Market Efficiency of Rubber: An Analytical Study Based on Co-integration Technique

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Abstract

India is the fourth largest producer of Natural Rubber which accounts 7% of world production. It is found that more than 12 lakh farmers directly depend on Natural Rubber for their livelihood strategies. When we analyses the global Natural Rubber market, we can see that in the recent years there is a sharp decline in the market prices of Natural Rubber at internationally and domestically. The present study analyses the interdependence of domestic and international market prices with the use of Co-integration technique to prove market efficiency. The integration of rubber market is measured by using the time series data from 2012–2015. By taking the data on rubber prices in the Kottayam market in India as domestic price, and Bangkok rubber market as the international price. Error Correction Model (ECM) for long run relationship and Granger Causality tests were also used for an in-depth analysis. The Granger test result indicates that there is causality in at least one direction, i.e. Bangkok price causes the price in Indian market as the *p*-value is 0.0399 which is less than level of significance at 5%. Overall, there is sufficient evidence to conclude that Indian rubber market is integrated with the Bangkok market in the long-run. The recent fall in domestic price of Natural Rubber was due to a fall in the international price.

1. Introduction

There was rapid increase in the global demand for Natural Rubber (NR) in the past decade and it is also expected to increase for the coming years. The NR world consumption is 12.3 mt for the 2015–16 (Rubber statistical news, 2016) and it estimated to reach 16.5 mt in 2023 (Rubber study, 2015). In the production of NR, India stands fourth position where Thailand leads the production followed by Indonesia and Malaysia. Production of Natural Rubber (NR) in India during the year 2015–16 fell 12.9% to 562,000 t from 645,000 t produced a year ago. The output registered lowest in about last five years. The sharp decline in the production of NR is caused by fall in the prices at international level. The price ruled around ₹ 220 kg⁻¹ in January 2011 came down to 111.5 kg⁻¹ at the 3rd quarter of 2015–2016. The fall in the international rubber price resulted from the plummeting crude oil price and restrictions on the import of rubber by China (Krishna, 2015). In the country, about 85% of the Natural Rubber is produced in Kerala providing livelihood options for 12 lakh farmers (The New Indian Express, 2015). The decline in the domestic rubber prices is creating worries in the Minds of rubber growers. The present study tries to analyses the interdependence of

domestic and international rubber market.

The persistent fall in the rubber prices causes concern among the rubber farmers in India. Table 1 indicates the average price of RSS-4 at Kottayam from 2006–07 to 2015–16. It is evident from the table that the average price of Natural Rubber stood

Table 1: Average price of RSS-4 at Kottayam, Kerala

Year	₹ 100 kg⁻¹
2006–07	9204
2007–08	9085
2008–09	10112
2009–10	11498
2010 –11	19003
2011–12	20805
2012–13	17682
2013–14	16602
2014–15	13257
2015-16ᴾ	11306

Source: Rubber board, 2016; P: provisional

high during the year 2011–12. Thereafter, we can see sharp decline in the average rubber prices of RSS-4 grade to reach Rs 11306 kg^{-1} at the end of 1st quarter 2016. The rising cost of production as a result of rise in wages and cost of fertilizers, the growers decided to stay away from production. This resulted in the decrease of output during the past year. The present study analyses the Co-integration between international and domestic rubber markets and examines whether the decline in the market prices was resulted from the fall in international prices or not.

1.1. Objectives of the study

The important objectives of the study are:

To examine the co-integrated relationship between domestic and international market prices of rubber.

To determine causality between international and domestic rubber prices.

2. Materials and Methods

2.1. Collection data

The present study uses secondary data for the analysis and interpretation. Rubber prices are collected from Rubber Board of India where price prevailing in Bangkok is considered as price of international market and Kottayam market price is preferred for domestic market price. At international and domestic level, the prices of grade RSS-3 and RSS-4 were chosen where RSS-3 for Bangkok market and the latter one for Indian market. Daily prices of natural rubber from the period of 02/07/2012 to 30/06/2015 were collected and analyzed. During this period, the market witnessed sharp decline in the NR prices.

