Can commodity futures accommodate India's farmers?

1. Introduction

Farmer participation, especially small-scale producers, in India's commodity futures markets has remained untenable since aggregation efforts, through officially sponsored projects, failed to sustain*. And this failure is attributed to several factors, namely membership fee, margin money, lot or contract size, technology, scalability, among others (Asokan and Arya, 2008; Fernades and Mor, 2009). However, this intervention helped reframe policy directives that the benefits to accrue to the farmers require more nuanced approaches as access to real-time price information is critical in dealing with price uncertainty (Newbery and Stiglitz, 1981; Larson et al., 1998 and Kang, 2005). Instead, they might use the futures market, if efficient, as a reference for their ready cash or spot markets. While a few studies examine the vitality of futures for growers (Ranjan, 2005; Berg, 2007 and Paul, 2011), Pennings and Leuthold (2000) capture several farmers' related factors, viz. market orientation, risk exposure, market performance, and entrepreneurial behaviour to assess their impact on the futures market adoption and participation in groups may enhance their bargaining power and thus, the realizations (Coe, 2006). Nonetheless, Turvey and Baker (1990), Collins (1997) and Pannell et al. (2007) find that adoption of futures by small growers (even in advanced economies) is abysmally low. In contrast, Lence (2003) develops a simulation to test whether futures market benefits farmers and concludes that irrespective of their shares (no of contracts taken in futures relative to size of the exposure) the market improves their income and the size of welfare gains is rather significant (Zant, 2001). Piloting Randomized Control Trial, Cole and Hunt (2010) observe that cotton, guar, and castor seed futures markets are instrumental in building growers' price expectations about their standing crops that enables them to adjust to the price signals emanating from the underlying futures. Notwithstanding their methodological congruence, the study fails to explore futures market efficiency and/or inter-temporal futures and spot price relationship adequately. This also fails to escape the limitations of selection bias and replicability.

Having stimulated by these mixed findings and after some broad brush strokes, India's commodity futures market regulator, the Forward Markets Commission (FMC) launched the 'price dissemination project' during the 11th Five Year Plan (2007-2012). The project envisaged to make the farmers enable for accessing futures prices of notified commodities traded on national level commodity exchanges, viz. Multi Commodity Exchange (MCX), National Commodity and Derivative Exchange (NCDEX) and National Multi Commodity Exchange (NMCE) (FMC, 2010). Impact of this project has yet to be appraised whether it benefited farmers, at least in some pockets, specific to their cropping pattern, income realization and adoption rate of futures (Cole and Fernando, 2008). If it meets the regulator's expectation, then it requires a special mention that futures market proves to be informationally efficient resulting in improved price discovery and subsequently, formation of price expectation. Nonetheless, mixed results have been reported on the efficiency front considering the fact that agricultural

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*Aggregation efforts could have claimed to be a benign effect of the National Agriculture Policy (2000). Though MCX and NCDEX made modest attempts in implementing the model, this has failed to withstand the test of time due to scale problem and the lack of technical expertise of the aggregator/farmer producer groups (see, MCX, 2008) commodities futures are more nuanced compared to other derivative markets with respect to standardization and delivery (Mohan and Love, 2004; Karande, 2006; Ge et al., 2008; Roy, 2008; Kumar and Pandey, 2009;Ali and Gupta, 2011; Dey, 2013). While a few studies report illiquid futures as compared to the spot, other research demonstrate the former as a thick one mainly because of trade volume, degree of participation, and liquidity (Mattos and Garcia, 2004). However, in India, unorganized and fragmented spot markets remain a major "stumbling block" for developing liquid futures markets (Nair, 2004).

With this backdrop, we intend to explore a few research questions from a sectoral (plantation) standpoint: (a) are select futures markets informationally efficient in price formation or/and dissemination?; (b) what is the direction of causality in terms of information flow between select commodities futures and spot markets or which market dominates to reveal the price information and does the dissemination faster?; and (c) do farmers need to adopt select futures rationalize their spot price expectations? Select futures and spot markets chosen for this study include, namely pepper, coffee and natural rubber (NR). Rationale behind the inclusion of these markets comprises several factors, viz. compulsory delivery logic as specified by the notified exchange, namely NMCE (Naik and Jain, 2002), stock-to-use ratios, mature spot or physical markets and India's reliance on imports of these commodities (either raw or processed forms) and impact of the ASEAN-India preferential trade agreement on plantations, especially rubber (see, Veeramani and Saini, 2011). For instance, in FY 2010, India imported about 0.15 million metric tonnes of these commodities (compiled by authors from several sources[†]). In this pie, NR accounted for a larger quantum (58%) followed by coffee (41%) and pepper (1%). It also implies the demand for domestic consumptions of coffee and NR. In domestic trading, there are inherent risks in production, which may be endogenous to the market system and attributed to several non-price factors, such as technology, irrigation, labour force, and market sentiment, among others (Ghosh, 2011). While this sector has witnessed a sheer concentration of some corporations, (Gupta, 2011), government has hardly reinitiated any structural reform post-nationalization of futures trading on the said commodities (Rao, 2009). Nevertheless, futures multiplier in rubber and coffee as measured by a ratio of trade volume to production has been declining while it has gone up astoundingly for pepper, from 38.44 in 2009-10 to 81.25 in 2010-11 (Sahadevan 2012). Low multiplier might have arrested liquidity in coffee and rubber markets, although bullish phase in pepper futures has been persistent for quite a long period. Therefore, the regulator and demutualised exchanges with renewed interests might improvise the contract specifications/features for injecting liquidity in plantations. Therefore, all these factors trigger base the study on a firm-ground.

The remainder of paper is structured as follows: Section 2 reviews related works and Section 3, data structure and methodology, Section 4 presents results and discussions, and Section 5 concludes.

2. Related Works

[†]Data were accessed from Coffee board, Rubber Board and Spices Board and DGCI&S, Kolkata, 2012-13.

Industry specificity of pepper, coffee, and natural rubber has been quite high compared to other commodities. On the one hand, international markets dictate their prices and on the other, their futures contracts account for a larger volume under compulsory delivery logic that might be instrumental for a natural convergence between futures and spot prices (NCDEX, 2013). The following sub-section reviews literature specific to these markets.

2.1. Pepper

Literature on pepper futures and spot markets has been scanty. A few studies showed that the market is a backwarded one wherein pepper futures prices remain below the spot prices and traders prefer to trade in spot markets mainly due to higher convenience yield realized (Chakrabarty and Sarkar, 2010). In contrast, Dey and Maitra (2012) observe that pepper futures market is informationally efficient relative to the spot and the former might appear to be instrumental in price risk management.

2.2. Coffee

Coffee futures and spot markets have extensively been studied for last two-to-three decades. Since coffee is often considered as "brown gold" and Least Developed Countries (LDCs) contribute a lion share to the world export, the commodity has gained importance among commodity experts and scholars. While a few studies explore the impact of futures on spot returns of different varieties of coffee (Mohan, 2003; Milas et al., 2004; Fry et al., 2011), others capture a non-linear price (spot) behaviour among them and obtain mixed findings specific to interdependence between spot prices (Adrangi and Chatrath, 2003). Fortenbery and Zapata (2004) investigate the speculative impact of coffee futures on its export prices. Mohan and Love (2004) show whether coffee producers can benefit from coffee futures forecasts and find that changes in futures prices do not explain changes in spot prices adequately. However, futures prices tend to adapt to contemporary spot prices. Mohan (2007) explores the cost-benefit metrics of option mechanism for hedging coffee grower's risk. In a different setting, Dey and Alur (2012) conduct a similar kind of study and argued that coffee futures market is not amenable to hedging and farmers' participation therefore may not be a viable proposition. In another study, Ghoshray (2010) examines a long-run relationship among spot prices of four varieties using co-integration and found that the law of one price does not hold since the market appears to be imperfect. Fry et al. (2011) investigate the interdependence of global coffee spot and futures markets and impact of speculative behaviour of futures on spot price uncertainties in major production centres and concluded that spot and futures markets are interdependent. They also put forward that spot appears to be more efficient as compared to futures that also corroborates Mohan and Love (2004) and Dey and Alur (2012) findings.

