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A STUDY ON MARKET INTEGRATION AND PRICE DYNAMICS OF INDIAN NATURAL RUBBER (RSS 4 GRADE): DOMESTIC VS. INTERNATIONAL MARKETS

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ABSTRACT

Natural Rubber is a perennial crop with an economical life span of 10 – 20 years. Price of natural rubber fluctuations has got multifaceted effect on the area, production, and productivity of the crop. The main objectives of the study are attempted to measure the degree of market integration and to analyse the extent of volatility in price of natural rubber at domestic and international markets. Kottayam and Kochin rubber markets at domestic level and Bangkok markets at international level were chosen for the study and the daily spot prices for selected markets were collected from April 2009 to March 2013. Johansen's Multiple Co-integration technique and GARCH model were applied to measure the degrees of market integration and analyze the extent of volatility in price of natural rubber for RSS 4. Results indicated that only two markets among three markets were found to be integrated between domestic and international markets for the RSS 4 grade and markets experienced low level of volatility during the study period. It is suggested that as the international price may influence the Indian producer's price, which has to be taken care by the policy makers.

KEYWORDS

co-integration, unit root test, price volatility, price transmission, ribbed smoked sheet (RSS), domestic market and international market.

INTRODUCTION

 Natural Rubber is an important perennial crop in India with an economical life span of 10-20 years. India is the fourth largest natural rubber producing country after Thailand, Indonesia and Malaysia. It is the third largest consumer of natural rubber in the world. India's share in the production has increased over the years and the country is now one of the largest producers of natural rubber in the world market. South Indian regions, especially Kerala, Tamil Nadu and Karnataka contribute major share of India's natural rubber production. In fact, 90 per cent of the total production comes from the state of Kerala. After the opening up of the Indian economy in 1990s, India's domestic rubber market started showing links to the international market. Probable determinants of volatility in natural rubber prices in domestic market are state administered procurement programs, inconsistent important export policies and global market trend.

The period from 1994 to 1998 was the most turbulent in domestic price trend of natural rubber. In June 1995 RSS 4 price shot up sharply to Rs. 6171 per quintal from Rs. 2599 a quintal in March 1995. The probable reason of this sudden price hike was decline in world production of natural rubber in main producing countries. Immediately after May 1995 India's import of natural rubber also increased. The maximum natural rubber import during 1991-92 to 2003-04 took place rose in anticipation of future supply tightness and shortage of some grades, because Australia forecasted to decline natural rubber production due to serious drought.

After that in February 1999, Indian Government banned rubber imports through ALS (Advance License Scheme), as a result of this rubber prices moved sideways. The removal of the quantitative restrictions from 1st April 2001 aggravated the decline price trends. The probable reason behind this firming up of natural rubber prices are up trend in global market, global natural rubber supply fails to catch up with growing demand, particularly from China. The prices have reached to Rs. 18807 per quintal as on June, 2012.

Demand for rubber is most evenly distributed over the years but due to absence of production in monsoon, supply shrinkage occurs. By June/July the production becomes normal, but lingering rains last for a couple of months. During rainy period tapping of rubber trees disrupted and production falls. Resultantly prices would rise at that time, unless there is an acute economic depression or similar negative factors. Rubber prices have been on the rise in recent months due to disruption of production in Kerala, which accounts for 90 per cent of the country's production. However, in August 2011, rubber prices dropped on account of higher output and imports. Rubber price fell from Rs. 214 per kg in July 2011 to Rs 207 on August 1 and to Rs. 203 on August 13, 2011. (Market Survey 2012)

SCOPE OF THE STUDY

Natural Rubber is a predominant of plantation crop of considerable significance to Indian economy having a share of 8.9 per cent of world's production and 8.7 per cent of consumption. An important feature which distinguishes the marketing of perennial crops from that of annual crops is their comparatively inelastic supply response to prices. Among commercially important perennial crops, natural rubber has a unique advantage in processing options, which also provide marketing options for the producers and enable them to design their marketing strategy, according to the prevailing market situations. Price fluctuations have got multifaceted effect on the area, production and productivity of the crop. Unexpected and wide fluctuations in prices may discourage farmers from taking up of improved production and plant protection methods which may result in low production and instability in farm income. The study of market co-integration would perform market efficiency in Indian rubber markets, which would signal for international rubber markets and policy reforms to avoid risk in both domestic and international markets. This would be much helpful for the exporters, processors and policy makers in taking timely decisions that would favor the rubber and its related markets. Further the assessment of policy analysis would be helpful in arriving meaningful policy to make the rubber market to be more efficient. Hence, in this context, the present study was taken up with the following specific objectives.

