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Empirical Investigation on Food Inflation and Efficiency Issues in Indian Agri-futures Market

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Abstract

In early 2007, the Government of India (GoI) banned futures trading on some essential agro-commodities such as wheat, rice, and two varieties of lentils due to rising food inflation. However, futures trading in agri-commodities such as chana (chickpea), soy oil, rubber, and potato were temporarily suspended. Professor Abhijit Sen's committee, constituted to study the relationship between futures trading and agricultural commodities inflation, did not find sufficient evidence of inflationary impact of futures trading in India due to too short period of commodity futures trading. Also, an efficient futures market is required for the producers, traders, and consumers to hedge their price risk. Thus, in this study, we analyze the market efficiency of agricultural futures market and the effect of futures trading on inflation with special reference to chana (chickpea) market in India. This study is for a time frame of 10 years from 2005–2014. The data on closing prices of chana in futures and spot markets and futures trading volume has been collected from National Commodity and Derivatives Exchange, and chana wholesale price index (WPI) monthly data from Office of the Economic Adviser, GoI. The collected data is analyzed for efficiency using Johansen cointegration approach and vector error correction (VEC) restrictions and inflationary effect using Toda Yamamoto (TY) version of Granger causality test. From the results, we find that the spot and futures prices for chana are cointegrated and unbiased, that is, the chana (chickpea) futures market is efficient. But, the futures trading of chana has inflationary impact, that is, futures trading volume of chana affects chana WPI. This research has got direct implications for government and market participants. India is the largest consumer of chana (chickpea)—the third most important pulse crop produced in the world. Thus, the inflationary impact of chana futures trading is a matter of concern for GoI.

Keywords

Cointegration, causality, inflation, chana, futures price

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Introduction

The wholesale price index (WPI) inflation experienced a regular northward movement from mid-2006 to the beginning of 2007.[1] Where WPI breached a level of 6.69 percent, consumer price index (CPI) touched 9.8 percent mark. In early 2007, India's parliamentary standing committee on food and public distribution held futures trading responsible for inflation in India and suggested to ban futures trading in essential agricultural commodities. Following the suggestions of the panel and an increasing pressure from political circles, the Government of India (GoI) banned futures trading on some essential agro-commodities such as wheat, rice, and two varieties of lentils. However, futures trading in commodities such as chana (chickpea), soy oil, rubber, and potato were temporarily suspended. A five-member expert committee headed by Professor Abhijit Sen was constituted to study the relationship between futures trading and agricultural commodities' inflation in India. The committee did not find sufficient evidence of inflationary impact of futures trading in India. Too short period of commodity futures trading was reported as the main hurdle to differentiate the effect of futures trading and cyclical adjustment (Sen, 2008). However, the rising food product prices continued to catalyze the general increase in price level leading to an average inflation rate of 12.46 percent during March 2008 and November 2011. Thus, there is a scope to study the inflationary effect of agricultural futures trading for a longer period of 10 years post introduction of agricultural futures.

Since the commencement of futures trading on online exchanges such as National Commodity & Derivatives Exchange Ltd. (NCDEX), Multi Commodity Exchange (MCX), and National Multi Commodity Exchange of India Limited (NMCE) in 2003, Indian commodity futures market has registered an unparalleled growth vis-à-vis other markets. The volume of trade has gone up to ₹181 trillion in FY 2012–2013 as compared to ₹27 trillion in 2006–2007. Futures prices give necessary indicators to producers and consumers about the likely future ready (spot) price and demand and supply conditions. But, this is possible only when the commodity futures markets are efficient. In an efficient commodity futures market, futures price provides expected futures spot price and thus removes the chances of guaranteed profit. Thus, it is imperative to analyze the commodity futures market for efficiency in India.

India is the largest consumer of chana (chickpea)—the third most important pulse crop produced in the world. Chana is the only comm-odity among the top three most weighted agro-commodities in MCX's Comdex (4.14% out of 20% of agri-index) as well as NCDEX's Dhaanya Index. Further, chana is among the commodities which faced temporarily suspension of futures trading in 2007. Thus, this study investigates the efficiency of agricultural futures market and inflationary effect of futures trading with special reference to chana market in India.

