An Analytical Study for Market Integration Hypothesis for Natural Rubber Cultivation of Kerala

Abstract:

The purpose of this article is to analyse the market integration and causal nexus between two market prices of rubber in Kerala Economy during the period of pre and post reform. Augmented Dickey Fuller (ADF) test is used ascertains that the variables are exact order of integration. Cointegration technique used to examine the validity of the market integration hypothesis with reference to prices of rubber in Kerala. After cointegration test, Error Correction Model (ECM) used to identify the that market prices of peripheral price on main market price and vice versa. The analysis shows that a strong evidence of an existence of market integration in Rubber price during the post reform period. More over, the price changes of rubber will be transmitted from peripheral to main market and vice versa during the reform period.

Introduction

As market integration is reckoned as a long-run process, this means spatial prices can impermanent aberrant from each other in the short-run and still be coherent with the idea of an integrated market in the long run.

The innovation of spatial arbitrage is to visualize traders buying in low priced market, channeling the item to a high priced market, and reselling the purchased good in different localities. These tend towards equality and move together with one another in integrated markets.

Markets that are not integrated may convey wide of the mark picture about price information that might twist production decisions and contribute to inefficiencies in markets, trauma the crowning consumer and head to low production and torpid growth, specifically in rural economy that is the anchor of the most of the developing countries including India.

In theory, spatial price determination models suggest that, if two markets are linked by trade in a free market regime, excess demand or supply shocks in one market will have an equal impact on price in both markets. Apart from this, domestic markets can also be partially insulated by large marketing margins that arise due to high transfer costs. Especially in developing countries, poor infrastructure, transport and communication services cause large marketing margins due to high costs of delivering the locally produced commodity to the border for export or the imported commodity to the domestic market for consumption. High transfer costs and marketing margins hinder the transmission of price signals, as they may prohibit arbitrage (Sexton, Kling and Carman, 1991; Badiane and Shively, 1998). As a consequence, changes in world market prices are not fully transmitted to domestic prices, resulting in economic agents adjusting (if at all) partly to shifts in world supply and demand.

Non-competitive behaviour such as that considered in pricing-to-market models (Dornbush, 1987; Froot and Klempeter, 1989; Krugman, 1986) can hinder market integration. Pricing-to-market models postulate that firms may absorb part of exchange rate movements by altering export prices measured in home currency to retain their market share.

Most of the studies use time series econometric analysis techniques that test for the co-movement of prices. The development of these techniques, which include cointegration and error correction models, has become the standard tool for analysing spatial market relationships, replacing earlier empirical tools, such as the bivariate correlation coefficient and regressions. Nevertheless, time series analysis has also being criticized as unreliable (Blauch, 1997; Barrett and Li, 2002) with recent research focusing on switching regime models that incorporate data on prices, volumes traded and transactions costs. The debate on the application methodology for testing for market integration and price transmission has a relatively long history starting with Harriss (1979). Blauch (1997) provides a review of the debate and examines the statistical performance of econometric tests for market integration.

During the four-year period from 2001-02 to 2004-05, production of Natural Rubber(NR) in the country increased at the average annual rate of 4.5 percent as compared to 3.5

percent during the previous four-year period. The increase in production was contributed by expansion in tapped area and improvement in the average productivity.

The average productivity of NR in the country after a period of stagnation, staged progressive improvements since 2002-03 to reach 1705 kg/ha during 2004-05. Given the fact that high yielding varieties covered almost the entire tappable area by the mid-nineties itself, the increase registered in productivity during the period since 2001-02 was not due to adoption of high yielding varieties, but due to short -term improvement in yield as a result of better agro-management practices adopted by the dominant smallholders. During 2005-06, it is expected that the average productivity would improve further to 1745 kg/ha.

The Indian NR, which was unknown in the overseas market until 2001-02, managed to find a niche in the highly competitive global NR market. Export of natural rubber from India rose from the low level of 6995 tonnes in 2001-02 to 55311 tonnes during 2002-03 and 75905 tonnes during 2003-04. Though India's relative share in the total world merchandise exports remain at 0.8 percent, the country's share in NR exports during 2003-04 was 1.3 per cent.

Let us go through earlier literature concerning the study area that will be immensely helpful in identifying the interruption of the study.

Mushtaq and Khalid (2006) discuss the implication of market integration in Pakistan. It is stated that the market integration reduces the cost of stabilization. The price integration is conducted to identify sets of markets that lead other markets such as agricultural market in the price transmission process. It provides better implication on best supply and consumption improves supply in the market on reliable prices and removes transaction cost.