2.3. Rubber

Empirical research on rubber markets, in general and rubber futures market, in particular has been quite sparse. Nittayagasetwat and Nittayagasetwat (2010) explore the informational efficiency of Thailand's rubber futures market. Guo-guang (2005) analyses the price relationships between Chinese NR futures and spot and found that both markets are devoid of co-integration. Studies on forecasting rubber spot prices using futures have also been minimal. Romprasert (2009) shows that daily and monthly futures prices serve as an unbiased predictor of future spot prices and concluded that rubber futures market is weak form efficient in Thailand. Maitra and Dey (2014) demonstrate that the dependence structures between India's and China's rubber futures markets appear to be pronounced in comparison to other Asian markets. Another measure of efficiency reported in the similar context is through modelling of volatility spillover and asymmetric effect of positive and negative shocks on rubber futures returns (Chang et al., 2010).

It is quite apparent that the methodological advancement to attain robustness and parsimony (of the model) for testing the futures market efficiency has been remarkable. Though the present study is not a departure from applying time-tested econometric techniques, it might be a distinct one on the motivation front from other empirical studies reviewed above.

3. Data Description and Methodology

3.1. Data Structure

Pepper, coffee, and natural rubber futures and spot prices (daily closing) were accessed from the NMCE so as to maintain a consistency in the analysis and subsequently, reporting. We utilized standard econometric techniques to investigate whether select futures markets are informationally efficient both in the long- and short run. The study used near month futures prices to avoid the potential problem of liquidity as per trading time hypothesis (Jegadeesh and Titman, 1993). Mid-and far-month futures were not considered for the entire analysis. Though it is important to consider all three months in the analysis from the hedger's point of view, we assumed that hedger can roll over the select contracts until the underlying commodity is ready for harvesting or disposal in the spot market.

The study considered pepper spot and futures prices from May 21, 2003 to March 28, 2011. There were 2,244 observations that followed continuity while reporting contract-statistics. It may be noted that pepper prices in consecutive two years, 2009 and 2010, witnessed significant price fluctuations. Similarly, coffee spot and futures prices, from February 22, 2005 to March 24, 2011, were accessed from NMCE comprising 1,062 observations that consisted of almost 25 bi-monthly coffee futures series. It is interesting to note that the exchange did not report 12 bi-monthly coffee futures series from November 2006 to September 2008. This might be because of either excessive price hike in spot market or illiquid coffee futures trade observed during that period. Following September 2006, March futures 2007 witnessed only one delivery. Average close price in that period stood at USD 144 per quintal whereas September coffee futures in 2006 showed an average close price of USD 117 per quintal. Despite very low trade volume and turnover reported from November 2006 to September 2008, futures trading continued without any suspension. Except a lag of about a year or so, the exchange observed continuity in coffee futures trading that is evident from the series statistics. In addition, an upward movement in trade volume had been observed, however this was temporary that remained in only six contracts during 2009 out of 25 contracts (NMCE, 2011). In case of rubber, the study considered daily rubber futures and spot prices from July 1 2003 to April 30 2010. It is worth mentioning that from October 2007 onwards, rubber futures prices continued to fluctuate and in May 2008, reached its peak, USD 200 per quintal that resulted in a temporary suspension and was lifted in end of 2008. During that period, prices moved in the bracket of USD 160 to USD 180 per quintal. Gradually, it reached USD 240 and then, USD 300 per quintal in end of 2010 and finally crossed USD 340 per quintal in early 2011. This might be due to high demand for consumptions observed in India and China.

Spot and futures returns were calculated considering the first difference of logarithmic prices (continuous compounding), i.e., $\{r_t = \ln(F_t/F_{t-1})$ & $\ln(S_t/S_{t-1})\}$. In order to arrive at common time frame, we considered only matching data points. Except pepper, presence of structural breaks (employing Chow's break point test) had been found in coffee and rubber futures from November 2006 to September 2008 and June 2008 to December 2008, respectively that did not account for the analysis (for co-movement of futures and spot prices, refer Figure 1-A, B & C). A detailed note on contract specifications of select futures contracts is presented in the table-8.

3.2. Methodology

Co-integration is employed using Johansen (1988, 1991) and Johansen and Juselius (1990) procedure co-integration test. It is generally used to explore a long-run relationship between the non-stationary variables that indicate the presence of a common stochastic trend. Standard VECM (Johansen, 1988) was estimated through the following set of equations.

$$\Delta Xt = \sum \Gamma i \Delta Xt - i + \pi Xt - i + \varepsilon i, i = 1..., \rho .... [1]$$
$$\varepsilon t \Omega t - i \in (0, \Xi t)$$

where X_t is a 2 X 1 vector $(S_t, F_t)'$ of the spot and futures prices respectively, Δ denotes the first difference operator, ε_t is 2 x 1 vector of residuals $(\varepsilon_{St}, \varepsilon_{Ft})'$ follow an as-yet-unspecified conditionally distributed with mean zero and time varying covariance matrix, H_t.
The characteristic roots of the n x n matrix Π are the values of λ, which satisfy the following equation $(\Pi - \lambda I_n) = 0$ where I_n is an n x n identity matrix. Johansen (1988) proposes the following two statistics for testing the rank of Π:

$$\lambda trace(r) = -T \sum \ln(1 - \lambda i), i = 1, 2, 3, ..., n .... [2]$$
$$\lambda \max(r, r+1) = -T \sum \ln(1 - \lambda i + 1) .... [3]$$

where λ' are the Eigen values to be obtained from the estimate of the Π matrix and T is the number of usable observations. The λ_{trace} tests the null that there are at most *r* co-integrating vectors, against the alternative that the number of co-integrating vectors is greater than r ($Ho: r < 0; H1: r \geq 0$) and the λ_{max} tests the null that the number of co-integrating vectors is r, against the alternative of r + 1 ($Ho: r < 1; H1: r \geq 1$).

VECM of time series (using futures and spot prices) is presented below.

$$R_{st} = \alpha_1 + \alpha_s ect_{t-1} + \sum \beta_{si} R_{s,t-i} + \sum \gamma_{fj} R_{ft-j} + \varepsilon_{st} .... [4]$$
$$R_{ft} = \alpha_2 + \alpha_f ect_{t-1} + \sum \beta_{fi} R_{ft-i} + \sum \gamma_{sj} R_{st-j} + \varepsilon_{ft} .... [5]$$

where R_{st} or ΔS_t is the return series from spot market and R_{Ft} is the return series of futures market, βs_i, γs_j, β_{Fi}, γ_{fj} are the short-run coefficients, Ω (S_{t-1}-F_{t-1}) is the error correction term (ECT), and $\varepsilon_{s,t}$ and $\varepsilon_{F,t}$ are residuals as explained earlier. The magnitude of the coefficients α_s and α_f determines the speed of adjustment back to the log-run equilibrium following a market shock or "unit shock" that is from spot to futures, within spot, within futures, and from futures to spot through Impulse Response Analysis. When these coefficients are large, adjustment is quick, and so Ω will be highly stationary and reversion to the long-run equilibrium will be rapid, where ζ is error coefficient, is adjusted through ECT that is Ω.

In the last section of analysis, we applied Generalized Forecast Error Variance Decomposition (GFEVD) test. It is noteworthy to note that impulse/innovation response analysis proves inconsistent to measure impulse responses for longer horizons (Enders, 1995). In order to address this, Sims (1980), Abdullah and Rangazas (1988) propose that GFEVD is superior to FEVD, while analysing a dynamic relationship between a set of variables, say bivariate (endogenous). While FEVD is susceptible to the ordering the endogenous variables, GFEVD is invariant to that property (Yang et al., 2005). Therefore, in the absence of this approach, inferences on statistical significance of interdependence between economic variables, such as select futures and spot prices, may be misleading. VECM coupled with 'Granger' causality test, and GFEVD attempt to test the information transmission between futures and spot markets through the multitude of spillover effects in mean returns of futures and spot prices. GFEVD provides the percentage of variation in returns of one variable as explained by the other one. In this study, the two variables considered were select commodities futures and spot returns.

4. Results and Discussions

4.1. Descriptive statistics of Pepper, Coffee, and Rubber Markets

Table-1 reports the descriptive statistics of pepper, coffee and rubber spot and futures return series. While both the return series of pepper and coffee are positively skewed, rubber markets show a negatively skewed distribution. However, the kurtosis, a measure of peakedness, was observed high for all select futures and spot markets implying a fat-tailed distribution (non-normal distribution), not modestly sized deviations. And this tailed distribution implies that variability in futures and spot return (gain/loss) appears to be high as compared to implied distribution. High leptokurtic distribution indicates non-normality of both series of the three markets. QQ plot (Fig 2-A, B, & C) also depicts that distributions of returns are most leptokurtic in coffee than pepper and rubber. Skewness is also highest in coffee in comparison to pepper and rubber. On the other hand, Jarque-Bera[‡] (JB), a diagnostic check for normality, proved that both series are devoid of normality and having fat tail. . This study used Augmented Dickey Fuller (ADF) test with both trend and intercept to detect unit root in the presence of correlated error term of futures and spot prices and reported unit root in level-data series, but not in return series, which implies that both series achieved the same order of integration (I (1)).

