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Full Length Research Paper

A tale of two markets: Who can represent the soybean futures markets in China?

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There exist two soybean futures markets in China Dalian commodity exchange (DCE), that is, No.1 and No.2 soybean futures markets (SB#1 and SB#2 for short respectively). Due to its dominant market share, trading volume and turnover, SB#1 is taken for granted to be the only representative of China's soybean markets; so that, there is an implicit misconception in current literature that researchers can simply study the SB#1 to obtain the understandings of the whole China's soybean futures markets and apply their findings in SB#1 to the whole soybean markets in China. This article mainly doubted whether SB#1 can represent China's soybean futures markets or not, and provided empirical evidence that although, SB#2 only take small percentage in the whole market share, it is completely distinct from the SB#1. The study also found by means of information share (IS) model that instead of the previous misconception, SB#2 is much more important in that its information share is larger than its market share.

Key words: No.1, soybean futures market (SB#1), No.2 soybean futures market (SB#2).

INTRODUCTION

As the world largest importer of soybeans, China's soybean markets are always concerned by the world agricultural producers and consumers. What's more, China Dalian Commodity Exchange (DCE) has become the world second largest soybean futures exchange only next to Chicago Board of Trade (CBOT). China's soybean futures markets thereby become a hot issue in current literature. However, China's soybean markets are somehow unique because there are two soybean futures markets in DCE, that is, No.1 and 2 soybean futures markets (SB#1 and SB#2 for short). Launched earlier than the other market, SB#1 is only designed for Non-GMO (Genetically Modified Organism) soybeans. In order to cover genetically modified soybeans, DCE launched a new kind of more inclusive futures contract to incorporate both GMO and Non-GMO produces, that is, SB#2 in December 22, 2004. SB#2 aims to connect China's and international soybean futures markets and enhance the impact of China's demands on international soybean markets. It also brought some new challenges to China's soybean futures markets researches.

Due to its dominant market percentage, trading volume and turnover (Table 1), SB#1 is taken for granted to be the only representative of China's soybean markets; so that, there is an implicit misconception in current literature that researchers can simply study SB#1 to obtain the understandings of the soyabean market as a whole, and apply their findings in SB#1 to China's soybean markets.

Based on the co-integration theory, this paper analyzes the relationship and difference between SB#1 and SB#2. Johansen co-integration approach (Johansen, 1988; Johansen and Juselius, 1990) is applied to test the long term relationship between the price time series of the two markets. If there exists a co-integration relationship between SB#1 and SB#2, vector error correction (VEC) model (Garbade and Silber, 1983) and impulse response function then are applied to observe the short-term fluctuations and long-term balance correction. Besides, Granger causality test is used to examine the cause and effect relationship. In order to investigate the actual market influence, IS model (Baillie et al., 2002; Hasbrouck,

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Table 1. 2008 statistics of SB#1and SB#2.

Product	Volume	Turnover	End of year open interest
SB#1	227363100	9519.02	366690
SB#2	85582	3.78	120

Volume, open interest: contract; turnover: RMB billion (by double side). The data are taken from Dalian Commodity Exchange.

Hasbrouck, 1995) is applied to estimate the information share of SB#1 and SB#2 respectively.

LITERATURE REVIEW

In the context of commodity futures markets studies, current researches usually focused on some specific topics such as price discovery (Fleming and Ostdiek, 1996; Garbade and Silber, 1983; Gay et al., 2009; Jian and Bessler, 2001), relationship of the same futures contracts in different settings (Booth et al., 1998, Xu and Fung, 2005), variability of futures market components (for example, volume and price) (Agnolucci, 2009; Fujihara and Mougoue, 1997) etc.

Although, there is a growing demand of understanding China's agricultural futures markets, few theoretical or empirical results can be found in current literature. Among these results, Hung-Gay Fung et al. investigated soybean and wheat cross-market interaction between U.S. and China's futures markets, and confirmed that volatility interaction is much more significant than prices interaction, and that connection between international and China's soybean futures markets is closer than that of wheat markets (Hung-Gay et al., 2003). Hua et al. held the same viewpoint of the relationship between international and China's soybean and wheat futures markets by means of co-integration theory (Renhai and Baizhu, 2007). Chan et al studied China's soybean, wheat and other futures markets, and found that negative returns appear to have a greater impact on volatility than positive returns do, while volume has a positive effect on volatility (Chan et al., 2004). Du and Wang believed China's wheat futures market are more suitable for GARCH among ARMA, ARCH and GARCH models (Du and Wang, 2004). Chen et al. found that informational/permanent components dominate China's futures returns, while non informational/transitory components dominate futures market trading volume, and that soybean futures market responses better than wheat futures market Chen et al., 2005). Wang and Ke found that China's soybean markets always have an equilibrium relationship between the futures and spot prices, but wheat futures markets are inefficient in short-term due to larger amount of irrational traders and more government regulations (Wang and Ke, 2005). Wang et al analyzed the linkage between DCE soybean and corn futures prices, but failed to find a significant co-integration relationship (Wang et al., 2009).