- i) To measure the degree of market integration in the domestic and international rubber markets and
- ii) To analyze the extent of volatility in price of natural rubber at domestic and international rubber markets.

REVIEW OF LITERATURE

A Comprehensive and up-to-date review of literature is necessary for any field of scientific enquiry so as to understand the various concepts to be used in the proposed study and more importantly to gain a clear knowledge on the gaps in the past studies so that proposed study would make a serious effort to address those gaps in the existing literature. There are several studies examining the market co-integration especially in agricultural commodity. However, relatively the following very few exists on market co-integration in agricultural commodities.

Myint and Bauer (2005) examined the long-term performance of domestic rice markets in Myanmar by evaluating the degree of spatial market integration using the co-integration methodology. Results from this study showed that the Myanmar rice markets were integrated, an indication of long-run interdependence of rice markets. A study by **Lokare (2007)** found that although Indian commodity market is yet to achieve minimum critical liquidity in some commodities (sugar, pepper, gur and groundnut), almost all the commodities show an evidence of co-integration between spot and future prices, revealing the right direction of achieving the improved operational efficiency, though at a slower rate. Further, hedging proves to be effective in respect of some commodities. However, for a few commodities, the volatility in future price has been substantially lower than the spot price indicating an inefficient utilization of information.

Ge et al., (2008) investigated the linkages between Chinese and US cotton futures market. They considered the futures prices of contracts trading on New York Board of Trade (NYBOT) in US and the Zhengzhou Commodity Exchange (ZCE) in China. They found that these markets were cointegrated and that there was

bidirectional causality in returns, between these markets. **Abdul (2009)** investigated domestic integration among ten major mango markets, i.e., Lahore, Faisalabad, Multan, Cujranwala, Sargodha, Karachi, Hyderabad, Sukkur, Peshawar, and Quetta employing Johansen's co integration approach and error correction model. The results of the study confirmed the presence of integration among major mango markets in Pakistan and these markets were able to adjust for 16 to 68 per cent of disequilibrium in one month, implying that it takes almost two to six months to remove any disequilibrium and to move back to long-run equilibrium. The Granger causality test shows that the Karachi market has bidirectional causality with Lahore, Faisalabad, Multan, Hyderabad, and Sukkur, and a unidirectional relationship with the rest.

Babar et al, (2010) analyzed the regional market integration in many agricultural commodities in Pakistan to provide information on the dynamics of price adjustment and to know whether there exists market imperfection. This study used the monthly wholesale price data from January 1991 to December 2006 of gram and estimated the degree of integration in gram markets of Pakistan using co-integration analysis. The results showed that all gram markets were highly integrated in the long run. **Dinkar Pawan and Mayank Nagpal (2010)** examined the market integration study on the pepper commodity between two markets. They also attempted to fit in an Error Correction Model (ECM), and co-integration technique to find the market integration and they used daily data for average spot price and closing futures price for the analysis. It found that an approximately one to one relationship between the futures price and the spot price, measured by the parameter β (0.9807). Hence, it concluded that the spot and futures price were co-integrated, implying a long term relationship between the two.

Anuja et al., (2013) analysed the price dynamics and market integration of natural rubber under major trade regimes of India and abroad. GARCH (1,1) model was applied to analyse the extent of volatility in prices of natural rubber for RSS 4 grade. Results indicated that the markets experienced high level of volatility during the study period (2005-06 to 2011-12). Uniformity in prices and thereby efficiency in marketing system can be brought about by integration of the markets. Johansen's co-integration analysis was used to test the market integration between domestic and international reference markets of rubber and the results revealed that there exists long run equilibrium.