2.2. Methodology

Co-integration of markets is analyzed with the help of Engle–granger test. Error correction model provides the consistency of co-integration. There are a few studies related to Co-integration of rubber markets. But these studies are more regions specific. In a study by Fathoni (2009) analyzed the market system and market integration for rubber cultivation in Jambi Province Indonesia. They used Johansen Co-integration technique and Granger causality test. The result showed that there is no significant integration for both the markets.

Philip (2008) analyzed rubber price in Kerala for pre and post-reform period and found that during post-reform period the market is co-integrated. He selected two regional rubber markets in Kerala and done co-integration of these markets. Kannan (2013); Grafoute and Yao (2012) adopted least squares method to determinants of production and export of NR in India, they found that export of Natural Rubber is positively influencing by world market price, world population, domestic rubber production and producer price.

In order to determine the nature of each bivariate relationship of the movement of the causality the study used Granger tests. Data analysis is done using Gretl software.

3. Results and Discussion

Time series data on the daily prices of rubber in domestic market i.e. Kottayam and international market i.e. Bangkok for the period from 2/7/2012 to 30/06/2015 was used for the analysis. The concept of Co-integration and Error Correction Model was used to analyze the co-movement of rubber price in domestic and international market and the extent of transmission of international prices to domestic market. The graph of the logarithmic value of two price series is presented in Figure 1. There is a high volatility with respect
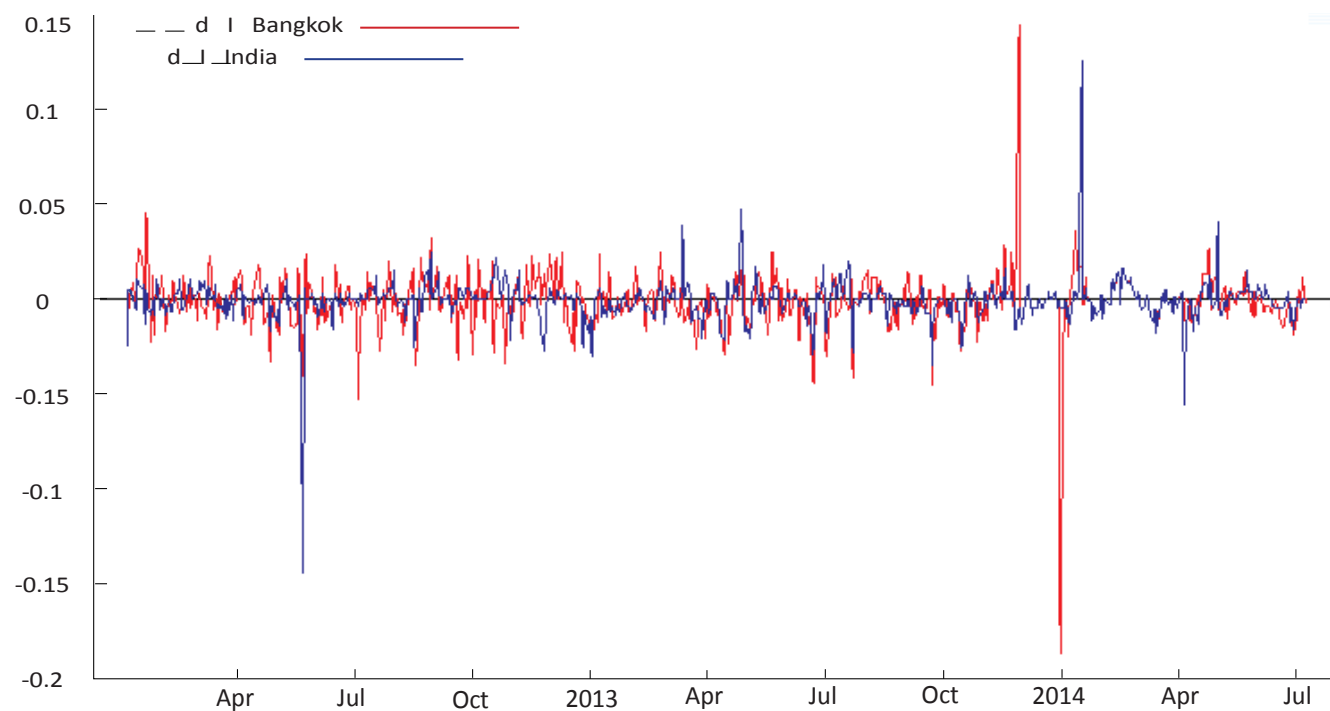
to both international and domestic market prices of Natural Rubber. It found to be non-stationary. To make it stationary, first difference is taken and the time series plot for the same is depicted in Figure 2. Now the variables are found to be

stationary.