Terrel etal (2006) analyses cointegrating relations between six East and Southeast Asian markets relative to a base cluster of three global markets are investigated in the framework of zero-non-zero (ZNZ) patterned vector error-correction modelling (VECM). The analysis focuses on market relations both before and after the Asian currency crisis. The strength of integration among markets is also evaluated by extending Geweke's measurement approach within this framework. The results show that, since the crisis, estimated integration strengths have become more powerful between the Asian and global markets, with the US market leading both the Asian *markets* and the markets *of* Japan and the UK.

Gupta and Mueller (1982) a technique is suggested for analyzing the price relationships between regional markets which avoid the ambiguity of the correlation coefficient. The method is based on Fama's concept of pricing efficiency and consists of tests included under the heading Granger Causality. The method is applied to price series from three regional markets for slaughter hogs in West Germany. The paper ends with an evaluation of the suggested method.

In this paper argue that, although there is some merit in the above criticisms, especially as far as non stationary transfer costs are concerned, time series analysis can provide useful insights into the issue of market integration and price transmission if an appropriate testing framework is employed and the results are interpreted correctly. Cointegration and error correction models provide an analytical tool that can focus beyond the case of market integration or complete price transmission, in testing notions such as completeness, speed, and asymmetry of the relationship between prices

Methodology

The methodology used in this study can be sketched as follow: Granger causality tests require that the time series be stationary. Otherwise, The F-statistics from the tests will follow nonstandard distributions, and the empirical results will be misleading (Sims et al., 1990). If the original series is non-stationary, they must be transformed into stationary series by differencing the series until they are stationary.

However, when two time series are cointegrated, there is a long-run equilibrium between the two series. Hence, in the presence of cointegration, the simple Granger causality tests can become inappropriate and should be modified, since only short-run effects will be captured when all the series are in first difference. Thus, standard Granger causality tests, augmented with error-correction terms (derived from the long-run cointegrating relationships), are used to examine the long-run effects. Such tests are carried out on I(0) time series to guarantee that inferences made from the tests are valid. (Engle and Granger, 1987).

Spatial equilibrium investigation has a long history back to Samuelson (1952). Many authors began to use time-series techniques to correlate prices in spatially separated markets in the late 1980s and early 1990s (deVany and Walls, 1993; Sauer. 1994: Asche et al. 2001). Cointegration trialing has become a usual way of probing the law of one price, and will be used together with an analysis of short-run price adjustments. The present paper's contribution is to apply these techniques to two markets of Kerala mainly Cochin and Kottayam, traded rubber.

Although contemporary economics rests fundamentally on the concept of markets, the discipline struggles with the important and practicable challenges of clearly defining a market empirically and of establishing whether markets are efficient in allocating scarce goods and services (Barrett, 2001). Much of the problem revolves around the concept of ‘market integration’ one employs and the empirical evidence thereby needed to demonstrate that condition. In macroeconomics and international economics, a common conceptualization of market integration focuses on ‘tradability’, the notion that a good is traded between two economies or that market intermediaries are indifferent between exporting from one nation to another and not doing so. Tradability signals the transfer of excess demand from one market to another, as captured in actual or potential physical flows.

Most of the studies utilize time series econometric analysis techniques that test for the co-movement of prices. The development of these techniques, which include cointegration and error correction models, has become the standard tool for analysing spatial market relationships, replacing earlier empirical tools, such as the bivariate correlation coefficient and regressions. Nevertheless, time series analysis has also being criticized as unreliable (Blauch, 1997; Barrett and Li, 2002) with recent research focussing on switching regime models that incorporate data on prices, volumes traded and transactions costs. The debate on the application methodology for testing for market integration and price transmission has a relatively long history starting with Harriss (1979).

Co integration technique is employed to examine validity of market integration hypothesis with special reference to prices of Rubber in Kerala economy. Mathematically for Xt and Yt if there exists a constant 'A'is such that Xt-Ayt is I(0), then the two series are cointegrated with 'A' as cointegrating parameter. Xt = Yt is the long run equilibrium relation and sometimes termed as an attractor (Granger 1983) and any deviation from this measures the degree to which the series are out of equilibrium.

Before any test of co integration, it is necessary in the first place to ascertain since cointegration between two variables arises only when there are of same order. Hence, the test for unit root becomes obvious. The Dickey –Fuller test (1979, 1981) is generally used which requires the estimation of the following equation:

$$DX_t = a_0 + b_1X_{t-1} + b_2T + e_t \qquad \text{.....................} (1)$$

Where D = change, and T = trend. The null hypothesis that X_t is I (0) is rejected in favour of the alternative hypothesis that X_t is I (1), provided b is negative and statistically significant. For testing purpose, t- statistic is taken as test ' statistic' through under the null hypothesis it does not follow the t- distribution.

