries. To study the latest relationship between the two markets, our data period went from February 25, 2007 to February 24, 2013. We picked Wednesday exchange rates between Chinese and US currency to represent the weekly exchange rates, while we used the same numerical variables for the US consumer price index in the same month. All of the price variables were calculated into the real prices so we could exclude the influence of the domestic inflation of grain prices. We also converted our price series into the logarithmic forms, by which we could not only reduce the volatility of the prices in those two markets, but also facilitate the economical explanation of our empirical results. Table 2 provideds the detailed information for our data.

In this study, we will use the Augmented Dickey–Fuller (ADF) test to check whether each of the variables are stable on the first difference or not, after which a Johansen co–integration test is employed to check whether co–integration relations exist between variables. Based on their co–integration relations, we will use a Vector Error Correction (VECM) Model to show the short–run relationship between variables. Furthermore, we will verify the causality of the domestic and international grain prices if their price showed a short–run relationship. We shall also check the impulse response function to reflect the impact of the external random shocks to the endogenous variables.

Dickey and Fuller (1981) developed a method, namely DF test, to avoid the bias in the traditional OLS regression. They also extended this method to ADF test to check the unit root test for variables. In our study, we must employ this unit root test to both Chinese and US CBOT grain price series, and also their corresponding differential sequences ΔP_c and ΔP_u before we use our data in the co–integration test and error correction model. The guideline suggests that a co–integrated relationship may exist only if their time differences become the same.

The ADF model can be shown as,

$$\Delta LNP_t = \alpha + \beta LNP_{t-1} + \sum_1^n \delta_i \Delta LNP_{t-1} + \varepsilon_t$$

Where, $\Delta LNP_t = LNP_t - LNP_{t-1}$, $\Delta LNP_{t-i} = LNP_{t-i} - LNP_{t-i-1}$, P_t means the grain prices at time t, ε_t is called a white noise and n stands for the lag phase. We will choose the lag phase so there is no autocorrelation in the residuals ε_t.

Null hypothesis of ADF test is H_0: $\beta = 0$, that is, the time series is non–stationary, while its alternative hypothesis is H_1: $\beta \neq 0$. The result of ADF test aims to obtain the t–value of the estimated value of β. We will accept the null hypothesis if the ADF statistic is greater than the critical value, which indicates LNP_t is non–stationary. Otherwise, we will refuse the null hypothesis, which means that LNP_t is stationary and we can name it as I (0).

In our study, we can employ a Johansen Co–integration Test when all of the grain prices in both Chinese and the US markets become stationary after the first difference. A linear combination of two or more non–stationary series may be stationary. Engle and Granger (1987) pointed out that the stationary linear combination is called the co–integrating equation and may be interpreted as a long–run equilibrium relationship among the variables. Johansen (1991, 1995) developed a Johansen co–integration test to determine whether non–stationary series are co–integrated or not, which followed a basis of the VAR (vector autoregression) specification. Applying this methodology to our study, we established the VAR (1) model as,

$$\begin{bmatrix} \Delta LNPC_t \\ \Delta LNPU_t \end{bmatrix} = \begin{bmatrix} \alpha_1 \\ \alpha_2 \end{bmatrix} + \begin{bmatrix} \pi_{11}-1 & \pi_{12} \\ \pi_{22} & \pi_{22}-1 \end{bmatrix} \begin{bmatrix} LNPC_{t-1} \\ LNPU_{t-1} \end{bmatrix} + \begin{bmatrix} \mu_{1t} \\ \mu_{2t} \end{bmatrix}$$

Where, LN means the natural logarithmic form of our price data, PC and PU are grain prices in Chinese and US markets, $\Delta PC_t = PC_t - PC_{t-1}$, $\Delta Pu_t = PU_t - PU_{t-1}$, α_1 and α_2 are constant terms, π_{11}, π_{12}, π_{22} and π_{22} indicate coefficients in each model, t stands for the weekly lag terms, and μ_{1t} and μ_{2t} means the random error terms. The model above can be converted when we generate some parameters, such as $Z_t = \begin{bmatrix} LNPC_t \\ LNPU_t \end{bmatrix}$, $\Delta Z_t = Z_t - Z_{t-1} = \begin{bmatrix} \Delta LNPC_t \\ \Delta LNPU_t \end{bmatrix}$, $\phi = \begin{bmatrix} \pi_{11}-1 & \pi_{12} \\ \pi_{22} & \pi_{22}-1 \end{bmatrix}$, $\alpha = \begin{bmatrix} \alpha_1 \\ \alpha_2 \end{bmatrix}$ and $U_t = \begin{bmatrix} \mu_{1t} \\ \mu_{2t} \end{bmatrix}$. Finally, our VAR (1) model becomes the following term,