Table 2 gives ADF test (Dickey and fuller, 1979) results of domestic and international price. The null hypothesis i.e. δ=0 (there is a unit root) is rejected by comparing asymptotic critical

Table 2: ADF test for stationary of domestic and international price

No. of lags	Indian price		Bangkok price	
	Level	Difference	Level	Difference
Lag one with trend	-2.35189	-15.5374	-3.05135	-15.7818
Lag one without trend	-1.04827	-15.5491	-0.85404	-15.7905
Lag four with trend	-2.35189	-10.9821	-3.05135	-10.9885
Lag four without trend	-1.04827	-10.9902	-0.85404	-10.9952

values i.e., Mackinnon critical values for lag 4 and 1 without trend @ 1%, 5%, 10% are -3.35, -3.14, -2.57 and for same lags with trend are -3.98,-3.43, and -3.13. The ADF test values were more than asymptotic critical values suggest that were stationary after differencing once. It reveals that price series were not stationary in the level form but attains stationary after differencing once or integrated of order I (1).

After unit root test is done and all variables indicate that I (1), the next step is to test co integration between two variables

utilizing Engle-Granger Co-integration test (Engle and Granger, 1989). The result of the Co-integration test is depicted in Table 3.

The estimated values of the co-integrating coefficients first difference of Bangkok, one lag of differenced Indian price series were 0.224980, 0.168649 respectively show high degree of association between two market prices. ADF test is helpful to identify co-movement of the price series. It indicates that both the series are co-integrated, but it do not provide any evidence for the extent of integration in terms of short-run and long- run correction for equilibrium price. For this purpose error correction model is necessary.

Table 3: Results of co-integrating regression

Independent variables	Dependent variable: d_l_India
constant	−0.000332221
d_l_Bangkok	0.224980
d_l_India_1	0.168649
Adjusted R-squared	0.127837
Durbin's h	−0.308846
Akaike criterion	−4184.729
Hannan-Quinn	−4179.509
ADF of residuals	-15.669

For getting co-integration between two markets prices, it is necessary that at least one of ECM co-efficient is should be negative and significant. It is evident from the Table 4 that the two series are strongly co-integrated and at least one way of

Table 4: Error correction model (ECM) estimates

Dependent variable	Error correction estimates			
	Constant	EC1	*p*-value	Adjusted R squared
d_l_India	1.14267e-05	−0.416694	1.33e-025***	0.152422
d_l_Bangkok	2.69059e-05	0.584279	2.44e-027***	0.162599

***p<0.001

co-integration is present. So to know the way of co-integration, we have to test for Granger Causality test.

The Granger test result indicates that there is causality in at least one direction (Table 5). The null hypothesis is rejected i.e. Bangkok price does not cause the price in Indian market

Table 5: Granger causality test result

Null hypothesis	F-Statistic	*p*-value
India does not granger cause Bangkok	0.72677	0.4839
Bangkok does not granger cause India	3.24028	0.0399*

* p<0.05

as the *p*-value is 0.0399 which is less than level of significance at 5%. Overall, there is sufficient evidence to conclude that Indian rubber market is integrated with the Bangkok market in the long-run. It can be concluded that Bangkok rubber market price causes market price of India. So it can be inferred that the recent fall in price was caused by the fall in international price of Natural Rubber.

4. Conclusion

The current price and lagged price in both markets are considered as variables that explains the market integration. Based on the co-integration analysis, it is evident that both domestic and international rubber prices are co-integrated. The Granger Causality showed that there is causality in at least one direction that the Bangkok price causes the price in Indian market. The recent fall in domestic price of Natural Rubber

was due to a fall in the international price.

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