Literature Review

There is a huge literature available on market efficiency of futures market in both developed as well as emerging markets. But there is dearth of research on inflationary impact of futures trading especially in Indian commodity futures market. Moreover, the results of research conducted on efficiency of different markets suggest conflicting findings. We find evidence of efficiency in works of A. Singh and N. P. Singh (2015), Gupta and Ravi (2013), Sehgal, Rajput, and Dua (2012), Ali and Gupta (2011), Chakrabarty and Sarkar (2010), Singh (2010), Lokare (2007), Bose (2009), Gulen (1998), etc. However, inefficiency evidence has been found in works of Inoue and Hamori (2014), Soni and Singla (2012), Easwaran and Ramasundaram (2008), Wang and Ke (2005), Mckenzie and Holt (2002), and many others, while mixed results have been found in the studies of Aulton, Ennew, and Rayner (1997), MacDonald and Taylor (1988), Wang and Ke (2005), Singh (2004), etc. Some of the important researches relating to efficiency and inflationary impact of futures trading have been summarized in the following sections.

Just and Rausser (1981) report that futures market gives better forecasts for soybean meal and oil, while some econometric forecasts were better for live cattle and hogs. The results were mixed for rest of the sample commodities. A similar study was conducted by Fama and French (1987). The result showed that futures prices of 10 out of 21 commodities exhibit spot price forecast power. Goss (1981) concludes that futures market of copper and zinc was efficient but that of tin and lead was inefficient. However, in his later study on these commodities, Goss (1985) reports conflicting results. Meanwhile, Bigman, Goldfarb, and Schechtman (1983) find that wheat, corn, and soybean markets are efficient for contracts up to 6-week expiration but inefficient for longer expiry.

Allen and Som (1987) examine London Rubber Market for weak form efficiency. Their results indicate that market is weak form efficient. However, Oellermann, Brorsen, and Farris (1989) report that the futures price Granger cause cash price for feeder cattle and futures market play price discovery function for live cattle. A study by Goodwin and Schroeder (1991) finds that there is information flow from futures to cash market and occasional feedback flow from cash to futures. Similarly, Mananyi and Struthers (1997) investigate London cocoa beans market for market efficiency using cointegration approach and find evidence of inefficient market. However, the results of study by Mckenzie and Holt (2002) suggest that markets for select agro-commodities were efficient and unbiased in the long run. Using GQARCH-M-ECM, they, however, find that corn and cattle futures markets to be inefficient and biased in short-run.

Singh (2002) in his doctoral thesis reports that among the sample commodities, castor seed (Ahmedabad and Mumbai) and pepper futures markets are efficient and unbiased while gur (Hapur and Muzaffarnagar) and turmeric markets are inefficient and biased. Similar mixed results are reported by He and Holt (2004) and Wang and Ke (2005). He and Holt (2004) conclude that the two series are neither cointegrated nor unbiased, that is, lumber, Oriented Strand Board (OSB), and Northern Bleached Softwood Kraft (NBSK) markets are inefficient. Wang and Ke (2005) report that soybean futures market are weakly efficient while the wheat futures market are inefficient due to overspeculation and government intervention. On the contrary, the results of Xin, Chen, and Firth (2006) indicate that copper and aluminum futures markets were efficient during 1999–2004.

In India, similar findings were indicated in the results of Lokare (2007). He finds an evidence of cointegration in both spot and future prices, showing improved operational efficiency in pepper, mustard, gur, wheat, sugar (S), cotton, sesame seed, gold, copper, lead, tin and bent crude oil, rubber, sesame oil, aluminum, zinc, silver, and furnace oil markets. Singh (2007) finds evidences of cointegration between the soy oil futures prices on MCX, NCDEX, and National Board of Trade (NBOT) exchanges. He also reports that Chicago Board of Trade (CBOT) has relatively high hedging efficiency than these three exchanges.

Singh (2010) find that guar gum, guar seed, and castor seed spot and futures markets are cointegrated and unbiased. Similar results were reported by Kaur and Rao (2010) in their study on the weak form efficiency futures markets. They conclude that guar seed, chana, and pepper commodities futures markets were efficient. However, Ali and Gupta (2011) and Sehgal et al. (2012) study efficiency and causality in commodity markets. The results of Ali and Gupta (2011) suggest that futures market is efficient for all select commodities except rice and wheat. They also report that for futures prices, Granger cause spot prices in case of 6 commodities while for other 3 (cashew, rice, and red lentil) spot prices Granger cause futures price. However, the relationship is bidirectional for rest of the select commodities. However, Soni and Singla (2012) and Inoue and Hamori (2014) conclude that the futures markets are inefficient for guar gum and MCX Comdex respectively. In a study on agro-commodities futures and farmers, Murthy and Reddy (2012) find that in case of chili and turmeric, futures prices influence spot prices.

