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	Inoue Takeshi, Hamori Shigeyuki
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Takeshi INOUE* and Shigeyuki HAMORI**

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Abstract

This paper aims to examine the market efficiency of the commodity futures market in India, which has been growing phenomenally for the last few years. We estimate the long-run equilibrium relationship between the multi-commodity futures and spot prices and then test for market efficiency in a weak form sense by applying both the DOLS and the FMOLS methods. The entire sample period is from 2 January 2006 to 31 March 2011. The results indicate that a cointegrating relationship is found between these indices and that the commodity futures market seems to be efficient only during the more recent sub-sample period since July 2009.

* Associate Senior Research Fellow, IDE-JETRO (takeshi_inoue@ide.go.jp).
** Professor, Faculty of Economics, Kobe University (hamori@econ.kobe-u.ac.jp).

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Market Efficiency of Commodity Futures in India

Takeshi INOUE

(Institute of Developing Economies)

and

Shigeyuki HAMORI

(Kobe University)

Abstract

This paper aims to examine the market efficiency of the commodity futures market in India, which has been growing phenomenally for the last few years. We estimate the long-run equilibrium relationship between the multi-commodity futures and spot prices and then test for market efficiency in a weak form sense by applying both the DOLS and the FMOLS methods. The entire sample period is from 2 January 2006 to 31 March 2011. The results indicate that a cointegrating relationship is found between these indices and that the commodity futures market seems to be efficient only during the more recent sub-sample period since July 2009.

1. Introduction

Following repeated changes in the rules and regulations by the authorities, the Indian commodity futures market has achieved a surge in values and volumes of traded commodities over the last decade. The history of commodity futures in India can be traced back to the end of the 19th century when the Bombay Cotton Trade Association established cotton contracts. In the interwar period, the futures market underwent rapid growth, although futures trading came to be prohibited during the Second World War under the Defence of India Act (FMC, 2011a, 1). After its transient resumption and prosperity in the mid-1950s, futures trading was again banned in 1966 except for a few minor commodities, and after that, it was practically deactivated. During the 1980s, commodity futures trading was partially permitted in a few commodities, but it was in the liberalization process beginning in 1991 that the Indian government reassessed the role of commodity futures trading in the economy.

In 2003, the government lifted the prohibition against futures trading in all the commodities, granting recognition to three electronic exchanges, namely National Multi Commodity Exchange of India (NMCE), Multi Commodity Exchange of India (MCX), and National Commodity and Derivatives Exchange (NCDEX), as national level multi-commodity exchanges (FMC, 2011a, 6). Moreover, Indian Commodity Exchange (ICEX) and ACE Commodity and Derivative Exchanges were also granted recognition as the fourth and the fifth national multi-commodity exchanges in 2009 and 2010, respectively. With the establishment of these exchanges, the commodity futures market has witnessed massive growth in India. For example, the total value of commodities traded has steadily increased, and after reaching Rs.52.49 trillion in 2008-09, it has outperformed the domestic stock market (see Figure 1). Certainly, the commodity market has grown to be among the major financial markets in India.

Generally, it is said that the futures market has the two important economic functions, i.e., price risk management and price discovery. By taking equal but opposite positions in the futures market, both the producer and the consumer can manage the price risk in the spot market, which is usually called the hedging of price risk in commodities. Apart from these participants who aim to hedge, there must also be someone in the futures market who aims to take risk and profit by doing so (Easwaran and Ramasundaram, 2008, 339). Having market participants with various objectives and information, the futures market enables the current futures price to act as an accurate indicator of the

spot price expected at the maturity of the futures contract. This is referred to as the price discovery function of the futures market. Only an efficient futures market can perform these functions. As proposed by Fama (1970), we consider the market as weak-form efficient if the futures price reflects all available information for predicting the future spot price and any participants cannot make profits consistently.[1]

Empirical analyses on market efficiency of commodity futures have been conducted mainly for developed countries so far. The examples include Chowdhury (1991) and Kellard (2002) for the UK, and Beck (1994) and McKenzie et al. (2002) for the US. Meanwhile, the relevant studies for emerging countries are significantly growing but still limited. In this paper, we especially focus on India, one of the emerging countries with phenomenal growth in its commodity market, and we empirically examine whether the market efficient hypothesis holds in the Indian commodity market. More specifically, we first estimate the long-run equilibrium relationship between multi-commodity futures and spot prices and then test for market efficiency in a weak form sense by applying the dynamic OLS (DOLS) and the fully modified OLS (FMOLS) methods, respectively.