[‡]J-B is a parametric test of normality. The skewness and kurtosis estimate shows the presence of normality through probability value of JB test. To attain normality for a data series, value of skewness should be zero and the value of kurtosis should not exceed three. The standard formula to estimate normality with JB statistics is $n/6[S^2 + (K-3)^2/4]$

(Table-1 here)

4.2. Co-integration

We employed Johansen's co-integration test adopting 'modified Pantula' principle to estimate exact number of co-integrating vectors in select futures and spot prices. Results in Table-2 shows that at least one (1) co-integrating vector (β_i) was identified for all the three markets that satisfied the case (i) noted under methodology section.

(Table-2 here)

4.3. Weak Exogeneity

Weak exogeneity is usually performed to test whether futures (spot) appears to be non-responsive to any shock emanating from the spot (futures) in the long run and if it does so, then futures (spot) must be weakly exogenous to the spot (futures) price. It is evident from pepper markets that futures was weakly exogenous to spot prices that is in contrast to coffee markets, wherein the latter one was weakly exogenous to the former one. If the futures markets are weakly exogenously then the dominant source of information in the price discovery process in long run is given by the futures markets, while the dominant role of information by spot markets puts a question on the efficiency of futures markets. On the other hand, though rubber futures prices had been observed weakly exogenous relative to the spot, it remains inconclusive and needs further exploration. Table-3 presents the exogeneity test results of select markets.

(Table-3 here)

4.4. VECM and 'Granger' Causality

After investigating the long run equilibrium relationships, we explored the short run integration or return-spillover between futures and spot returns applying linear 'Granger' causality (Block Exogeneity) test. In order to obtain a parsimonious model, BIC information criterion was chosen[§]. Results show that error correction coefficient (α of ECT) of pepper futures return (R_{ft}) was positive and statistically insignificant at 5% level whereas ECT of spot return (R_{st}) was negative but statistically significant at 5% level. This implies that error correction mechanism (ECM) was instrumental for the convergence between futures and spot prices. It is interesting to note that while futures appeared to be non-responsive (or sedentary in nature) to the spot, spot responded to futures and corrected itself to reach a steady state in the long run. Hence, futures can be held responsible for impacting spot. The short run coefficients, β_{s1} and γ_{f1} were statistically significant at 5% level indicating the return spillover from spot to spot and futures to spot, respectively. 'Granger' causality test shows that there was unidirectional causality from futures to spot return that is also in-sync with VECM results.

[§]Information criterion includes, namely Akaike (AIC), Bayesian (BIC) and Hannan-Quinn (HQIC), which are considered for a parsimonious yet robust model. Amongst these, BIC was selected as it helped to augment the model fit considering a lag-order, minimum value of criterion and explained finite prediction error (Enders, 1995).

On the other hand, ECTs of coffee futures return (R_{ft}) and spot return (R_{st}) were positive and negative, but both were statistically significant at 5% level, respectively. This implies that changes in futures and spot prices responded to each other instantaneously because of ECM and therefore, both the price series tended to reach a long-run steady state. The short run coefficients, namely β_{f1}, β_{f2} and γ_{f1} that measure the return-spillover from futures to spot return were statistically significant at 5% level and β_{s1}, γ_{s2} were also found significant at 5% level measuring the return spillover from spot to futures. It may be noted that since ECTs of both futures and spot return were statistically significant at 5% level, a lead-lag relationship might not be apparent. However, futures and spot prices moved in tandem due to the presence of co-integration. On the short run causality front, there was bidirectional causality, but impact of spots was pronounced compared to futures.

In the case of rubber, ECTs of both futures and spot return (R_{ft} & R_{st}) were positive indicating a non-stable explosive correction that is a marked deviation from Engle and Granger's (1987) ECM representation. Though ECT of rubber futures was statistically insignificant and ECT of spot, statistically significant at 5% level, there was very little possibility of convergence between the two. In other words, the divergence might have led a sharp decline in rubber futures trade as reported by the NMCE (2011). However, the short run coefficients of spot (β_{s1}, γ_{s1}) and futures return (γ_{f1}, γ_{f2}) were statistically significant at 5% level indicating a short run causality (through VAR measures) as also confirmed by 'Granger' causality test. Table-4 & 5 present VECM and 'Granger' causality tests results of respective commodities markets.

(Table-4 here)

(Table-5 here)

4.5. Generalized Forecast Error Variance Decomposition

We estimated orthogonal variance decomposition of forecast error up to ten lags after VECM-fit. While first two rows of Table-6 presents variation in pepper futures as explained by its lagged- and spot returns, and the variation in spot as explained by its lagged- and futures returns. On the one hand, magnitude of variation in futures returns explained by its lag (ranging from 100 to 99.99%) was pronounced than that of spot returns (0.00-0.01%). On the other hand, magnitude of variation in spot returns explained by its own lag was lesser (54.75-5.4%) than the same explained by futures returns (45.24-94.6%). Thus, findings seek to reinstate an efficient futures market in the short run too.

Similarly, second two rows of Table-6 presents variation in coffee futures returns as explained by its lagged-and spot returns and variation in spot as decomposed by its lagged-and futures returns. Contrary to pepper markets, magnitude of variation in coffee futures return explained by its own lag was higher and varying from 58.32 to 56.53% and variation in futures return explained by spot returns ranged from 41.67 to 43.47%. On the other hand, variation in spot returns explained by its own lag was pronounced (100-89.7%) than that of futures returns (0-10.39%). Therefore, it is apparent that coffee spot was informationally efficient compared to its futures in the short run.

GFEVD tested for rubber seemed to be consistent with coffee markets, which is evident from Table-6. While magnitude of variation in futures explained by its own lag value was ranging from 65.29 to 64.46%, variation in futures explained by spot returns varied from 34.71 to 35.53%. On the contrary, magnitude of variation in spot explained by its own lag was higher (100-73.60%) than that of futures return (0.00-26.40%). Hence, rubber spot appeared to be efficient alike coffee spot market in the short run. Table-6 below present GFEVD test results of respective markets.

(Table- 6 here)

To sum up, it is plausible that amongst three markets, pepper and coffee (futures and spot) show error correction by spot, and both futures and spots, respectively. While pepper and coffee exhibited convergence, rubber futures and spot showed a sign of divergence. In addition, the direction of information flow captured through 'Granger' causality test obtained remarkably consistent results for all the three markets. Unidirectional causality from pepper futures to spot market is observed wherein the former was weakly exogenous to the latter and while, bidirectional causality is observed in coffee and rubber futures and spot markets. Contrary to NR markets, coffee spot appeared weakly exogenous. From a return-spillover point of view, coffee and rubber spot markets seemed more efficient in decomposing variance of futures and spot returns (forecast errors) compared to their futures in the short run. Conversely, pepper futures appeared more efficient than its counterpart. Table-7 below presents a summary of above findings.

(Table- 7 here)

4.6. Discussions

With the application of standard time series techniques, this study attempted to demonstrate futures market efficiency at least in select commodities. While pepper futures appeared to be informationally efficient, analysis supported the dominant role of coffee and rubber spot markets in price discovery and price dissemination. Though pepper futures acted as a leader in driving spot prices, coffee and rubber futures and spot were moving in tandem. However, non-stable explosive correction showed a sign of divergence between rubber spot and futures markets unlike the other two. It may be noted that India's rubber futures market has been a subject of controversy ever since NMCE initiated trading in 2003.