$$\Delta Z_t = \rho + \phi Z_{t-1} + U_t$$

Where, ΔZ_t is first difference of the natural logarithmic form of grain prices in Chinese and the US markets, and Z_t follows I (1) because both of LNPC and LNPU belong to time series data which are non–stationary and have the same unit roots. Therefore, $\Delta Z_t = Z_t - Z_{t-1}$ follows I (0). We generate γ as the metrical rank of ΔZ. As ρ and U_t are both stable. LNPC and LNPU will not be co–integration when $\gamma = 0$. In addition, LNPC and LNPU will show co–integration when $0 < \gamma < n$ (n is the number of vectors). Granger's representation theorem asserts that if the coefficient matrix has reduced rank to ($\gamma < k$), then there exist $\gamma \times k$ matrices α and β, each with rank γ such that $\phi = \alpha\beta$ and $\beta' Z_{t-1}$ is I(0). So γ is the number of co–integrating relations (the co–integrating rank), and the elements of α is known as the short–run adjustment parameters to the previous term in the VEC model, while each column of β is the co–integrating vector which shows the long–run equilibrium relationship of vector of Z_t. Johansen's method is to estimate the matrix ϕ from an VAR and to test whether we can reject the restrictions implied by the reduced rank of ϕ.

We can run the VECM model when the variables are found co–intergraded, which reports the short–run equilibrium relationships between the vectors. The equation of VECM in this study can be written as,

$$\Delta LNPC_t = \alpha_0 + \sum_1^m \alpha_k \Delta LNPU_{t-k} + \sum_1^m \beta_k \Delta LNPC_{t-k} + \sigma(LNPC_{t-1} + \omega LNPC_{t-1}) + \varepsilon$$

Where, $\sigma(LNPC_{t-1} + \omega LNPC_{t-1})$ is called an error correction term whose value shows negative. And σ is the coefficient of this error correction term, which adjusts the speed of a variable to go back to its equilibrium when some specific bias appears. The parameter of ε is the random error term. Therefore, when the error correction term is positive, which means that $LNPC_{t-1} > \omega LNPC_{t-1}$, the previous value of Chinese grain prices are greater than the value of equilibrium, so the negative value of σ could pull the dependent variables back to its equilibrium value. Otherwise, a negative error correction term indicates that the previous value of Chinese grain prices is less than the value of equilibrium, so the role of σ is to provide a positive effect to bring the Chinese grain price back to equilibrium. In this study, the estimated value of σ shows the speed of the Chinese grain prices approaching its equilibrium value in short time. We regard a rapid equilibrium approach when the estimated value of σ is significantly close to –1, while a slow equilibrium approach is accepted when the estimated value of σ is significantly close to 0.

The Granger Causality Test developed by Granger (1969) will be used to the first difference grain prices between the two selected markets, only if these series are stationary. We shall test the short–run dynamic effects of the first difference of the grain prices between the two selected markets. A bivariate regressions form of the Granger approach in this study can be shown as,

$$\Delta LNPC_t = \alpha_0 + \sum_1^p \alpha_i \Delta LNPC_{t-i} + \sum_1^p b_j \Delta LNPU_{t-j}$$

$$\Delta LNPU_t = c_0 + \sum_1^p c_i \Delta LNPU_{t-i} + \sum_1^p d_j \Delta LNPC_{t-j}$$

Where, $\Delta LNPU_t$ is said to be Granger–caused by $\Delta LNPC_t$ when $b_1 \neq b2 \neq \ldots \neq b_p$, or equivalently the fluctuation of the international grain prices help statistically significantly in the prediction of the fluctuation of the Chinese domestic grain prices. Similarly, $\Delta LNPC_t$ is said to be Granger–caused by $\Delta LNPU_t$ when $d_1 \neq d_2 \neq \dots \neq d_p$.