The above researchers had studied the market behavior and their relation between interstate and different international markets by using the co-integration test and spatial integration of the market, for the specific commodity. In the present study, Johansen's Multiple Co-integration framework has been used to analyze the integration of the domestic and international natural rubber markets.

METHODOLOGY

The secondary data have been used for the study. For the purpose of market integration study, Kottayam and Kochin rubber markets at domestic level and Bangkok market at international level, were chosen. Further, the daily spot market prices for both domestic and international markets have been collected for the analysis. The concerned data were collected from the website of Indian Rubber Board Statistics compiled by Indian Rubber Board and International Rubber Study Group (IRSG) for the period from April 2009 to March 2013. Almost 75 per cent of the rubber is processed and traded in the domestic markets as RSS 4 grade and therefore the price of same grade was taken as the representative price of natural rubber. The following specific statistical tools such as Stationarity Test, Granger Causality Test, Johansen's Multiple Co-integration Technique, Error Correction Mechanism and Price Volatility were adopted in this study.

RESULTS AND DISCUSSION

PRICE ANALYSIS OF NATURAL RUBBER: DOMESTIC Vs. INTERNATIONAL MARKETS

The daily prices were collected from the domestic and international market for the period of April 2009 to March 2013. The major natural rubber markets prices selected for the study were Kochin, Kottayam and Bangkok. The prices were analysed for the existence of integration, volatility and level of adjustment to the equilibrium state. First of all the time series price data were disinflated and then converted to logarithmic form. The data were tested for presence of unit root and then based on results; the first difference was taken to make the data series to stationery condition.

RESULTS OF STATIONARITY TESTS

To verify whether the level and first differenced price series were indeed stationary, Augmented Dickey-Fuller (ADF) unit root test was used. The ADF test results were presented during the study period of investigation for the current research. The equations were estimated with an intercept and no time trend for the Augmented Dickey-Fuller (ADF) unit root tests for each price series. The null hypothesis of non stationarity was tested, based on the critical values reported by MacKinnon (1991). The price series appeared non stationary in the levels, but all the series were stationary in first differences for the study period.

UNIT ROOT ANALYSIS OF NATURAL RUBBER MARKET PRICE

India is one of the major exporter and importer in natural rubber among the world countries. The time series data were collected for RSS 4 grade and is processed for the presence of unit root, co-integration, causality and vector error correction mechanism. The price data on RSS 4 was tested for presence of unit root and it is presented in Table 1. The ADF statistics and p values along with first difference are also given in the table. In the level (zero differencing) there is presence of unit root since the calculated ADF value is more than the critical value. After first differencing the ADF statistics was found to be statistically significant were it is lower than the critical value at one per cent level.

TABLE 1: RESULTS OF UNIT ROOT TEST ON PRICES OF NATURAL RUBBER IN DIFFERENT MARKETS

Markets	Level		1 st Difference		Critical Value (1%)
	ADF Statistic at level	p-value	ADF Statistic at First difference	p-value	
Kochin	-1.96141	0.3042	-27.5971	0	-3.43557
Kottayam	-1.94148	0.3133	-27.5971	0	-3.43557
Bangkok	-2.03012	0.2739	-23.242	0	-3.43557

It is confirmed that the price series were stationary in their first differences, co-integration between the markets was tested by using both Johansen's maximum likelihood procedure and the bivariate co-integration technique of Engle and Granger for the presence of long run relationship between the domestic and international natural rubber markets and associated price transmission and resultant price volatility in the domestic markets for natural rubber.

MARKET INTEGRATION AND PRICE TRANSMISSION: DOMESTIC Vs. INTERNATIONAL MARKETS

Relationship between prices of domestic and international natural rubber markets were studied through the Granger's Causality test. Market integration between international and domestic markets on prices of natural rubber was worked out with the help of Johansen's multiple co-integration frame work. The market transmission between international and domestic rubber markets were also analysed through estimates of the VECM frame work. The econometric analyses were carried out by using the software Eviews 3.1.