Intuitively, pepper futures might have some speculative impact on its underlying market and therefore, 'contango' – an expected market phenomenon (Brennan, 1991) appeared to persist. This implies that local supply might outstrip local demand and therefore, market participants might be reluctant to store pepper for a longer period in warehouses and/or under any storage premises. The efficient role of pepper futures might be due to the efforts put in by the concerned authority that has led to a better maturity. Considering the importance of futures trading, trading in pepper futures started in 1957 under the auspices of Indian Pepper and Spice Trade Association (IPSTA), a regional exchange based at Kochi in Kerala. In August 2001, IPSTA offered international pepper futures contracts through its international commodity exchange division. Notwithstanding this remarkable breakthrough, the response in exercising these contracts had observed very low that indeed affected domestic pepper contracts and futures prices as well. Post 2002, national level commodity exchanges started offering pepper futures contracts. Amongst these exchanges, NMCE has witnessed a phenomenal growth in terms of trade volume and participation (Naik, 2009). Moreover, consequent on unidirectional feedback emanating from pepper futures to spot prices, speculative behaviour of the former might be responsible to push the latter up considerably. These findings are, apparently, contrary to Chakraborty and Sarkar's (2010) but similar to Dey and Maitra's (2012) work. It is interesting to note that non-participants have been investing in select futures from around 2006, during initial signs of US housing markets' ultimate collapse (Newman, 2009). However, the impact of financial trading on commodity futures markets may not be a culprit to food price inflation and global food crisis in 2007-08 (Bose, 2009).

Results obtained from coffee markets tend to fall in line with other empirical research by Kellard (2002), Mohan and Love (2004) and Dey and Alur (2012). Though adopted methodology showed a departure from Mohan and Love's (2004) work, findings are similar to and corroborate their study. The dominant role of coffee spot as compared to its counterpart might be due to the fact that coffee futures markets are in developing phase. Unlike pepper, the origin of organised futures trading in coffee started in 2005 only; before which the Coffee Futures Exchange of India set up in 1997 was the only regional exchange that facilitated the trading.

A key feature of the world coffee market is the substantial short-term spot price fluctuations. Empirical evidences show that producer revenues tend to depend on international coffee futures prices (Gemech and Struthers, 2007). Commodity futures market is one of the risk minimization tools available for them to hedge price risk (Mohan, 2003; Mohan and Love, 2004). Thus, coffee futures market needs to be efficient in price discovery and amenable to hedging (Dey and Alur, 2012). Some policy instruments need to be designed for mitigating the potential imbalances between demand and supply in global coffee markets that might help allowing a fair trade (Valkila and Nygren, 2010). However, abolition of International Coffee Agreements had induced volatility of coffee prices (Gemech and Struthers, 2007). Hence, impact of market-based instruments like forward/futures or/and option on coffee industries coupled with growers' welfare might be a way forward for future research.

Since empirical research on rubber markets in particular has been limited, this study might shed some light on inefficiency or/and resiliency of rubber futures. This may be attributed to several externalities, namely intermittent suspension on rubber futures trading during 2008 and influence of Asian markets, namely China, Japan, Singapore and Thailand on both reference and speculative pricing. India is the second largest consumer of natural rubber after China, while it ranks fourth in production. Several stakeholders are involved in this market like India's Rubber Dealer's Federation, Automotive Tyre Manufacturers' Association, India's Rubber Growers Association, Association of Rubber Producing Countries, Rubber Board, among others (Rubber Board, 2010). Participation of ATMA members and concerned plantation growers in rubber futures market has been minimal right since its inception as this market has been observed inefficient akin to coffee futures (Dey et al., 2012). Therefore, exchanges and the regulator should make concerted efforts to enhance the liquidity and participation of these key players.

However, Brenner and Kroner (1995) and Kellard (2002) caution that commodity markets might not be efficient in the long run since futures and spot may not be co-integrated due to several counts, namely arbitrage, time series property of nominal interest rate reflected in prices and other macroeconomic factors. Apart from a technical analysis, additional variables, such as supply of storage, real effective exchange rate, domestic interest rate, (marginal) convenience yield, to name a few need to be included for an incisive analysis of futures market efficiency. It is evident that in the period of higher volatility (observed mostly in foodgrains and pulses), a long-run relationship between futures and spot prices can be established using co-integration methodology detecting the presence of potentially unknown structural breaks (Peri et al., 2013). The paper intends to explore the potential benefits of futures markets for producers. However, the study has a limitation that it has not considered co-integrating relationship with breaks. Since India's commodity futures markets are of recent origin, the long-run relationship between futures and spot markets under different regimes could be better understood if the data consist of longer horizon.

Efficient and liquid select futures markets might help rationalize farmers' expectation in two ways: one is through agricultural investment (rational decision making) like choice of crops to be sown and thus, cropping pattern or rationalising spot price expectation and the other one, by influencing their marketing decisions or engaging in organized spot markets, for instance, coffee growers can obtain the electronic warehouse receipts conforming to grade and lot size of coffee beans to the National Spot Exchange and eventually, the exchange would organise the auction between growers and buyers at the behest of the Coffee Board for obtaining a right price. In other words, in an expectation of a better price, group of growers or aggregators can avail loan by pledging their produce in the exchange's designated warehouses (under lock and key condition) and the exchange would gradually market the produce and help the growers repay their dues. Since this study raised serious concerns about the vitality of coffee and rubber futures markets, regulatory supervision of agents' economic behaviour has to be increased manifold. And the government need to revamp futures market functioning by initiating a phase-wise structural reform. If the role of futures markets in price discovery is not as efficient as in the case of two important plantation crops, coffee and rubber then in the long run, this might keep the farmers away from attaining a better realization.

It is worth noting that India is a net importer of select commodities. Thus, domestic trade cannot outweigh the world market in regard to pricing that includes both speculative and reference pricing (Pavaskar, 2010). Therefore, commodity exchanges offering these futures contracts need to work in-sync with trans-national markets for improving contract specifications and thus, the market performance. However, in the wake of sliding rupee against dollar – alarming situation, India needs to cut its imports by incentivizing domestic production of respective commodities.

5. Concluding Observations

This paper attempted to examine whether select futures markets can accommodate the growers. It was mostly found that futures markets are away from their role of rationalizing grower's price expectations. Until and unless the futures markets are being participated by a large number of producers and traders including small and marginal ones, benign role of these markets cannot be realized (Ali and Gupta, 2011; Ramaswami and Singh, 2007). It may be noted that small growers are often reluctant to venture into risky entrepreneurial activities in the absence of effective mitigation measures (Sarangi and Lahiri, 2007). Therefore, their participation in futures trading is a utopian proposition. Though the Task Force recommended to form plantation co-operatives for trading in futures at the behest of small growers (Subramani, 2007), this aggregation effort also failed to scale up. In other words, aggregator model, though an attractive proposition, has its own set of constraints (Asokan and Arya, 2008). Thus, growers' indirect participation in futures may rather help form and/or revise their expectations towards agricultural investment (Cole and Hunt, 2010).

Acharya (2004) and Ranjan (2005) opine that one of the ways in which a greater growers' participation could be achieved is through aggregation of their produce under the aegis of institutional arrangements, for instance NABARD-sponsored and MCX-facilitated aggregator model in castor seed markets in Gujarat. Growers may choose the spot format either given inefficient futures markets (coffee and rubber) and aggregator may perform a host of functions co-ordinating with group of farmers, assayers (warehouse service providers), financial institutions, and spot exchanges (Sinha and Kumar, 2011). As spot exchanges float farmers' contract through daily net settlement, aggregator can keep a track of daily pooled spot prices and a ledger of the trading account (prices and quantities bought and sold in the market yard). Thus, real time price information through spot exchanges can be available at growers' disposal.

Futures market efficiency needs to be interpreted succinctly considering a few instrumental factors, viz. liquidity, heterogeneity in participation (of hedgers and scalpers or/and arbitrageurs), delivery logic of the contract, among others. To this end, the regulator has to keep a vigil on settlement and delivery processes (continuous and staggered) of the contract that might curb in extra speculative behaviour and ultimately, would benefit the growers sustaining a healthy trade. For a desired impact of the project, theoretically, futures market a priori needs to be efficient to make the price dissemination faster. It seeks to help the underlying market by impounding information and reflecting a 'true' or a 'fundamental' value of the commodity. However, information (scarce or privilege) is costly to obtain and store entailing a robust market structure that can improve seamless interaction between futures and spot. As a result, futures may rationalize its existence forming a legitimate price expectation among growers. To this end, the following points as a way out may help enhance growers' awareness and thus, indirect participation (Organization for Economic Co-operation and Development, 2000).