The impulse response function measures the effect of exogenous shocks on the domestic and international grain prices, which tests a standard random disturbance impact. An impulse response function traces the effect of a one–time shock to one of the innovations on current and future values of the endogenous variables. Accordingly, its model can be written as,

$$\Delta LNPC_t = \alpha_{11} \Delta LNPC_{t-1} + \dots + \alpha_{1k} \Delta LNPC_{t-k} + b_{11} \Delta LNPU_{t-1} + \dots + \alpha_{1k} \Delta LNPU_{t-k} + \varepsilon_{1t}$$

$$\Delta LNPU_t = \alpha_{21} \Delta LNPU_{t-1} + \dots + \alpha_{2k} \Delta LNPU_{t-k} + b_{21} \Delta LNPC_{t-1} + \dots + \alpha_{2k} \Delta LNPC_{t-k} + \varepsilon_{2t}$$

Where, changes in the parameter of ε stands for the exogenous shocks, and the impulse response function can graphically describe the influence of this shock on the grain prices.

RESULTS

In this study, we conduct our research for co–integration analysis only if both of the grain prices series in Chinese and US markets are non–stationary, but both of them are required as I (1). Table 3 shows the result of ADF test for grain prices in China and the US, which reports that all of the weekly grain prices in these two markets are non–stationary. However, our result also suggests that they are stationary at 1% significance level in their first differences, based on which we can conclude that all of our grain prices series belong to I (1), and there might be co–integrations existing between the same grain's prices.

Results of Johansen co–integration test in table 4 show that there are long–run integration between the Chinese grain prices and the US grain prices. Our results of the trace statistics and the Max–Eigen statistics for soybeans, wheat, corn, indica rice and japonica rice suggest that co–integration for the grain prices in those two markets exist at the 5% significance level.

In addition, we found co–integrating equations for the individual grains, as shown in table 5. The results indicate that a significant long–run co–integrationrelationship between the Chinese and US grain prices except for the wheat prices, among which coefficient of soybeans, corn, indica rice and japonica rice are 0.7941, 0.5576, 0.3001 and 0.1273, respectively. All of these coefficients are less than 1, implying that the Chinese grain prices fluctuati less than those in the US grain markets. In addition, the US soybeans prices affect the Chinese domestic soybeans prices most, followed by corn, indica rice and japonica rice.

Table 3. Result of Augmented Dickey–Fuller test for weekly grain prices in China and the US

Variables	Test type (C, T, K)	ADF–test statistic	Prob.	Critical values (1% level)	Critical values (5% level)	Results
soybeans–CN	(C, T, 1)	–2.002	0.5974	–3.988	–3.424	Non–stationary
△soybeans–CN	(N, N, 0)	–24.01	0.0000	–2.572	–1.942	Stationary
corn–CN	(C, T, 4)	–2.414	0.3716	–3.988	–3.424	Non–stationary
△corn–CN	(N, N, 2)	–7.701	0.0000	–2.572	–1.942	Stationary
wheat–CN	(C, T, 1)	–1.858	0.6736	–3.988	–3.424	Non–stationary
△wheat–CN	(N, N, 1)	–10.91	0.0000	–2.572	–1.942	Stationary
indica rice–CN	(C, T, 1)	–1.976	0.6116	–3.988	–3.424	Non–stationary
△indica rice–CN	(N, N, 0)	–23.15	0.0000	–2.572	–1.942	Stationary
japonica rice–CN	(C, T, 1)	–2.187	0.4949	–3.988	–3.424	Non–stationary
△japonica rice–CN	(N, N, 0)	–26.37	0.0000	–2.572	–1.942	Stationary
soybeans–US	(C, T, 1)	–2.475	0.3405	–3.988	–3.424	Non–stationary
△soybeans–US	(N, N, 0)	–20.70	0.0000	–2.572	–1.942	Stationary
corn–US	(C, T, 0)	–2.286	0.4399	–3.988	–3.424	Non–stationary
△corn–US	(N, N, 0)	–17.84	0.0000	–2.572	–1.942	Stationary
wheat–US	(C, T, 0)	–2.290	0.4376	–3.988	–3.424	Non–stationary
△wheat–US	(N, N, 0)	–17.75	0.0000	–2.572	–1.942	Stationary
milled rice–US	(C, T, 0)	–2.418	0.3694	–3.988	–3.424	Non–stationary
△milled rice–US	(N, N, 0)	–16.95	0.0000	–2.572	–1.942	Stationary

Source: Authors' calculation.
Note 1: Time period: February 25, 2007 – February 24, 2013;
Note 2: (C, T, K) stands for the estimated equation for unit root test, in which C, T and K represent intercept, trend, and lag terms, respectively. N means that there is no intercept or trend;
Note 3: Δ stands for the first difference of each variable.
Note 4: All of the grain prices are in logarithmic form.