This paper is organized as follows. The next section briefly reviews the relevant literature and discusses the contributions of this study. Section 2 explains the definitions, sources, and properties of the data, while the third section presents the model and shows the empirical results. In the final section, we summarize the main findings of this study and suggest policy implications.

2. Literature Review

Since the introduction of cointegration theory, a growing body of literature has empirically tested market efficiency of commodity futures around the world. If the non-stationary spot and futures prices are cointegrated, it ensures that there exists a long-run equilibrium relationship between them. However, if these two price series are not cointegrated, they diverge without bound, such that the futures price would provide little information about the movement of the spot price (Lai and Lai, 1991, 569). Therefore, cointegration between the spot price and the futures price is a necessary condition for market efficiency (*ibid*. 568). Market efficiency also requires that the futures price is an unbiased predictor on average, indicating that these two price indices have a cointegrating vector (1,

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[1] Fama (1970) classified market efficiency into three categories: weak form efficiency, semi-strong form efficiency, and strong form efficiency. Unlike weak form efficiency, the semi-strong efficiency indicates that all public information is calculated into current prices, while the strong form efficiency indicates that all information in a market, whether public or private, is accounted for in prices.

-1).

So far, market efficiency has mainly been studies for developed countries such as the US and the UK, and studies on emerging and developing counties are few. Among the latter, examples other than India include Wang and Ke (2005) for wheat and soybeans and Xin et al. (2006) for copper and aluminum, both of which examine the commodity market efficiency in China using cointegration methods.

The prior research on India consists of Bose (2008), Jabir and Gupta (2011), and Goyari and Jena (2011).[2] Bose (2008) examines some characteristics of Indian commodity futures in order to judge whether the prices fulfill the efficient functions of the markets or not. She analyzes this issue by applying different methods such as correlation, cointegration and causality and using the price indices from the MCX and the NCDEX from June 2005 to September 2007. The results show that the multi-commodity futures indices help to reduce volatility in the spot prices of corresponding commodities and provide for effective hedging of price risk, while the agricultural indices do not exhibit these features clearly. Also, Jabir and Gupta (2011) analyze the efficiency of 12 agricultural commodity markets by examining the relationships between the futures and spot prices from 2004 to 2007. As the results from their cointegration and causality tests, they indicate that cointegration exists in these indices for all commodities except wheat and rice and that the direction of causality is mixed, depending on the commodities. Finally, Goyari and Jena (2011) examine the commodity futures market from June 2005 to January 2008 using the daily spot and futures prices of gold, crude oil and guar seed. The results of their cointegration test state that the spot price and the futures price are cointegrated for three commodities, suggesting that they have a long-run relationship.

As mentioned above, all these studies use the period before 2008 as their sample period and so do not cover the period during which Indian commodity futures gained momentum significantly. Besides, they conduct the Johansen cointegration test but do not test the cointegrating parameter restriction for the unbiasedness hypothesis. This paper differs from the surveyed studies on these two points.

3. Data

The sample period is from January 2006 to March 2011. We use the daily data for this period, and

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[2] Easwaran and Ramasundaram (2008) and Vishwanathan and Pillai (2010) examine the Indian commodity futures market by using techniques other than cointegration.

the number of observation is 1,590 in total. In contrast to the previous studies using individual agricultural commodities, this paper uses the multi-commodity price indices, i.e., the spot index (MCXSCOMDEX) and the futures index (MCXCOMDEX) obtained from the website of MCX (http://www.mcxindia.com/Home. aspx). Figure 2 depicts the movements of the closing price of MCXSCOMDEX and MCXCOMDEX, respectively.