- real-time price information dissemination through installing of more number of price-ticker boards under the price dissemination project at the behest of the FMC/competent authorities;
- mandi modernization scheme to be implemented for integrating both spot and futures markets;

- support of government machineries like civil supplies, plantation board, ministry of agriculture to promote several pro-growers programmes on how to market their produce effectively and efficiently;
- extension wings of the Ministry of Agriculture need to work in consonance with other actors for displaying price information of major crop-arrivals in Agricultural Produce Market Committee-market yards and its sub-yards;
- plantation Boards, such as Coffee, Rubber need to encourage farmers to cultivate the tradable or 'basis' variety, for instance, Malabar Gold-1 (garbled) for pepper, REP bulk for coffee and RSS-3/4 for NR so as to attract the secondary (forward and/or futures) markets for a better realization

From a market microstructure point of view, liquidity and participation are *sine-qua-non* to improve the market performance (O'Hara, 1995). Since distribution of income or/and returns has been skewed in the plantation sector, especially in select markets, government intervention cannot be brushed aside either. To this end, the regulators' role for futures and spot markets is indispensable too. Since market participants in plantation are diverse and discursive, researchers need to be cautiously optimistic while drawing any inference about the futures market efficiency and its role in price discovery. Finally, a robust surveillance mechanism under prudent regulatory structures, if put in place, might insulate the growers from any untoward market moves or eventually, bail them out from unanticipated market failures (Ghosh, 2011).

It is worth mentioning that India's commodity derivative markets regulator, FMC is yet to permit the launch of broad-based option contract. Thus, inclusion of option-based literature is out of the scope in this study. Further, western markets have already experienced the impact of option pricing in commodities where spot markets are quite organized unlike in India. In addition, select commodities are hardly covered under the price support scheme declared by the government and thus, market-based instruments need to be utilized judiciously in developing or/and emerging market economies (Fernandes and Mor, 2009).

Apart from a secondary research as is similar to this study, some field research might help enrich our understanding of futures and spot markets dynamics. And it could be piloted in some notified production centers, namely Ernakulum, Idukki and Wayanud districts of Kerala (pepper and rubber grown areas) and Gulbarga, Raichur, Shimoga, and Bellary districts of Karnataka (coffee grown areas) to note the farmers' opinion towards the adoption of futures markets. A longitudinal survey method might be designed using certain inclusion criteria, viz. selection of experimental and control villages; choosing futures contracts of select commodities on notified exchange platform; identifying subject matter specialist and training on price dissemination; and follow-up and feedback (Cole and Hunt, 2010). Some non-profit or voluntary organizations (like Mysore Resettlement Development Agency, popularly known as MYRADA partnered with NCDEX for marketing pulses) may be approached for the survey at the behest of the principal investigator (Ramaseshan, 2012). Unless the market format appeals to the growers, legitimacy of any policy directive or its execution might remain a questionable claim. Hence, growers' proclivity to adopt the market could be a key challenge for the exchanges, regulators, and policy makers.

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References

Abdullah, D.A. and Rangazas, P.C. (1988), "Money and the business cycle: another look", *Review of Economics and Statistics*, Vol. 70, pp.680-685.

Adrangi, B. and Chatrath, A. (2003), "Non-linear dynamics in futures prices: evidence from the coffee, sugar and cocoa exchange", *Applied Financial Economics*, Vol. 13, pp.245–256.

Acharya, S. S. (2004), *State of the Indian farmer – Agricultural Marketing*, Vol.17, Academic Foundation, New Delhi.

Ali, J. and Gupta, K.B. (2011), "Efficiency in Agricultural Commodity Futures Markets in India – Evidence from co-integration and causality test", *Agricultural Finance Review*, Vol. 71, no. 2, pp. 162 – 178.

Asokan, S. R. and Arya, A. (2008), "Farmers' participation in futures trading: problems and prospects", *Productivity*, Vol. 48, No. 4, pp. 359-366.

Bailey, R.E. (2005), *The Economics of Financial Markets*, Cambridge University Press, New York.

Banerjee, S. (2010), "Commodity futures in india: analysis of convenience yields in select commodities" in Velmurugan, P.S., Palanichamy, P. and Shunmugam, V. (Eds), *Indian Commodity Market (Derivatives and Risk Management)*, Serials, New Delhi,pp. 404-426.

Berg, A. E. (2007), "The HAFED experience: wheat hedging on the NCDEX", available at http://www.fmi-inc.net/news/pdfs/HAFEDExperience.pdf (accessed 12 November, 2010).

Bose, S. (2009), "The role of futures market in aggravating commodity price inflation and the future of commodity futures in India", *Money and Finance: ICRA Bulletin*, pp 1-28, [online] http://www.indianjournals.com/ijor.aspx?target=ijor:mf&volume=4&issue=1&article=004.pdf (accessed December 26 2009).

Brennan, M.J. (1991) 'The price of convenience and valuation of commodity contingent claims', in D. Lund and B. Oksendal (Eds.): *Stochastic Models and Option Values*, pp.33–71, Elsevier, North Holland.

Brenner, R.J. and Kroner, K.F. (1995), "Arbitrage, co-integration and testing the unbiasedness of hypothesis in financial markets", *Journal of Financial and Quantitative Analysis*, Vol. 30, pp. 23-42.

Brooks, C. (2008), *Introductory Econometrics for Finance*, Cambridge University Press, New York.

Chakrabarty, R. and Sarkar, A. 2010; 'Efficiency of the indian commodity futures market' in Velmurugan, P.S., Palanichamy, P. and Shunmugam, V. (Eds), *Indian Commodity Market (Derivatives and Risk Management)*, Serials, New Delhi,pp. 404-426.

Chang, C. L., McAleer, M., Khamkaew, T. and Tansuchat, R. (2010), "Modelling conditional correlations in the volatility of asian rubber spot and futures returns", *Mathematics and Computers in Simulation*, pp. 1-19, available at doi:10.1016/j.matcom.2010.07.004 (accessed 20 August, 2012).

Coe, C. A. (2006), "Farmer Participation in Market Authorities of Coffee Exporting Countries", *World Development*, Vol. 34, No. 12, pp. 2089 – 2115.

Cole, S., and Fernando, N. (2008), "Assessing the importance of financial literacy", *Finance for the Poor*, Vol. 9, No. 3, pp.1.

Cole, S., and Hunt, S. (2010), "Information, expectations and agricultural investment: evidence from a field experiment in India", working paper-*USAID/BASIS Grant Research* (August), Harvard Business School.

Collins, R. (1997), "Towards a positive economic theory of hedging", *American Journal of Agricultural Economics*, Vol. 79, No. 2, pp.

Dey, K. (2013), *Price Discovery in India's Commodity Futures Market: an Empirical Exercise with Select Commodities*, PhD Thesis, Institute of Rural Management, Anand.

Dey, K. and Alur, S. (2012), "Do Futures benefit Indian coffee producers?", *International Journal of Economic Policy in Emerging Economies,* Vol. 5, No.4, pp. 318-341.

Dey, K. and Maitra, D. (2012), "Price discovery in Indian commodity futures market: an empirical exercise", *International Journal of Trade and Global Markets*, Vol. 5, No.1, pp. 68-87.

Dickey, D.A. and Fuller, W.A. (1979), "Distribution of the estimators for autoregressive time series with a unit root", *Journal of American Statistical Association*, Vol. 74, No. 366, pp.427-431.

Enders, W. (1995), *Applied Econometric Time Series*, John Wiley & Sons, New York

Engle, R.F. and Granger, C.W.J. (1987), "Co-integration and error correction: representation, estimation and testing", *Econometrica*, Vol. 55, No. 2, pp.251-276.

Fernandes, K. and Mor, N. (2009), "Risk management for the small farmer" in Kaul, S. (Ed), *India Commodity Year Book 2009*, National Collateral Management Services Limited, Mumbai, pp. 68-73.

Fortenbery, R. and Zapata, H. (2004), "Developed speculation and underdeveloped markets-the role of futures trading on export prices in less developed countries", *European Review of Agricultural Economics*, Vol. 31, pp.451–471.

Forward Markets Commission (2010), "Price dissemination project – a note", available at www.fmc.gov.in (accessed 28 April, 2012)

Fry, J., Lai, M.B. and Rhodes, M. (2011), "The interdependence of coffee spot and futures markets", working paper – 1, International Network for Economic Research (INER).

Ge, Y., Wang, H.H. and Ahn, S.K. (2008), "Implication of cotton price behaviour on market integration", Proceedings of *the NCCC-134 Conference on Applied Commodity Price Analysis, Forecasting, and Market Risk Management*, St. Louis, Missouri.

Gemech, F., and Struthers, J. (2007), 'Coffee price volatility in Ethiopia: effects of market reform programmes", *Journal of International Development,* Vol. 19**,** pp. 1131-1142.