Table 4. Johansen co–integration test for the Chinese and the US grain prices

Grains	Soybeans		Wheat		Corn		Indica Rice		Japonica Rice	
Lag (s)	4		1		1		1		2	
No. of CE (s)	None*	At most 1*	None*	At most 1*	None*	At most 1*	None*	At most 1*	None*	At most 1*
Eigen value	0.05646	0.005054	0.04268	0.02118	0.09013	0.005726	0.04541	0.006031	0.03938	0.003703
Trace Statistic	19.52	1.566	20.29	6.680	31.26	1.792	16.33	1.881	13.65	1.154
Critical Value	12.32	4.130	20.26	9.165	12.32	4.130	12.32	4.130	12.32	4.130
Probability	0.00270	0.2474	0.04960	0.1444	0.00000	0.2126	0.01010	0.2003	0.02980	0.3295
Max–Eigen Statistic	17.96	1.566	13.61	6.680	29.47	1.792	14.45	1.881	12.49	1.154
Critical Value	11.22	4.130	15.89	9.165	11.22	4.130	11.22	4.130	11.22	4.130
Probability	0.002900	0.2474	0.1106	0.1444	0.00000	0.2126	0.01310	0.2003	0.02980	0.3295
cointegrating eqn (s)	1		0		1		1		1	

Source: Authors' calculation.

Table 5. Long–run cointergrationships between the Chinese and US grain prices

Grains	Long–run equation
Soybeans	LNSC=1.509*+0.7941*LNSU
Wheat	LNWC=5.936*–0.05523LNWU
Corn	LNCC=2.636*+0.5576*LNCU
Indica rice	LNIC=4.234*+0.3001*LNRU
Japonica rice	LNJC=5.474*+0.1273*LNRU

Source: Authors' calculation.
Note 1: SC, WC, CC, IC, JC represent prices for Chinese soybeans, wheat, corn, indica rice and japonica rice. SU, WU, CU, RU represent prices for US's soybeans, wheat, corn and milled rice.
Note 2: * denotes significance under 1% level.

As all of the variables showed co–integration, we can run the VECM model to examine the short–run relationship between the two grain markets. Table 6 provides the result. According to the Akaike Information Criterion (AIC), we selected lagged weeks as 4, 1, 1, 1 and 2 for soybeans, wheat, corn, indica rice and japonica rice, respectively. Our results suggest that the estimated error correction term coefficients are –0.04749, –0.002187, –0.0009480, –0.005806 and –0.004652 for soybeans, wheat, corn, indica rice and japonica rice, respectively, and all of them were significant at the 1% significance level, based on which we can conclude that when the previous Chinese grain prices bias to its equilibrium value, a significant short–run adjustment can force it back to equilibrium. In addition, all of the estimated values of the error correction term coefficients are close to 0, indicating slow equilibrium approaches for each grain. However, the absolute values of the estimated coefficients provide us the information that the adjustment speed for Chinese soybeans prices located the fastest, followed by indica rice, japonica rice, wheat and corn.

Especially, we can also conclude from table 5 that the US soybean prices show a significant influence on the Chinese soybean prices at 4 weeks lagged behind. As the first differences for the soybeans prices in the two markets show stationary, we use a Granger Causality Test to check the short–run dynamic effects between the two selected markets (Table 7). We cannot reject the hypothesis that D (LNSC) does not Granger cause D (LNSU) but we do reject the hypothesis that D (LNSU) does not Granger cause D (LNSC). Therefore it appears that Granger causality runs one–way from D (LNSU) to D (LNSC) and not the other way, which indicates that the volatility for the US soybeans prices can Granger–cause the Chinese soybeans prices to fluctuate.

We also used the impulse response function to check the impact of one standard deviation innovation shock to the endogenous variables. Fig. 3 tells the result for soybeans and corn. Chinese soybean prices respond immediately to its own standard deviation innovation, increasing by 0.025%, and the reducing to 0.017 in the following week, while its impact on the new information from the US soybean prices is steadily rising. The US soybeans prices also increase rapidly by about 0.045% to its own standard deviation innovation, and then reduce by 0.01% in the following week. Response for Chinese corn prices are smoother than for soybeans. The result shows a 0.012% increase to its own innovation, and it reduces by about 0.02%, after which it gradually increases. Influence from one standard deviation innovation from the international corn prices to the Chinese domestic corn prices increase slowly by about 0.001% after the fourth week. Response of the US corn prices to its own innovation is a rapid 0.05% increase and decrease gradually, while the influence from the Chinese markets is negative until the fourth week.