In general, many papers in current literature focused on one or more components of a single market or just simple relationship between international and domestic futures markets. Empirical results are lack of highly related futures markets like SB#1 and #2 in China. Furthermore, in current literature of soybean futures markets studies, without any strong empirical or theoretical evidence, researchers simply studied SB#1 and applied their findings to the whole China's soybean futures markets. But can we simply ignore SB#2? What insights of the soybean markets as a whole might be lost in the ignorance in the contexts without SB#2? There is no answer to the questions in current literature.

THEORIES AND MODELS

According to Dickey and Fuller (1981), we applied ADF, that is, augmented Dickey-Fuller, to test the stationarity and the phase-lag for the integration of the series. If the null hypothesis ($H_0 : \delta = 0$) in Equation (2.1) is rejected, y_t is stationary, or this series has a unit root.

$$y_t = \propto + \beta t + \delta y_{t-1} + \sum_{j=1}^{p} \lambda_j \quad y_{t-j} + u_t \tag{1 2.1}$$

Because two-step estimation procedure Granger and Engle (1987) can hardly infer parameters and determine the co-integration rank of the equation, the study used Johansen's co-integration approach (Johansen, 1988; Johansen and Juselius, 1990) based on VAR model (Sims, 1980) to test the co-integration relationship and estimate equation parameters by maximum likelihood method. In this paper, the VAR model is given by (k is chosen by Akaike Info. Criterion):

$$y_t = c + \sum_{i=1}^{k} \beta_{1i} x_{t-i} + \sum_{i=1}^{k} \beta_{2i} y_{t-i} + u_{1t} \tag{2 2.2}$$

Because the results of Granger causality test, tested whether the added explanatory variable can improve the explanatory ability of the primary equation, largely depend on the choice of lag and co-integration relationship, the study also executed the Granger causality test in VAR model. If the test rejects the null hypothesis that the coefficient of the explanatory variable is zero, it is the Granger reason of the explained variable. If a co-integration relationship between the time series is identified, an error correction model can be established (Granger, 1986; Engle and Granger, 1987). By introducing a co-integration constraint to VAR model (VEC), we added an error correction term to the equation:

$$y_t = ecm + \sum_{i=1}^{k} \beta_{3i} x_{t-i} + \sum_{i=1}^{k} \beta_{4i} y_{t-i} + u_{2t} \tag{3 2.3}$$

Table 2. ADF test of SB#1 and SB#2.

Series	Exogenous	ADF test statistic	Test critical values		
			1%	5%	10%
	(*c*,*t*,2)	-1.1658	-3.9685	-3.4149	-3.1296
SB#1	(*c*,0,2)	-1.3482	-3.4375	-2.8646	-2.5685
	(0,0,2)	0.6143	-2.5676	-1.9412	-1.6165
⊿*SB*#1	(*c*,*t*,1)***	-25.5303	-3.9685	-3.4149	-3.1296
	(*c*,*t*,2)	-1.3246	-3.9685	-3.4149	-3.1296
SB#2	(*c*,0,2)	-1.4918	-3.4375	-2.8646	-2.5685
	(0,0,2)	0.5589	-2.5676	-1.9412	-1.6165
⊿*SB*#2	(*c*,*t*,1)***	-25.1225	-3.9685	-3.4149	-3.1296

Note: *c* stands for constant, *t* stands for linear trend, *n* stands for lag length and ⊿ stands for the first differences. Akaike Info Criterion (AIC) is applied as automatic selection of lag length. $(c,t,n)^{i**}$ (i=1,2,3) stands for rejecting the null hypothesis that the series has a unit root respectively at the 0.1, 0.05, 0.01 significance level.

We introduced impulse response (IR) and variance decomposition (VD) functions based on VEC estimation model. IR is applied to measure how the series fluctuate in the future when they are influenced by one standard deviation innovation now. VD and IS model based on VEC model associated with the SB#1 and SB#2 markets is defined as the proportional contribution of that markets' innovations to the innovation in the common efficient price (Hasbrouck, 1995). According to Baillie et al., 2002, average of upper and lower bound is the information share of the market. Because the first equation information share of the VEC model is larger than the following ones, the study can get different upper bounds and lower bounds by changing the order of the equations.