Ghosh, N. (2011), "Market as a bail-out institution: commodity exchanges are in liberalized trade regime' in *Commodity Insights Yearbook 2011*, Price Waterhouse Coopers and Multi Commodity Exchange, Mumbai.

Ghoshray, A. (2010), "The extent of the world coffee market", *Bulletin of Economic Research*, Vol. 62, No. 1, pp.97-107.

Granger, C.W. J. (1981), "Some Properties of Time Series Data and Their Use in Econometric Model Specification", *Journal of Econometrics*, Vol. 16, pp.12-130.

Guo-guang, G. (2005), "Analyses on the price relation between Chinese natural rubber futures markets and spot markets", *Finance and Economics of Xin Jiang*, available at doi.CNKI: SUN: XJCJ.0.2005-05-013 (accessed 18 August, 2012).

Gupta, S. (2011), "Returns in plantation sector skewed towards marketing", News article, *Economic Times – Market Pulse*, May 5, 2011, available at http://articles.economictimes.indiatimes.com/2011-05-06/news/29517005_1_plantation-sector-value-chain-tea (accessed 28 May, 2011).

Hansen, H. and Juselius, K. (1995), *Cats in Rats: Co-Integration Analysis of Time Series*, Evanston Illinois, Estima, USA.

Hjelm, G. and Johansson, M.W. (2005), "A monte carlo study on the pitfalls in determining deterministic components in co-integrating models", *Journal of Macroeconomics*, Vol. 27, pp.691-703.

Jegadeesh, N. and Titman, S. (1993), "Returns to buying winners and selling losers: implications for stock market efficiency", *Journal of Finance*, Vol. 48, pp.65–91.

Johansen, S. (1988), "Statistical Analysis of co-integration vectors", *Journal of Economic Dynamics and Control*, Vol. 12, No. 2-3, pp.231-454.

Johansen, S. and Juselius, K. (1990), "Maximum likelihood estimation and inference on co- integration with applications to the demand for money", *Oxford Bulletin of Economics and Statistics*, Vol. 52, No. 2, pp.169-210.

Kang, M.G. (2005), "An introduction to market-based instruments for agriculture price risk management", Working paper, *Food and Agriculture Organization of the United Nations*.

Karande, K. (2006), *A Study of Castor Seed Futures Market in India*, PhD Thesis, Indira Gandhi Institute of Development Research (IGIDR), Mumbai.

Karbuz, S. and Jumah, A. (1995), "Co-integration and commodity arbitrage", *Agribusiness*, Vol. 11, pp.235-243.

Kebede, Y. (1993), "Causality and efficiency in the coffee futures market", *Journal of International Food and Agribusiness Marketing*, Vol. 5, pp.55–71.

Kellard, N. (2002), "Evaluating commodity market efficiency: are co-integration tests appropriate?", (unpublished), London Guildhall University, London.

Kumar, B. and Pandey, A. (2009), "Role of indian commodity derivatives market in hedging price risk: estimation of constant and dynamic hedge ratio and hedging effectiveness, available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1452881 (accessed 20 January, 2011).

Larson, D., Varnagis, P. and Yabuki, N. (1998), "Commodity Risk management and development", Working paper – 1963, *Research Group Rural Development*, World Bank.

Lence, S.H. (2003), "Do futures benefit farmers who adopt them?", ESA working paper – 03-20, *Agricultural and Development Economics Division*, Food and Agriculture Organization of United Nations.

MacKinnon, J.G., Haug, A. A. and Michelis, L. (1999), "Numerical distribution functions of likelihood ratio tests for co-integration", *Journal of Applied Econometrics*, Vol. 14, No. 5, pp.563–577.

Maitra, D., and K. Dey (2014), "Copulas and Dependence Structures – Evidences from India's and Asian Rubber Futures Markets', *Int. J. of Financial Markets and Derivatives*, Vol. 3, No.4, pp. 322-357.

Mattos, F. and Garcia, P. (2004), "Price discovery in thinly traded markets: cash and futures relationships in Brazilian agricultural futures markets", Proceedings of the NCR-134 Conference on Applied Commodity Price Analysis, Forecasting, and Market Risk Management at St. Louis, Missouri, April, 2004.

Milas, C., Otero, J. and Panagiotidis, T. (2004), "Forecasting the spot prices of various Coffee types using linear and non-linea error correction models", *International Journal of Finance and Economics*, Vol. 9, pp.277–288.

Mohan, S. (2003), "Assessment of coffee producers' price risk", Proceedings of Peebles 2003 Scottish Doctoral Conference, United Kingdom.

Mohan, S. and Love, J. (2004), "Coffee Futures: role in reducing coffee producers' price risk", *Journal of International Development*, Vol. 16, pp.983 –1002.

Mohan, S. (2007), "Market-based price-risk management for coffee producers", *Development Policy Review* Vol. 25, pp. 333-354.

Naik, G. and Jain, S.K. (2002), "India Agricultural commodity futures market – a performance survey", *Economic and Political Weekly*, Vol. 37, No. 30, pp. 3161-3173.

Naik, V. (2009), "Pepper: king of spices", *Commodity Vision*, Vol. 3, No. 1, pp.80-88.

Nair, C.K.G. (2004), "Commodity futures markets in india: ready for take-off?" Newsletter available at http://www.nseindia.com/content/press/jul2004a.pdf (accessed 21 February 2011).

National Commodity and Derivative Exchange (2013), 'Study of impact of staggered delivery system', Working paper (February) (restricted to public access).

National Multi Commodity Exchange (2011), "Historical pepper futures and spot series statistics and contract specifications", available at http://www.nmce.com/marketdata/hdata.aspx (accessed 28 April, 2011).

_________(2011), "Coffee futures and spot historical data and contract specifications", available at http://www.nmce.com/marketdata/hdata.aspx (Accessed April 29, 2011).

_________(2011), "Rubber Futures and spot historical data and contract specifications', available at http://www.nmce.com/marketdata/hdata.aspx (Accessed 5 May, 2011).

Newman, S. (2009), "The new price makers: An investigation into the impact of financial investment on coffee price behaviour", *NCCR Trade Regulation Working Paper No. 2009/7.*

Newbery, M.G.N. and Stiglitz, J. (1981), *The Theory of Commodity Price Stabilization*, Oxford University Press, Oxford.

Nittayagasetwat, W. and Nittayagasetwat, A. (2010), "The relationship between spot and futures prices of ribbed smoke-rubber sheet traded on agricultural futures exchange of Thailand", *International Journal of Business and Economics Perspectives*, Vol. 5, No.2, pp. 1-15.

O'Hara, M. (1995), *Market Microstructure Theory*, Blackwell, United Kingdom.

Organization for Economic Co-operation and Development (2000), *Income Risk Management in Agriculture,* OECD publication unit, Paris.

Pannell, D., Hailu, G., Weersink, A. and Burt, A. (2007),"More reasons why farmers have so little interest in futures markets', working paper – 0702, *School of Agricultural and Resource Economics*.

Paul, I. (2011), 'An assessment of the opportunities and challenges of the ethiopian commodity exchange', *Journal of Sustainable Development in Africa*, Vol. 13, No. 1, pp.1–16.

Pavaskar, M. (2010) *Readings in Commodity Derivative Markets*, Takshashila Academia of Economic Research (TAER), pp. 100-107, Book Well, New Delhi.

Pennings, J.M.E. and Leuthold, R.M. (2000), "The role of farmers' behavioural attitudes and heterogeneity in futures contract usage", *American Journal of Agricultural Economics*, Vol. 82, No. 4, pp.908–919.

Peri, M., Baldi, L., and Vandone, D. (2013), "Price discovery in commodity markets", *Applied Economic Letters*, Vol. 20, pp. 397-403.

Phillips, P.C.B. (1991), "Optimal inference in co-integrated systems", *Econometrica*, Vol. 59, pp.283-306.

Phillips, P.C.B. and Perron, P. (1988), "Testing for a unit root in time series regression", *Biometrica*, Vol. 75, No. 2, pp.335-346.

Ramaswami, B. and Singh, J.B. (2007), "Hedging and the emergence of commodity futures: the soya oil exchange in India", *Review of Futures Markets*, Vol. 16, No. 1, pp.33–54.

Ramaseshan, R. (2012), "Market design- the forgotten key", news article, *Business Line*, August 5 available at http://www.thehindubusinessline.com/industry-and-economy/agri-biz/article3731501.ece (accessed 24 September, 2012).