To confirm the properties of the data, a unit root test was carried out for the natural logarithm of each price. Table 1 shows the results of the augmented Dickey-Fuller test (Dickey and Fuller, 1979). From this table, it can be seen that the level of each variable was found to have a unit root, while the first difference of each variable was found not to have a unit root. Therefore, we can say that each index is a non-stationary variable with a unit root.

Next, we conducted the Johansen cointegration test for the spot and the futures price indices (Johansen, 1988). There are two kinds of Johansen-type tests: the trace test and the maximum eigen-value test. Table 2 shows the results of cointegration test. Here, we used the lags 1, 2 and 3 to check the robustness of empirical results. As is evident from this table, the null hypothesis of no cointegrating relation is rejected in all cases at the 1 % level, while the null hypothesis of one cointegrating relation is not rejected in all cases. Therefore, it is found that the existence of a cointegrating relation was statistically supported for the multi-commodity spot and futures prices

4. Empirical Results

4.1 Full-sample Analysis

The basic model is specified as follows:

$$\ln(S_t) = \alpha + \beta \ln(F_t) + u_t \qquad (1)$$

where S_t is the spot index, F_t is the futures index, α is the risk premium and u_t is the error term. We estimate Equation 1 by two alternative methods, namely the fully modified OLS (FMOLS) and the dynamic OLS (DOLS) to test the market efficiency of commodity futures in India (Phillips and Hansen, 1990; Stock and Watson, 1993). If market efficiency holds, it requires that $\beta = 1$. The null and the alternative hypothesis are as follows:

$$H_0 : \beta = 1$$
$$H_A : \beta \neq 1$$

Table 3 shows the results of the hypothesis test. From this table, it is found in the case of the DOLS that the estimated value of β is 1.032 and that the null hypothesis of $\beta = 1$ is rejected at the conventional level. The result is the same in the case of the FMOLS. Therefore, we find that the Indian commodity futures market is not efficient when considering the entire sample period from 2006 to 2011.

4.2 Sub-sample Analysis

Next, we divide the full sample period into three sub-sample periods to check whether there have been changes in market efficiency over time. The sub-sample periods are as follows:

Sub-sample A: 2 January 2006 – 30 June, 2008
Sub-sample B: 1 July, 2008 – 30 June, 2009
Sub-sample C: 1 July, 2009 – 31 March, 2011

The sub-sample periods roughly correspond to the trends of commodity price indices. Specifically, after having increased until the middle of 2008 (Sub-sample A), both indices plummeted in the subsequent year (Sub-sample B), and since then (Sub-sample C), they have again shown a significant increasing trend.

Table 4 shows the results of each sub-sample period. Concerning Sub-sample A, the null hypothesis of $\beta = 1$ is rejected and the estimated value of β is 1.027 in the case of the DOLS and 1.026 in the case of the FMOLS. Next, concerning Sub-sample B, the null hypothesis of $\beta = 1$ is rejected and the estimated value of β is 1.101 in the case of the DOLS and 1.110 in the case of the FMOLS. Finally, concerning Sub-sample C, the null hypothesis of $\beta = 1$ is not rejected and the estimated value of β is 0.990 in both cases.

In short, market efficiency is not satisfied in Sub-samples A and B, while it is likely that market efficiency is fulfilled during the more recent Sub-sample C period. This suggests that, as the commodity futures market has developed, the efficiency has increased in India.

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5. Conclusion

In this paper, we empirically analyze whether the growing Indian commodity futures market satisfies market efficiency using the multi-commodity price indices released by the MCX, the largest national commodity exchange in India. For this, we conduct the Johansen cointegration test for the spot and the futures price indices from January 2006 to March 2011. The results show that there is a cointegrating relation between them, which means that a necessary condition for market efficiency is satisfied.

Based on these results, we proceeded to test another necessary condition for market efficiency, that is, the unbiasedness hypothesis. This hypothesis implies that the current futures price of a commodity should equal the future spot price of the commodity at contract maturity (McKenzie et al., 2002, 478). By estimating the DOLS and the FMOLS, we perform the hypothesis tests to examine whether two price indices have a cointegrating vector (1, -1). The results are follows:

(1) During the entire sample period, the null hypothesis that the futures price becomes the unbiased predictor is rejected, which implies that the commodity futures market in India is not market efficient.