GRANGER'S CAUSALITY TEST ON PRICES OF DOMESTIC AND INTERNATIONAL MARKETS

The causal relationship between the price series of domestic and international natural rubber markets were approached through Granger's causality technique and the results on prices of RSS 4 grade between domestic and international markets were carried out.

TABLE 2: RESULTS OF GRANGER'S CAUSALITY TEST ON DOMESTIC AND INTERNATIONAL MARKETS PRICE

	F - statistic	p - value
KOCH4 does Granger Cause BANG4	62.6772	0.000
BANG4 does not Granger Cause KOCH4	1.31060	0.270
KOTT4 does Granger Cause BANG4	68.4891	0.000
BANG4 does not Granger Cause KOTT4	1.26797	0.281
KOTT4 does Granger Cause KOCH4	79.6085	0.000
KOCH4 does not Granger Cause KOTT4	0.66271	0.515

The results of causality test of the international natural rubber prices on the domestic markets for RSS 4 grade is presented in Table 2. The results revealed that the Kochin Market granger causes the Bangkok market, but the Bangkok market operation doesn't influence the Kochin market prices. The Kottayam market influences the Bangkok market price but the Bangkok market price doesn't influence Kottayam market price. The Kottayam market price causes Kochin market price, but the Kochin market price doesn't cause Kottayam market price. Hence, only unidirectional causality exists between the domestic and international markets, there was no existence of by directional causality.

MULTIVARIATE CO-INTEGRATION TESTS ON DOMESTIC AND INTERNATIONAL MARKETS

Results of multivariate co-integration tests on natural rubber markets for RSS 4 grade of India with the international market are discussed in this section. As the entire data series were integrated of the same order, the tests for co-integration was done using by the Johansen and Juselius maximum likelihood test procedure as it provided most efficient estimate of the co-integrating vectors and also identified the number of co-integrating relationships among the non-stationary variables.

TABLE 3: RESULTS OF MULTIPLE CO-INTEGRATION TESTS ON DOMESTIC AND INTERNATIONAL MARKETS

No. of CE (s)	Eigen value	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.172283	240.9795	29.79707	0.0001
At most 1	0.008023	13.70107	15.49471	0.0915
At most 2 *	0.003338	4.018618	3.841466	0.045

Trace test indicates 1 co-integrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values.

The results of Multivariate Co-integration Tests on domestic and international natural rubber markets for RSS 4 grade is presented in Table 3. Results of co-integration analysis of domestic markets with international natural rubber market revealed that as per the Trace test there exists 1 co-integrating equation at the 0.05 level. It indicates that only two markets among the three markets were found to be integrated among the domestic and international markets for the RSS 4 grade.

VECTOR ERROR CORRECTION MECHANISM (VECM) ON DOMESTIC AND INTERNATIONAL MARKETS

As discussed in the earlier, before proceeding to vector error correction mechanism, lag order of variables to be included in the model had to be ascertained. The optimal lag length was identified as one for all the variables under research investigation.

For the present study, the Vector Error Correction Mechanism (VECM) was adhered for the domestic rubber markets for RSS 4 grade, which was having long run association with global natural rubber market such as Bangkok market. Accordingly, VECM for the domestic and international rubber markets for RSS 4 grade was computed, results are presented and discussed below.

TABLE 4: RESULTS OF REDUCED FORM VECTOR ERROR CORRECTION ESTIMATES ON DOMESTIC AND INTERNATIONAL MARKETS

Error Correction:	D(BANG4)	D(KOCH4)	D(KOTT4)
CointEq1	-0.00012	0.001588	-0.00022
	[-0.22791]	[5.26681]	[-0.75019]
D(BANG4(-1))	-0.20225	-0.01111	-0.00817
	[-6.94549]	[-0.64794]	[-0.49699]
D(BANG4(-2))	0.017913	-0.03595	-0.03456
	[0.62932]	[-2.14424]	[-2.15111]
D(KOCH4(-1))	0.115386	-0.04075	-0.04393
	[0.50914]	[-0.30526]	[-0.34351]
D(KOCH4(-2))	0.025328	0.022931	0.015763
	[0.15564]	[0.23925]	[0.17163]
D(KOTT4(-1))	0.387114	0.392251	0.399457
	[1.67743]	[2.88581]	[3.06712]
D(KOTT4(-2))	0.249054	-0.03187	-0.0318
	[1.45736]	[-0.31661]	[-0.32973]