Ranjan, N. (2005), "Role of commodity exchanges, futures and options – a case study on soya oil", Occasional paper – 46, Department of Economic Analysis and Research, National Bank of Agriculture and Rural Development (NABARD).

Rao, G.V. K. (2009), "Coffee: Production and marketing challenges" in Kaul, S. (Ed), *India Commodity Year Book 2009*, National Collateral Management Services Limited (NCMSL), Mumbai, pp. 154-162.

Romprasert, S. (2009), Forecasting of natural rubber ribbed smoke-sheets no. 3 (RSS-3) price in the Agricultural Futures Exchange of Thailand, PhD Thesis, National Institute of Development Administration, available at http://libdcms.nida.ac.th/thesis6/2009/b165268.pdf (accessed 18 August, 2012).

Roy, A. (2008), *Dynamics of Indian spot and futures wheat markets: issues and implications*, PhD Thesis, Indian Institute of Management Ahmedabad.

Rubber Board (2010), *Rubber Statistical News,* Department of Statistics and Planning, Vol. 68, No.9.

Sahavevan, K. G. (2012), "Commodity Futures and Regulation", *Economic and Political Weekly*, Vol. 47, No. 52, pp. 106 – 112.

Sarangi, S and Lahiri, D. (2007), "Empowering rural women through skill formation training: an empirical study of Swarnajayanti Gram Swarojgar Yojona, India", *Asia-Pacific Journal of Rural Development*, Vol. 27, No. 2, pp. 107-122.

Sims, C. (1980), "Macroeconomics and reality", *Econometrica*, Vol. 48, pp.1-48.

Sinha, R. K., and Kumar, V. (2011), "Limitations of agriculture markets: can spot exchanges deliver?" in Sanjay Kaul (Ed.) *India Commodity Year Book 2011*, National Collateral Management Services Limited, Mumbai.

Subramani, P. (2007), "Allow small growers to hedge risks in futures markets", News article, *Business Line*, March 3.

Valkila, J., and Nygren, A. (2010), "Impacts of fair trade certification on coffee farmers, cooperatives, and laborers in Nicaragua", *Agriculture and Human Values,* Vol.27, No.3, pp.321-333

Veeramani, C. and Saini, G. K. (2011): "Impact of ASEAN-India Preferential Trade Agreement on Plantation Commodities: A Simulation Analysis", *Economic and Political Weekly*, Vol. 46, No. 10, pp. 83-92.Yang, J., Brian, B. R. and Leatham, D.J. (2005) "'Futures trading activity and commodity cash price volatility", *Journal of Business Finance Accounting*, Vol. 32, No. 1-2, pp. 297-323.

Zant, W. (2001): "Hedging Price Risks of Farmers by Commodity Boards: A Simulation Applied to the Indian Natural Rubber Market", *World Development*, 29(4), 691 – 710.

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TABLES

Table 1: Descriptive statistics of select futures and spot markets

	Return Series	Mean (%)	SD (%)	Skewness	Kurtosis	J-B	ADF
Pepper	Spot	0.06	1.50	0.17	6.01	425.23*	-30.04*
	Futures	0.06	1.95	0.08	6.65	127.82*	-32.76*
Coffee	Spot	0.075	1.629	5.68	91.74	353902*	-11.11*
	Futures	0.008	0.198	4.95	75.41	236187.7*	-25.75*
NR	Spot	0.0286	1.27	-0.0794	9.46	946.04*	-20.16*
	Futures	0.0349	1.78	-0.3359	7.93	564.41*	-24.38*

Note-*-denotes *p*-values, which are significant at 5% level. The null hypothesis of ADF test was spot/futures return has unit root. SD is standard deviation from average return. Both mean and SD are expressed in percentage. We conducted PP, KPSS, Ng-Perron test also to detect unit root considering both trend and intercept of the same data series. Since these test results did not considerably differ from ADF, we did not report other test results.

Table 2: Johansen's Co-integration test statistics

Futures and spot Prices	Co-integrating vector (r or β_j): λ-trace (H_0: $r<0$; H_1: $r \geq 0$) & λ-max (H_0: $r<1$; H_1: $r \geq 1$)	Eigen value	λ -Trace statistic	λ-max Eigen statistic
Pepper	H_0: $r<0$; 1	0.0815	94.393*	93.648*
	H_1: $r \geq 0$; 1	0.00068	0.7451	0.7451
Coffee	H_0: $r<0$; 1	0.0298	33.12*	32.06*
	H_1: $r \geq 0$; 1	0.00099	1.057	1.057
NR	H_0: $r<0$; 1	0.037	20.445*	20.224*
	H_1: $r \geq 0$; 1	0.00041	0.22	0.22

Note- *denotes rejection of the null hypothesis at 5% level of significance, which are Mackinnon-Haug-Michelis (1999) estimated *p*-values.

Table 3: Weak Exogeneity test results

Futures and spot prices	Chi-square (χ^2)	Remark
Pepper	78.37*	Futures
Coffee	4.741*	Spot
NR	0.085*	Inconclusive

Note- *denotes rejection of alternate hypothesis at 5% level of significance.

Table 4: VECM – Pepper, Coffee and Rubber

Parameters	Pepper Co-integrating eq.($F_t = 0.269 - 1.027^*S_t + \varepsilon_t$)		Coffee Co-integrating eq.($S_t = -0.18 - 0.9773^*F_t + \varepsilon_t$)		Rubber Co-integrating eq.($F_t = -0.024 - 0.9973^*S_t + \varepsilon_t$)	
	R_{ft}	R_{st}	R_{ft}	R_{st}	R_{ft}	R_{st}
α_f (ect_{t-1})	0.011 (0.043)	-0.263* (0.028)	0.041* (0.017)	-0.039* (0.016)	0.011 (0.037)	0.096* (0.022)
β_{f1}	-0.014 (0.050)	-0.215* (0.039)	0.200* (0.041)	-0.243* (0.04)	0.033 (0.06)	-0.275* (0.049)
β_{f2}	-0.0132	0.008	-0.019*	-0.085	0.034	0.058

	(0.046)	(0.032)	(0.042)	(0.3960)	(0.059)	(0.041)
γ_{s1}	-0.047	0.269*	0.382	0.400*	-0.216*	0.374*
	(0.059)	(0.033)	(0.0435)	(0.0389)	(0.083)	(0.035)
γ_{s2}	0.052	0.052	0.117*	0.067	0.084	0.168*
	(0.049)	(0.030)	(0.042)	(0.0401)	(0.069)	(0.035)
c	0.0005	0.0005	0.0004	0.000517	0.0002	0.0004
	(0.0006)	(0.0004)	(0.0005)	(0.00046)	(0.000)	(0.000)

Note- *denotes the level of significance at 5% and figures in parentheses are standard errors of parameters.

Table 5: 'Granger' causality test result

	Futures→ Spot	**Spot→ Futures**
Pepper	73.26*	1.423
Coffee	105.89*	7.77*
NR	109.6*	8.45*

Note-*denotes the rejection of null hypothesis at 5% level of significance, Chi-Square test considered two degrees of freedom.

Table 6: GFEVD of Pepper, Coffee and Rubber

Particular	**Explained by**	**Lag**			
		1	**4**	**7**	**10**
Pepper futures return	**Future returns**	100%	99.97%	99.98%	99.99%
	Spot returns	0.00%	0.03%	0.02%	0.01%
Pepper spot return	**Spot returns**	54.75%	15.19%	8.29%	5.4%
	Futures returns	45.24%	84.80%	91.7%	94.6%
Coffee futures return	**Future returns**	58.32%	56.57%	56.54%	56.53%
	Spot returns	41.67%	43.43%	43.46%	43.47%
Coffee spot return	**Spot returns**	100%	89.63%	89.62%	89.7%
	Futures returns	0.00%	10.37%	10.38%	10.39%
Rubber futures return	**Future returns**	65.29%	64.48%	64.47%	64.46%
	Spot returns	34.71%	35.52%	35.53%	35.53%
Rubber spot return	**Spot returns**	100%	73.59%	73.60%	73.60%
	Futures returns	0.00%	26.41%	26.39%	26.40%

Note- number denotes the lag period considered for fitting GFEVD model.