Fig. 4 shows the impulse response for milled rice and wheat. The result indicates that Chinese indica rice and japonica rice response similarly to their own innovations and the international prices. However, japonica rice is more influenced by its own price innovation, which increased by 0.017% and dropped by about 0.008% in the following week, compared to a 0.004% reduce for indica rice. Response of the US rice prices to its own innovation is around 0.04%, and both the information from Chinese indica rice and japonica rice are

Table 6. Result s of vector error correction models of the Chinese and US grain prices

Variable	△LNSC		△LNWC		△LNCC		△LNIC		△LNJC	
	coefficient	t–Stat.	coefficient	t–Stat.	coefficient	t–Stat.	coefficient	t–Stat.	coefficient	t–Stat.
ecm(–1)	–0.04749***	–3.134	–0.0009480**:	–3.480	–0.002187***	–5.531	–0.005806***	–3.514	–0.004652***	–3.539
△LNPc(–1)	–0.2622***	–4.711	–0.1281**	–2.279	–0.1810*–**	–3.247	–0.2909***	–5.363	–0.449264***	–8.001
△LNPc(–2)	0.02949	0.5111	–0.007800	–0.5862	–0.003082	–0.3628	–0.01761	–0.8349	–0.09129	–1.624
△LNPc(–3)	–0.01558	–0.2711							0.02728	1.108
△LNPc(–4)	0.1120**	2.003							–0.03212	–1.301
△LNPu(–1)	0.02099	0.6265								
△LNPu(–2)	0.04644	1.386								
△LNPu(–3)	–0.04104	–1.217								
△LNPu(–4)	0.09622***	2.902								
R–squared	0.2115		0.01745		0.03962		0.09162		0.1920	
Log likelihood	706.3		938.6		1062		868.6		818.4	
AIC	–4.513		–5.998		–6.791		–5.549		–5.231	
DW	1.951		1.954		1.961		2.080		2.008	

Source: Authors' calculation.
Note 1: SC, WC, CC, IC, JC represent prices for Chinese soybeans, wheat, corn, indica rice and japonica rice. SU, WU, CU, RU represent prices for US's soybeans, wheat, corn and milled rice.
Note 2: *, **, *** denotes significance under 1%, 5% and 10% level, respectively.

Table 7. Result s of Granger Causality Test of soybeans prices in China and US

Null Hypothesis	Obs	F–Statistic	Prob.
D(LNSU) does not Granger Cause D(LNSC)	309	5.952	0.0001000
D(LNSC) does not Granger Cause D(LNSU)	309	0.8063	0.5219

Source: Authors' calculation.
Note 1: SU and SC represent soybeans prices in COBT's and Chinese markets.

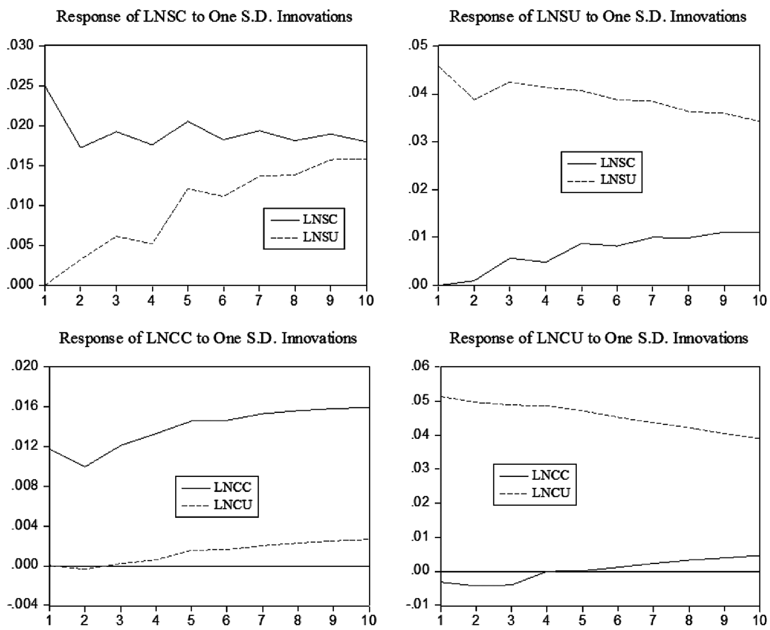

Fig. 3. Response of soybeans prices and corn price to one S. D. innovations.
Source: Authors' calculation.
Note 1: SC and CC represent prices for Chinese soybeans and corn. SU and CU represent prices for US's soybeans and corn.
Note 2: Vertical axis calculates the level of the impulse response (%).