Literature available on the relationship between futures trading and inflation is limited to few studies such as Yang, Balyeat, and Leatham (2005), Ranjan (2005), Indian Institute of Management (2008), Sen (2008), Nath and Lingareddy (2008), Sahoo and Kumar (2009), and Sehgal et al. (2012). The methodology has changed from pre- and postvolatility analysis to causality test. Yang et al. (2005) concludes that unexpected increase in futures trading volume Granger causes cash price volatility for all but hogs and soybeans in US commodity markets. However, just opposite results are given by Ranjan (2005) for soy oil market in India. He finds stabilizing effect of futures trading of soy oil on seasonal price volatility and daily price fluctuations. Gorton and Rouwenhorst (2006) examine the correlation of commodity futures returns with inflation as one of the objectives. They report that commodity futures returns are positively correlated with inflation and unexpected inflation. In India, Sahi and Raizada (2006) report a poor price discovery process and inflationary effect of wheat futures market. However, Nath and Lingareddy (2008) and Sen (2008) don't find any evidence of relation between inflation and futures trading. Sen (2008) concludes that due to short period of study or functioning of commodity futures market, the committee has no material evidence of inflationary impact of commodity futures market in India. Similar results have been reported by another study conducted by Indian Institute of Management (2008).

Sahoo and Kumar (2009) report that out of five select commodities, trading volume Granger causes spot price in crude oil case only. So, they do not report material evidence of inflationary impact of futures trading in India. Similarly, Bose (2009) suggests that futures trading cannot be held responsible for aggravating inflation based on the recommendations of US Commodity Futures Trading Commission (CFTC) and the Indian Expert Committee on Futures Trading (ECFT). Similarly, Sehgal et al. (2012) find that select markets are efficient for all but one commodity (turmeric). However, their results showed bidirectional Granger causality for all select commodities except turmeric.

From literature review, it is evident that commodity futures market efficiency is important to bring in price stabilization in market. Moreover, the results of most of these studies are mixed. There is further scope to study the relationship between futures trading and inflation in India. Moreover, none of the study has used Toda Yamamoto (TY) modified granger causality test in this context. Thus, we are motivated to study market efficiency and analyze the inflationary effect of commodity futures trading in India using TY version of Granger causality approach.

Objectives of the Study

The present study intends to analyze the efficiency of chana futures market at NCDEX using Johansen's cointegration technique and effect of chana futures trading on WPI chana inflation using TY-modified Granger causality test.

Data, Methodology, and Empirical Findings

The monthly data on closing spot and futures prices and futures trading volume of chana has been taken from NCDEX, the leading national agro-commodity exchange. Monthly data for chana WPI inflation has been taken from the Office of the Economic Advisor, GoI. The period of study is 10 years, that is, from January 2005 to December 2014. We have used logarithmic series of these variables for testing efficiency and causality analysis.

In this research article, we apply cointegration technique to test efficiency. Two integrated series of first order are said to be cointegrated if their linear combination is a stationary series. A number of techniques have been used in the literature for testing cointegration. However, this study makes use of most widely used Johansen's cointegration approach to test for efficiency (Ali & Gupta, 2011; K. S. Lai & M. Lai , 1991; Mckenzie & Holt, 2002; Wang & Ke, 2005). Johansen's cointegration tests can be conducted using a general *k*th order VAR model:

$$\Delta Y_t = \mu + \Pi Y_{t-1} + \sum_{i=1}^{k-1} \Gamma_i \, \Delta Y_{t-1} + \varepsilon_t \qquad \text{...(1)}$$

where Y_t is the vector to be tested for cointegration and $\Delta Y_t = Y_t - Y_{t-1}$; Π and Γ are coefficients matrices; μ is the deterministic term, and k represents lags of differenced dependent variable. There are two likelihood ratios to test for cointegration under Johansen's cointegration approach. These statistics are trace, λ_{trace}, and max Eigen value, λ_{max}.

So before we test for cointegration, we should test the series for unit roots. Here we have used Augmented Dickey Fuller (ADF). It is the most widely used method to test stationarity of data. The results for the level and first difference for both intercept, and trend and intercept models have been shown in Table 1. It is evident from the results that the null hypothesis of unit root is rejected for all the series at first difference, that is, all the series are first difference stationary.