Table 7: Test-summary

Commodity	**Co-integration & long run equilibrium**	**'Granger' causality**	**Weakly exogenous**	**Magnitude of variance decomposition in forecast error**
Pepper	Yes	Unidirectional	Futures	Futures> spot
Coffee	Yes	Bidirectional	Spot	Spot > futures
NR	Inconclusive*	Bidirectional#	Futures	Spot > futures

*,#Though α parameter of ECTs of futures and spot return indicated a non-stable explosive correction, β & γ of respective variables (futures and spot) confirmed bidirectional causality.

Table – 8 Contract specifications

The contract specifications for NMCE pepper, coffee and rubber futures are as follows: minimum lot/contract size of trading and delivery unit is 1 mt. for pepper and NR. In case of coffee futures contract, minimum lot/contract size of trading and delivery unit is 1.5 mt which is equivalent to 25 bags of 60 kg each. Trading is from Monday to Friday of each month (except holidays) from 10 A.M. to 5 P.M. On Saturday, the timing is 10 AM to 2 P.M. Tick size (minimum price difference between different buy (bid) and sell (offer) prices of the same contract) is kept INR 1 for pepper and rubber futures whereas it is INR 0.05 for coffee. Quotation or base value of pepper, coffee and rubber futures is standardized at INR per 100 kg or per quintal. Other specifications are presented in the table below.

Parameters	**Pepper**	**Coffee**	**NR**
Price band	Daily Price Limit: Initial- (+)/(-) 3%, Final-(+)/(-) 4% (3+1)	Daily Price Limit: Initial- (+)/(-) 2%, Final price limit:(+)/(-)4% (2+2)	Daily Price Limit: Initial- (+)/(-) 3%, Final-(+)/(-) 4% (3+1)
Delivery logic Limit on position	Compulsory Member-4,500 mt or 15% of total open position Client- 900 mt Near-month Limit Member-1,500 mt or 15% of total OI, Client-300 mt	Compulsory Member-6,000 mt or 15% of total Open Interest (OI) Client-2,000 mt Near-month Limit Member-1,200 mt or 15% of OI Client-400 mt	Compulsory Member-12,000 mt or 15% of total open position Client- 4,000 mt Near month Limit Member-5,000 mt or 15% of total OI, Client-1,250 mt
No. of delivery contracts in a year	Maximum 12; monthly contract and minimum 2 bi-monthly contract running concurrently on NMCE	Maximum 6, bi-monthly contracts in a year (12 months)	Maximum 12 contracts monthly or minimum 2 bi-monthly contract running concurrently on NMCE
Delivery centres	CWC warehouses located in Cochin/Ernakulam, Kottayam, Calicut, Malapuram, & Trichur	Kushalalnagar or Coorg, Hassan, Chikmagalur in Karnataka & Kalpetta in Kerala, India	Central Warehousing Corporation's (CWC) warehouses located in Cochin/Ernakulam, Kottayam, Calicut, Malapuram and Trichur of Kerala state of India

FIGURES

Fig-1 -A - Pepper futures and spot price-series (INR/Qtl)

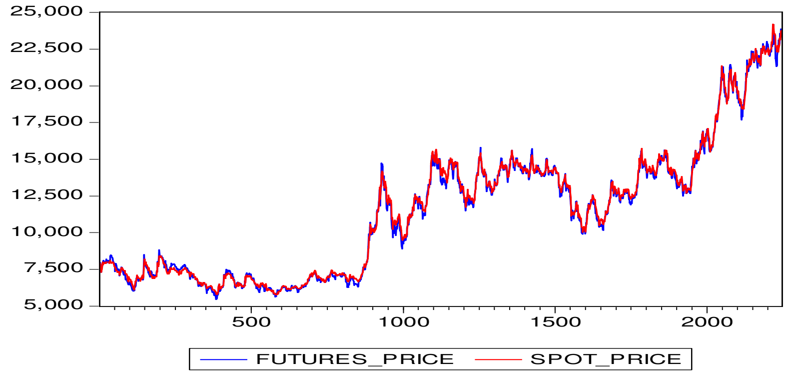

Fig-1-B - Coffee futures and spot price-series (INR/Qtl)

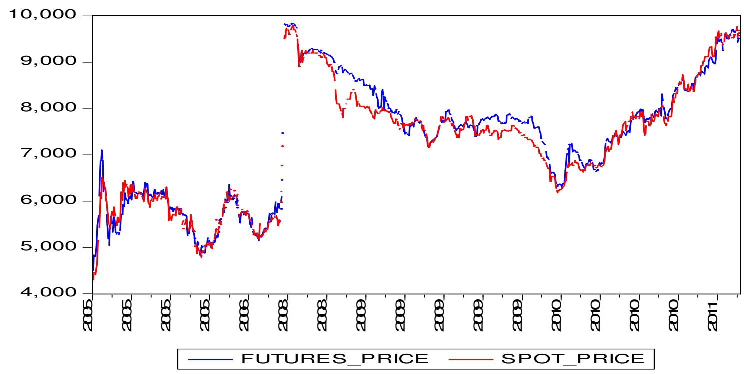

Fig-1-C - Rubber futures and spot price-series (INR/Qtl)

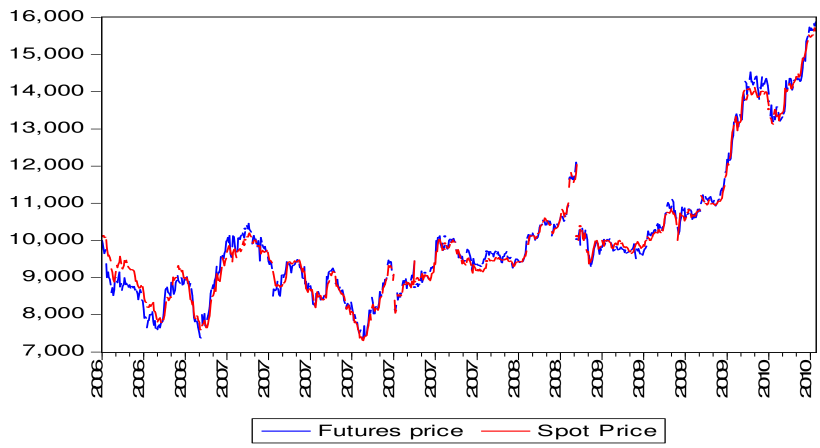

Fig-2-A- QQ plot of coffee futures and spot returns

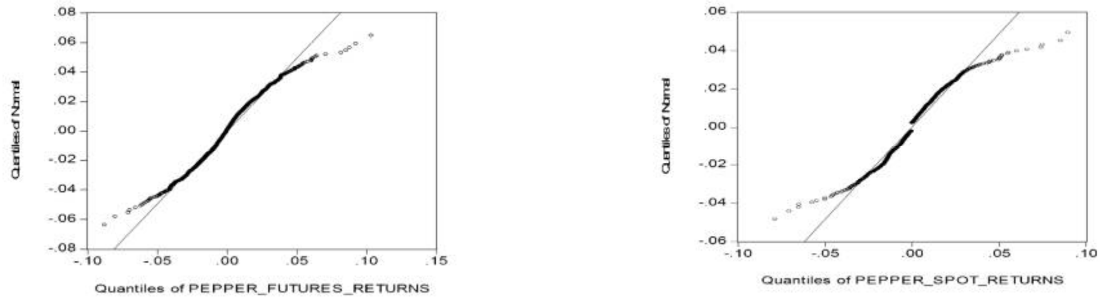

Fig-2-B- QQ plot of coffee futures and spot returns

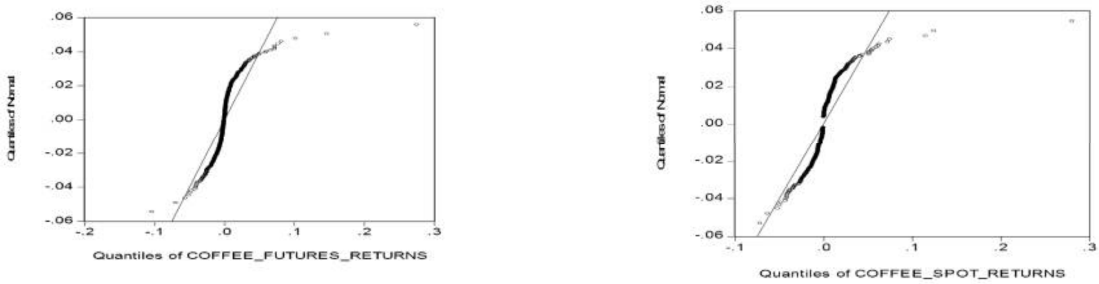

Fig-2-C- QQ plot of rubber futures and spot returns