(2) With the sample period divided into three sub-samples, the unbiasedness hypothesis is not rejected only when the more recent sample period after July 2009 is used. Therefore, market efficiency is supported in India during the more recent period.

So far, the relevant literature has generally analyzed the cointegrating relation between the spot and futures prices of the individual agricultural commodities and has used the sample period before the phenomenal growth in traded value of commodity futures in India. In fact, the total value of commodities traded has shown the significant growth since 2008-09 (see Figure 1). In addition, in line with this trend, the commodity price indices have also increased since the middle of 2009 (see Figure 2). The result of our paper implies that, as the market size expands, the commodity futures market fulfills weak form efficiency in that the futures price generally operates as an unbiased predictor of the future spot price.

In India, whenever the futures price of a commodity increases sharply, it is usually regarded as the result of speculative activity, and the authorities tend to impose several kinds of regulations. Considering our results, however, the commodity market has significantly improved its

efficiency with the increase of trade value during the recent period, suggesting that the futures market performs the functions of price risk management and price discovery. Accordingly, in order to utilize the futures market, the Indian government will be required to further enhance its institutional infrastructure for smooth commodity transactions in line with market development, rather than to strengthen the restrictions on commodity transactions.

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Figure 1 Total Value of Commodities and Stocks in India (Rs. billion)
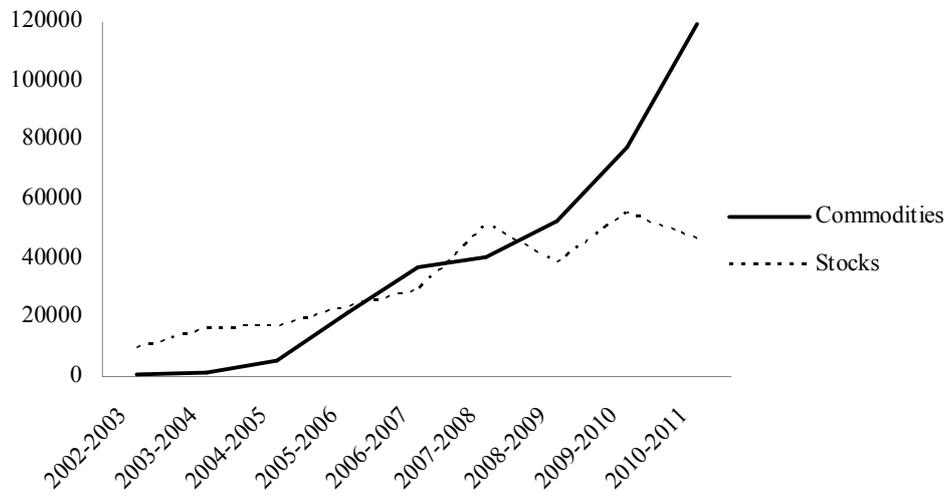
Sources: FMC (2011a, 2011b), MOCAFPD (various issues), and SEBI (2012).

Figure 2 The Movements of Commodity Price Indices

.... Spot index

———— Futures index
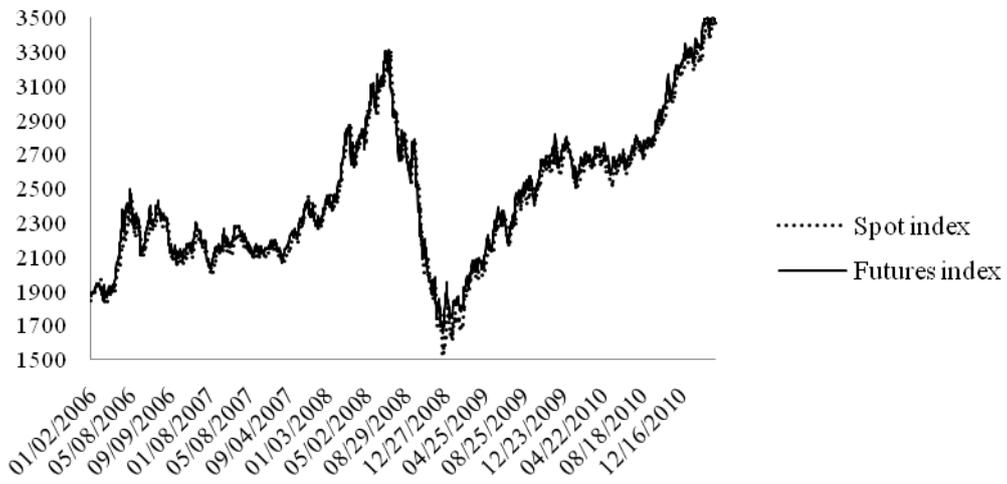
Source: Compiled by the authors from the web page of MCX (http://www.mcxindia.com).