First, we conduct Johansen's test run for different data trends and test types. The results suggest that there is at least one cointegrating relation. As we know that Johansen's approach is sensitive to the lag length, we use different criterion such as Akaike Information Criterion (AIC) and Schwarz's Bayesian Information Criterion (SBIC) for optimal lag length selection. Here, the optimal lag length of VAR is 1 according to these criteria. Table 2 shows the results for trace statistics λ_{trace} and max Eigen value statistics λ_{max} for VAR lag 1.

Table 1. ADF Test Results

		Level		1st Difference	
Log Series	**Test Form**	**Test Stat. (Crit. Value)**	***p*-value**	**Test Stat. (Crit. Value)**	***p*-value**
Spot price (LNSP)	Intercept	–1.89 (–2.89)	0.3370	–10.34 (–2.89)	0.0000
	Trend & intercept	–2.12 (–3.45)	0.5263	–10.33 (–3.45)	0.0000
Futures price (LNFP)	Intercept	–1.99 (–2.89)	0.2880	–12.18 (–2.89)	0.0000
	Trend & intercept	–2.30 (–3.45)	0.4302	–12.17 (–3.45)	0.0000
Futures volume (LNFV)	Intercept	–2.63 (–2.89)	0.0890	–10.80 (–2.89)	0.0000
	Trend & intercept	–2.70 (–3.45)	0.2377	–10.77 (–3.45)	0.0000
Chana WPI (LNWPI)	Intercept	–2.18 (–2.89)	0.2141	–6.22 (–2.89)	0.0000
	Trend & intercept	–2.27 (–3.45)	0.4489	–6.31 (–3.45)	0.0000

Source: Authors' computation.
Note: Figures in parenthesis show MacKinnon critical values (for ADF Test) at 5 percent.

Table 2. Johansen Test Results

Hypothesized No. of CE(s)	Eigen Value	λ_{trace} Statistics	Prob. For Trace Test	λ_{max} Statistics	Prob. for Max Eigen Value Test
$r = 0$ (None)	0.22795	35.51581 (15.4947)	0.0000	32.07898 (14.26460)	0.0000
$r \leq 1$ (at most 1)	0.02734	3.436834 (3.8414)	0.0638	3.436834 (3.84147)	0.0638

Source: Authors' computation.
Note: The critical values have been shown in parentheses.

$$B\,(r, 1)^*LSP_t + B\,(r, 2)^*LFP_t \qquad (2)$$

Examining the trace test, we can see that the null hypothesis of r = 0 is rejected at 5 percent significance level as the λ_{trace} statistics 35.51581 considerably exceeds the critical value 15.4947. However, in the second row, the λ_{trace} statistics is considerably less than the critical value 3.84. So we cannot reject the null hypothesis of $r \leq 1$ at 5 percent significance level. The "max" test confirms the result of trace test. Therefore, the null hypothesis of at most one cointegrating relation cannot be rejected. Hence, we conclude that there is a long-run equilibrium relationship between spot and futures log prices for chana, that is, the two series are cointegrated. Similar results are reported by Sehgal et al. (2012) and Singh (2010) for chana futures market in India.

The presence of cointegration between the spot and futures price series is a necessary (but not sufficient) condition for market efficiency. The markets should be cointegrated and unbiased. To test unbiasedness, we put restriction on vector error correction (VEC) for the cointegrating relation given in Equation 2. Table 3 shows the results of VEC restriction. The null hypothesis is rejected as *p*-value is 0.000. So the restriction of B (1, 2) = 0 is not supported by the data. Thus, we conclude that the cointegrated relation must contain log of FP_t providing the evidence of unbiasedness of futures market of chana.

From the results of Johansen's test and VEC restrictions, we conclude that the chana futures market in India is efficient. Our results are similar to the results of Sahoo and Kumar (2009), Singh (2010), and Sehgal et al. (2012).

Table 3. Test of VEC Restriction

Cointegration Restrictions: B (1, 2) = 0		
LR Test For Binding Restrictions (Rank = 1)		**Prob.**
Chi-sq. (1)	28.60032	0.000000

Source: Authors' computation.