Figures in parentheses indicates 't' values

The Reduced Form Vector Error Correction Estimates for international natural rubber and domestic natural rubber markets for RSS 4 grade is presented in Table 4. The results reveal that the Kochin market prices adjust to its equilibrium price from the price shocks within short period of one day. All other markets such as Bangkok and Kottayam markets do not adjust to their equilibrium position in a short period. The Bangkok market own price converges to its equilibrium position within one day lag. The Bangkok market is influenced by the Kottayam market to converge to its equilibrium price with two days lag period. Similarly the Bangkok market is influenced by the Kottayam market for converging to its equilibrium prices. In case of Kottayam market, both the Kochin as well as Kottayam markets (own price) influence with one period lag for diverging from its equilibrium position.

PRICE VOLATILITY ON DOMESTIC AND INTERNATIONAL MARKETS

Global market integration for natural rubber and transmission of international prices to the domestic markets were discussed in detail in the previous section. The price volatility in domestic and international markets is discussed below.

TABLE 5: RESULT OF PRICE VOLATILITY ON DOMESTIC AND INTERNATIONAL NATURAL RUBBER MARKETS

Markets		Coefficient	Std. Error	z-Statistic	Prob.
Kochin	ARCH (α)	1.267469	1.556183	0.814473	0.4154
	GARCH (β)	-0.93952	0.30619	-3.06843	0.0022
	$\alpha + \beta$	0.327945	-	-	-
Kottayam	ARCH (α)	1.27701	1.570947	0.812892	0.4163
	GARCH (β)	-0.9495	0.238539	-3.98046	0.0001
	$\alpha + \beta$	0.327515	-	-	-
Bangkok	ARCH (α)	1.211539	1.0343	1.171362	0.2415
	GARCH (β)	-0.88736	0.21482	-4.13073	0
	$\alpha + \beta$	0.324175	-	-	-

The price volatility for the domestic and international markets for RSS 4 is given in Table 5. The Price volatility was indicated by the sum of coefficients for the ARCH (α) and GARCH (β). If the sum is near to one, it indicates the presence of price volatility and it is less than one then it indicates the absence of price volatility. The results reveals that the sum of the ARCH (α) and GARCH (β) was found to be less than one in all the markets, as well as in the grade RSS 4. Hence it could be concluded that both the domestic and international natural rubber market prices for the RSS 4 grade was relatively free from the price volatility.

CONCLUSION

On the basis of above observations, it can be concluded that the causality test for RSS 4 grade revealed that only unidirectional causality exists between the domestic and international markets, there was no existence of bidirectional causality. In the selected Kochin, Kottayam and Bangkok markets, only two markets were found to be integrated in RSS 4 grade. In case of the RSS 4 grade in short run only the Kochin market adjust to its equilibrium price from the price shocks within short period of one day and other markets such as Bangkok and Kottayam markets do not adjust to their equilibrium position in a short period. In long run the Kochin and Kottayam markets were influenced by the Bangkok market to adjust to its equilibrium price. During the study period, the sum of the ARCH and GARCH was found to be less than one in all the markets, as well as in the grade RSS 4 and among the three selected markets such as Kochin, Kottayam and Bangkok there was no existing of much price volatility. Hence, it could be concluded that both the domestic and international natural rubber market prices for RSS 4 grade was relatively free from the price volatility.

SUGGESTIONS

The overall conclusion is that the domestic and international markets were found to be integrated and influence each other and hence the international price may influence the Indian producer's price therefore, the study suggests that the producer's procurement price for natural rubber has to be maintained at the reasonable and affordable rate by the policy makers.

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