Data and variables

In order to avoid the detrimental effect of DCE soybean futures contract's launching on January 9, 2006, the study matched 884 couples of SB#1 and SB#2 daily closing prices from January 9, 2006 to August 21, 2009. The data are taken from Reuters Database© and Dalian Commodity Exchange. Because futures prices of the contract month in the middle are stable, the study chose the third one from the upcoming futures contracts. To maintain the data's statistical properties and remove heteroscedastic influence, the natural logarithm series were used. Before further empirical analyses, the study tested the stationarity of the futures prices series. By ADF test, both SB#1 and SB#2 are found to be first-difference stationary $(SB\#1\ I(1), SB\#2\ I(1))$ (Table 2). Thereby, there may be a co-integration relationship between them.

EMPIRICAL ANALYSES

Are SB#2 and SB#1 co-integrated?

Co-integration relationship means long term equilibrium. The VAR model was established between SB#1 and SB#2 to precede Johansen's co-integration approach. The best lag of this model is four selected by four different tests, namely, AIC, LR (sequential modified LR test statistic), FPE (Final prediction error) and HQ (Hannan-Quinn information criterion). From Table 3, both Trace and Max-Eigen results indicate that there is only one co-integration relationship between the two markets. Although SB#1 and SB#2 are non-stationary, there is a common long-term tendency so that the China's soybean markets as a whole is stationary. Compared with the results in reference (Wang et al., 2009), the relations between the two markets are much closer than those among the other agricultural futures markets in China. Some economists therefore, believe that SB#1 alone can stand for China's soybean markets because of its dominant market share and the long-run equilibrium with SB#2. Is this implicit assertion true? The following results of Granger causality and IR and VD functions may provide better insights into this question.

Is SB#2 Granger reason of SB#1?

Economists in China's soybean futures domain usually studied only SB#1 market but declared that they were studying the whole markets. As Granger causality test can tell us which time series can be the Granger reason, we carried out the test and found that SB#1 and SB#2 are Granger causing each other, and that fluctuations in both markets have an impact on each other (Table 4). The results indicate that SB#1 is Granger causing SB#2 while SB#2 also is Granger causing SB#1, which implies that SB#2 has exerted certain influence on SB#1 thus cannot be simply ignored despite its small market share. The current misconception therefore, may be unsuitable and groundless.

Are the short-term fluctuations of the two markets identical or fundamentally different?

In order to further understand the short-term fluctuations and the repairing function when short-term fluctuations

Table 3. The results of Johansen test.

Eigen value	Trace		Max-Eigen		Hypothesized number of CE(s)	Conclusion
	Statistic	5% CV	Statistic	5%CV		
0.0220	21.5289	15.4947	19.5676	14.2646	None*	There is only one co-integration relationship
0.0022	1.9613	3.8415	1.9613	3.8415	More than 1	

Note: CV stands for Critical Value; * denotes rejection of the null hypothesis at the 0.05 level.

Table 4. Granger causality test of No.1 and 2 soybean futures prices.

Null Hypothesis	Chi^2	Probability	Conclusion at the 0.01 level
H_0 (*SB*#1 not to *SB*#2)	36.2894	0.0000	reject
H_0 (*SB*#2 not to *SB*#1)	24.1926	0.0001	reject

Note: H_0 (*SB*#1 not to *SB*#2) is the null hypothesis, that is, *SB*#1 is not the Granger reason of *SB*#2; whereas H_0 (*SB*#2 not to *SB*#1) is the null hypothesis that *SB*#2 is not the Granger reason of *SB*#1.

Table 5. VEC model of No.1 and 2 soybean futures prices.

Induced variable	ECM	*c*	Dependent variable lag	1	2	3	4
⊿SB#1	-0.0174	0.0005	*⊿SB#1*	-0.3504**	-0.1463**	-0.0983*	-0.0578
			⊿SB#2	0.1267**	0.0774*	0.1278**	0.0432
⊿SB#2	0.0570**	0.0004	*⊿SB#1*	0.1211**	0.1551**	0.1145*	0.0038
			⊿SB#2	-0.2763**	-0.1338**	-0.0026	0.0317

Note: **(*) stands for passing the t-test at the 0.01 (0.05) level. $t_{0.01}$ = 2.576, $t_{0.05}$ = 1.960.

deviates long-term equilibrium, the study removed non stationary by taking the differential form, and established the VEC model, (Table 5). The results of error correction model (ECM) are also given in Table 5, which aims to find the deviation of the current state from its long-run equilibrium and the short-run dynamics.