Now, we attempt to analyze the effect of futures trading on WPI inflation in case of chana. For this, we use TY version of Granger causality approach. This method was introduced by H. Y. Toda and T. Yamamoto in 1995. According to them, "we can apply usual lag selection procedure as far as the order of integration of the process does not exceed the true lag length of the model." Also, Toda and Yamamoto have shown that the *F*-statistic for Granger non-causality test becomes invalid in case time series data are integrated. The following VAR system represents TY version of Granger causality test.

$$Y_t = \alpha_0 + \sum_{i=1}^{k} \alpha_{1i} Y_{t-i} + \sum_{j=k+1}^{d\max} \alpha_{2j} Y_{t-j} + \sum_{i=1}^{k} \beta_{1i} X_{t-i} + \sum_{j=k+1}^{d\max} \beta_{2j} X_{t-j} + \epsilon_{1t} \quad (3)$$

$$X_t = \gamma_0 + \sum_{i=1}^{k} \gamma_{1i} X_{t-i} + \sum_{j=k+1}^{d\max} \gamma_{2j} X_{t-j} + \sum_{i=1}^{k} \delta_{1i} Y_{t-i} + \sum_{j=k+1}^{d\max} \delta_{2j} Y_{t-j} + \epsilon_{2t}, \quad (4)$$

where X_t and Y_t are log series of spot and futures prices; α_0 and γ_0 are constant drift terms; ϵ_{1t} and ϵ_{2t} are error terms; k is lag length of VAR system, and d_{max} is the maximum order of integration.

From ADF test results shown and discussed above, d_{max} is 1. To determine optimal lag length k, we use different criterions such as AIC, SBIC, and Lutkepohl. These criterions give different values of k. AIC and SBIC give $k = 2$ whereas Lutkepohl gives $k = 3$. Since Granger causality is sensitive to lag length, we have used both the values of k. Thus, Table 4 shows results for $k + d_{max}$ varying lag lengths 3 and 4. The results are robust as the null hypothesis of no causality from trading volume (*lnfv*) to WPI (*lnwpi*) is rejected for both cases at 5 percent and 10 percent level of significance. Thus, we can say that chana futures trading results in higher inflation.

Table 4. TY Granger Causality Test/Block Exogeneity Wald Test Results

	Chi-sq. (*p*-value) for Different VAR Lengths $k + d_{max}$	
Null Hypothesis	3	4
lnwpi does not Granger cause *lnfv*	3.02 (0.22)	3.71 (0.29)
lnfv does not Granger cause *lnwpi*	5.55 (0.06)*	7.58 (0.05)#

Source: Authors' computation.
Note: # and * represent significant results at 5 percent and 10 percent level of significance.

Research Implications

This research has got direct implications for government and market participants. An efficient chana futures market would help the market participants to hedge price risk associated with chana trading. Also, it will be of great help to GoI to decide minimum support price (MSP) for chana. Also, India is the largest consumer of chana (chickpea)—the third most important pulse crop produced in the world. Thus, the inflationary impact of chana futures trading is a matter of concern for GoI. This study throws some challenges to the government to take necessary action to contain food inflation.

Conclusion

Due to rising food prices, the GoI banned futures trading on some essential agro-commodities following the suggestions given by India's parliamentary standing committee and pressure from other political parties. However, futures trading in agri-commodities like chana (chick pea) along with others were temporarily suspended. The committee headed by Professor Sen did not find sufficient evidence of inflationary impact of futures trading in India due to too short period of commodity futures trading. The rising food product prices continued to catalyze the general increase in price level leading to an average inflation rate of 12.46 percent during March 2008 to November 2011. Given that India is the largest consumer of chana (chickpea)—the third most important pulse crop produced in the world—it becomes important to study the market efficiency of chana futures market and the effect of chana futures trading on chana (chickpea) WPI inflation in India for a time frame of 10 years from January 2005 to December 2014. The collected data is analyzed for efficiency using Johansen's cointegration approach and inflationary effect using TY version of Granger causality test. The results of Johansen's cointegration and restriction test indicate that the spot and futures prices for chana are cointegrated and unbiased, that is, the chana (chickpea) futures market is efficient. But, TY-modified Granger causality test results show that the futures trading in chana has inflationary impact. This research has got direct implications for government and market participants. The inflationary impact of chana futures trading is a matter of concern for GoI. This study throws some challenges to the government to take necessary action to contain food inflation.

Note

1. This work was presented by the authors in fifth IIMA International Conference on "Advanced Data Analysis, Business Analytics and Intelligence" held on April 8–9, 2017 at Indian Institute of Management, Ahmedabad.

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