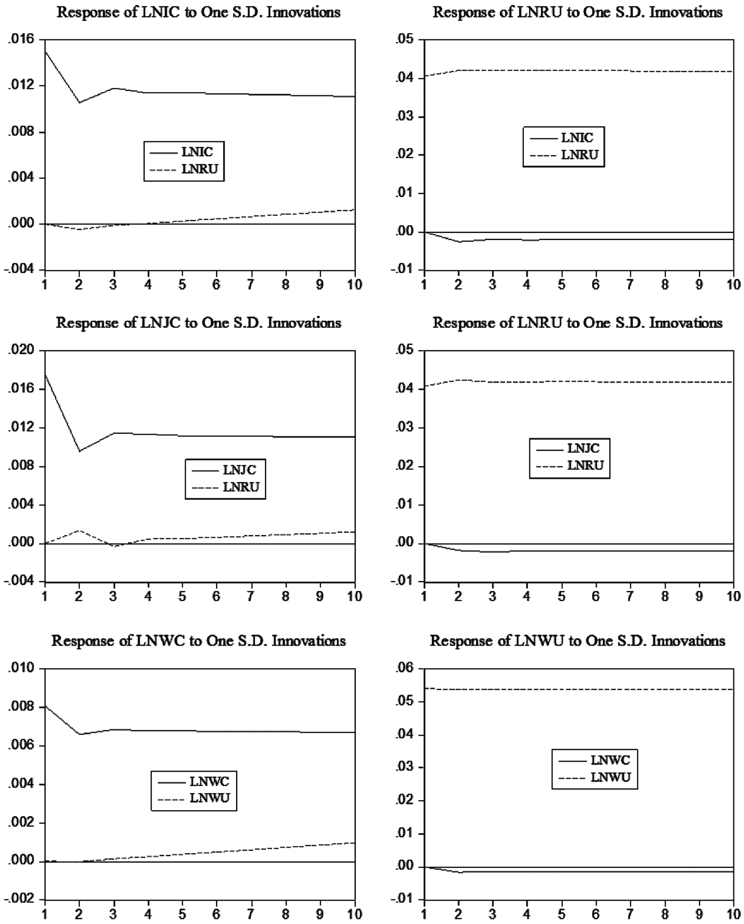

Fig. 4. Response of prices of indica rice, japonica rice and corn to one S. D. innovations.
Source: A uthors' calculation.
Note 1: WC, IC, JC represent prices for Chinese wheat, indica rice and japonica rice. And WU, RU represent prices for US's wheat and milled rice.
Note 2: Vertical axis calculates the level of the impulse response (%).

small and negative. Impulse response for wheat is similar to milled rice resuting in a slow and gradual influence of the US prices on the Chinese domestic wheat prices.

DISCUSSION

This study studied the grain price translation from the international grain markets to Chinese grain markets. The Johansen co–integration test and VECM model are applied to the weekly grain price data.

The result of ADF test for grain prices in China and the US, indicate that all of the weekly grain prices in these two markets belong to I (1), and there might be co–integrations existing between the same grain's prices. Furthermore, there are long–run integrations between the Chinese grain prices and the US grain prices. Our results suggest that co–integration for the grain prices in those two markets exist at the 5% significance level. In addition, we found significant long–run cointergrationships between the Chinese and US grain prices except for the wheat prices, among which the coefficients of soybeans, corn, indica rice and japonica rice are 0.7941, 0.5576, 0.3001 and 0.1273, respectively.

Our results from the VECM model also suggest that the estimated error correction term coefficients are –0.04749, –0.002187, –0.0009480, –0.005806 and –0.004652 for soybeans, wheat, corn, indica rice and japonica rice, respectively, all of which are sighificant at the 1% significance level. In addition, the Granger Causality Test indicates that the volatility of the US soybean prices is a reason for causing the chinese soybean prices fluctuation.

Finally, Chinese grain prices respond immediately to its own standard deviation innovation and the impact from the international markets is more significant for soybeans. Prices of the US soybeans and corn show significant effect on their own innovations.

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