In the VEC model of SB#1, the numerical result of ECM (Table 5) is negative, which indicates the error correction term has a positive effect on restoring the initial equilibrium. The results of ECM for SB#2 per contra are positive, which implies that SB#2 has a tendency of deviating from the initial equilibrium. Almost all the dependent variables whose lag phase less than 3 pass the t-test, which means market information of SB#1 and SB#2 can be quickly and effectively transmitted to each other and adjust synchronously to a new equilibrium state. But the coefficients of *SB*#1 and *SB*#2 with a lay of 4 are not remarkable, which implies the information's impact is negligible since the fourth trading day. On the contrary, ECM for SB#2 market is significant so that No.1 and 2 soybean futures price formations are fundamentally different. SB#1 fluctuation is only led by history market information, while SB#2 fluctuation is influenced by both market mechanism and history price information.

In order to get further understanding of the impacts of different market fluctuation mechanisms on the two markets, the study applied impulse response analysis to observe how SB#1 and SB#2 prices fluctuate when they are impacted by one standard deviation innovation. From Figure 1, the study found that when one external standard deviation innovation shock (0.0223 for SB#1, 0.0242 for SB#2) disturbs the soybean futures markets, SB#1 responses much faster than SB#2 does. SB#1 can restore new market equilibrium in the next 10 trading days after the standard deviation innovation impact, while SB#2 needs almost 100 trading days to restore the equilibrium level. Both markets are strongly influenced by the impacts from themselves at first. But during the phase of SB#2 adjustment, influence of itself diminishes while influence from SB#1 enhances. At last, impact from SB#1 gradually surpasses the impact from itself.

Specifically, SB#1 reacts rapidly to the impact from itself, but the innovation impact diminishes in the following days and remains 68% of one standard external deviation innovation finally. SB#1 reacts slightly to the impact from SB#2, while the impact maintains 18% of one standard external deviation innovation in the end and both rebound in the forth trading day. But the two markets