Table 1 Unit Root Tests

Variable	Specification	Test Statistic	P-value
LS	C and T	-1.4869	0.8340
	C	-0.9542	0.7710
LF	C and T	-1.4709	0.8392
	C	-0.8780	0.7955
ΔLS	C	-39.1610	0.0000
	None	-39.1288	0.0000
ΔLF	C	-39.9291	0.0000
	None	-39.8927	0.0000

Table 2 Cointegration Tests

Number of Lags	Test	Null Hypothesis	Test Statistic	P-value
1	Trace	R=0	365.491	0.000
		R=1	0.793	0.373
	Max-Eigen	R=0	364.699	0.000
		R=1	0.793	0.373
2	Trace	R=0	127.191	0.000
		R=1	0.880	0.348
	Max-Eigen	R=0	126.311	0.000
		R=1	0.880	0.348
3	Trace	R=0	67.735	0.000
		R=1	1.118	0.290
	Max-Eigen	R=0	66.617	0.000
		R=1	1.118	0.290

Notes:

Lag order indicates the number of lags for the difference VAR system.

R indicates the number of cointegrating vector under the null hypothesis.

Table 3 Cointegration Estimation Results

$\ln(S_t) = \alpha + \beta \ln(F_t) + u_t$

	DOLS			FMOLS	
$\hat{\beta}$	t-statistic $(H_0 : \beta = 0)$	t-statistic $(H_0 : \beta = 1)$	$\hat{\beta}$	t-statistic $(H_0 : \beta = 0)$	t-statistic $(H_0 : \beta = 1)$
1.032	187.251**	5.851**	1.032	188.487**	5.772**

Notes:

The number of leads and lags is set to 3 when estimating the DOLS.

** indicates that the null hypothesis is rejected at the 1% level.

Table 4 Cointegration Estimation Results

$\ln(S_t) = \alpha + \beta \ln(F_t) + u_t$

Sub-sample A: 2, January 2006 – 30, June, 2008

	DOLS			FMOLS	
$\hat{\beta}$	t-statistic $(H_0 : \beta = 0)$	t-statistic $(H_0 : \beta = 1)$	$\hat{\beta}$	t-statistic $(H_0 : \beta = 0)$	t-statistic $(H_0 : \beta = 1)$
1.027	131.475**	3.464**	1.026	129.947**	3.258**

Sub-sample B: 1, July, 2008 – 30, June, 2009

	DOLS			FMOLS	
$\hat{\beta}$	t-statistic $(H_0 : \beta = 0)$	t-statistic $(H_0 : \beta = 1)$	$\hat{\beta}$	t-statistic $(H_0 : \beta = 0)$	t-statistic $(H_0 : \beta = 1)$
1.101	89.085**	8.168**	1.100	91.896**	8.371**

Sub-sample C: 1, July, 2009 – 31, March, 2011

	DOLS			FMOLS	
$\hat{\beta}$	t-statistic $(H_0 : \beta = 0)$	t-statistic $(H_0 : \beta = 1)$	$\hat{\beta}$	t-statistic $(H_0 : \beta = 0)$	t-statistic $(H_0 : \beta = 1)$
0.990	167.591**	-1.623	0.990	168.713**	-1.679

Notes:

The number of leads and lags is set to 3 when estimating the DOLS.

** indicates that the null hypothesis is rejected at the 1% level.