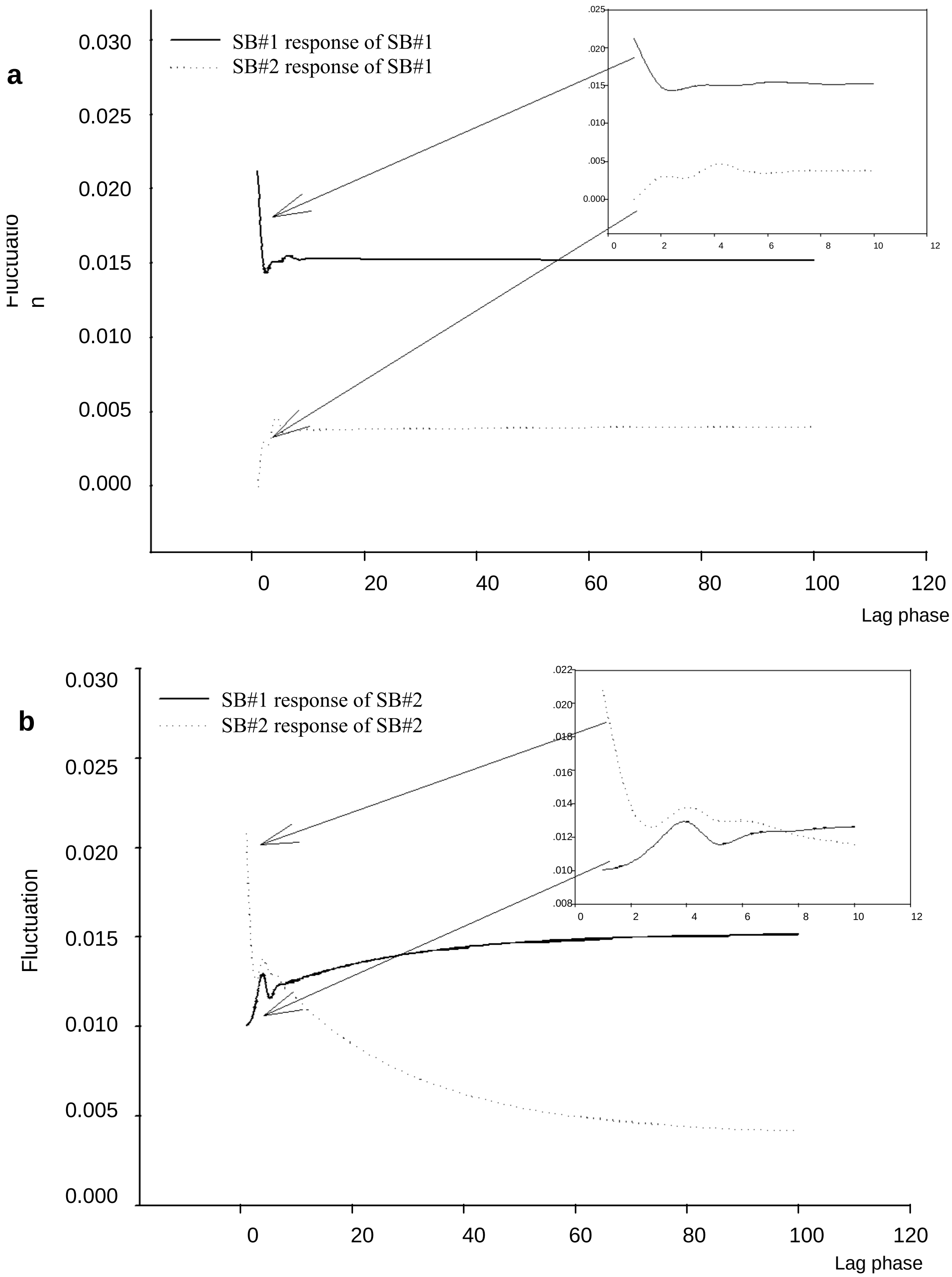

Figure 1. Impulse response analyses of SB#1 (a) and SB#2 (b) (imbedded panels illustrate the short term impulse response of the two markets).

markets react fundamentally differently to one standard external deviation innovation. SB#2 responses more strongly to the impact from the other side than SB#1 does. After 100 trading days, SB#2 goes back to market balance with 62% of the innovation impact from SB#1 and 17% of the impacts from its own.

Table 6. Variance Decomposition of the two markets.

Lag length	SB#1		SB#2	
	IS of SB#1	IS of SB#2	IS of SB#1	IS of SB#2
1	100.0000	0.0000	18.9461	81.0539
2	98.6814	1.3186	25.2504	74.7496
4	96.6611	3.3389	34.6214	65.3786
10	95.3269	4.6731	42.8090	57.1910
50	94.2186	5.7814	67.8867	32.1133
100	93.9527	6.0473	79.0332	20.9668
150	93.8486	6.1514	83.6578	16.3422
200	93.7949	6.2051	86.0857	13.9143
250	93.7625	6.2375	87.5667	12.4333

These two prices series maintain new long-term equilibrium in favor of the impulse's direction, which implies that the prices are rigid in China's soybean futures markets so that it is hard for them to come back to the initial market equilibria. After the innovation shocks, both markets can not instantly recover from the deviation of the short-term equilibria.

The new balance has a positively correlated with the external shocks, namely, if there is one positive impact on China's soybean futures markets, the relevant futures prices would adjust to new equilibria which are higher than the initial prices. Above all, price formation of SB#1 and SB#2 is significantly different and these two futures markets need different period of time to adjust to the new equilibria.

Considering of the results of Granger causality, that is, SB#2 is the Granger causality of SB#1, a reasonable inference can be made that SB#1 can not represent the overall China's soybean markets.

Information share—another perspective on market positions of the two markets

It is not enough to say SB#1 cannot stand for China's soybean markets as a whole; the study still needs to know the actual market position of the two markets. Thereby, the study applied the IS model which can measure the information share of the spot and futures markets of the same commodity (Baillie et al., 2002; Hasbrouck, 1995). The IS model helps us estimate the information share as a weight or measure for market position of each soybean futures market in informational point of view. To obtain the information share, first of all the study calculated the Variance Decomposition upon the VEC model (Table 5).

From Table 6, the study obtained the information share of SB#1 (90.66%), and that of SB#2 (9.32%). It is astonishing to find that the information share of SB#2 takes up one tenth of the total although the actual market share of SB#2 is less than 1%. The relative high information share of SB#2 implies that, the market is much more influential than what it appears to be, and that this market can not be simply neglected in the current literature. Otherwise, the results would be spurious in one-sided and biased story. If it grows larger, the promising market will play a greater role in China's soybean markets.

Conclusions

In this paper, the study found that No.1 soybean futures market can not represent the whole China's soybean markets due to the following reasons: Firstly, No.2 soybean futures market is the Granger reason of No.2 soybean futures market. Secondly, the short term fluctuation characteristics of the two markets are different in that of information transmission and market reaction of SB#1 are much faster than those of SB#2. On the contrary, it takes longer time for SB#2 to restore new equilibrium after an exogenous shock. Thirdly, the information share of SB#2 is much greater than its actual market share, which implies that the market is much more influential than what it appears to be, and that this market can not be simply neglected in the current literature.

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