If cointegration is ascertained, there is one (or several) stationary linear combination of non-stationary time series. In this sense one can call it an empirical equilibrium, where economic variables may drift apart in the short-run, but in the long run certain factors will bring them together again (Granger, 1986). Stock (1987) indicated that for cointegrated systems the use of OLS extends to consistent estimators, which converge even more rapidly than in the classical regression model (super consistency). The common t- and F-tests for these estimators cannot be applied because asymptotically there exists no normal distribution for them. To investigate this we have to follow Engle and Granger (1987) and estimate a co integrating regression of the form.

$$InCP_t = \gamma_0 + \gamma_1 \text{In} (KPt_t) + U_t \qquad \text{--------------} \quad (2)$$

$$InCP_t = \gamma_0 + \gamma_3 \text{In} (KP_t) + U_t \qquad \text{---------------} \quad (3)$$

where CPt and KPt represents the rubber price in Cochin and Kottayam Market respectively.

Error Correction Model

After confirming the cointegration between Xt and Yt, one should search for proper error correction model, using the definition of co integration; the 'Granger representation theorem' (Granger 1983) states that if sets of variables are co integrated, there exists a valid error correction representation of the data. It captures the short run dynamic adjustment of variables (Granger 198&0. Hence the following adjustment of error correction regression equation can be estimated.

DXt = a0 + p1Et-1 + Lag (Dxt, Dyt) = U1t ……………… (4)

Dyt = b0 + P2Et-1 + Lag (Dxt, Dyt) = U2t ………………(5)

Where, D = Change, Et-1 = the lagged error obtained from cointegration regression equation, U1t, U2T = finite order moving averages, and P1 P2 = 0. The error correction model explains two possible sources of causation of Xt by Yt in equation (4) either through lag Yt or through Et-1 term. It is also claimed that the temporal causality can be traced through error correction term. (Miller and Ruzzek 1990).

In this paper, as far as non-stationary transfer costs are concerned, time series analysis can provide useful insights into the issue of market integration and price transmission if an appropriate testing framework is employed and the results are interpreted correctly. Market integration is formally testable, if one adheres to the definition implied by the standard spatial equilibrium model. However, the *extent* of price transmission is an inherently ambiguous concept. Cointegration and error correction models provide an analytical tool that can focus beyond the case of market integration or complete price transmission, in testing notions such as completeness, speed, and asymmetry of the relationship between prices.

Empirical Results and Conclusion

Dickey Fuller test, cointegration technique and error correction model were employed to examine the objective of the present study. Kottayam as a main market and Cochin as the peripheral market were considered for the analysis.

We can first test for the order of integration. Number of tests, the Augmented Dickey Fuller (ADF) test (Dickey and Fuller, 1979) and the Zt and Zr tests by Phillips (1987) and Phillips and Perron (1988) are used to test for the order of integration. The ADF is the most commonly used test, but sometimes it behaves poorly, especially in the presence of serial correlation. Dickey and Fuller correct for serial correlation by including lagged differenced terms in the regression, however, the size and power of the ADF has been found to be sensitive to the number of these terms. The Phillips and Perron tests are non parametric tests of the null of the unit root and are considered more powerful, as they use consistent estimators of the variance.

Table 1. Unit root tests for rubber market prices

	Levels		
	with drift	with drift and trend	
Indicator Price			
ADF test	-2.145	-2.335	
Phillips Perron test Zt	-2.034	-1.8375	
Phillips Perron test Zr	-2.486	-2.362	

	with drift		with drift and trend	
Critical values	5 percent	10 percent	5 percent	10 percent
ADF and Phillips Perron Zt	-2.88	-2.57	-3.43	-3.13
Phillips Perron test Zr	-13.7	-11.0	-20.7	-17.5

Table 1 presents the unit root test statistics. The ADF test is performed by including up to 12 lagged terms of the differenced terms in the regression and we use the Akaike Information Criterion (AIC) to choose the appropriate lag length by trading off parsimony against reduction in the sum of squares. The ADF test statistics presented in

Table 1 correspond to the regression that has maximized the AIC. On the basis of both the ADF and Phillips and Perron tests, both with and without a deterministic trend, we can conclude that there is insufficient evidence to reject the null hypothesis of non stationarity for all price series. When applied to the differenced series, both tests reject the null, signaling that all price series are I (1).

Table 2. Market integration tests for the rubber market in Kerala

Johansen test for cointegration				
No. of cointegrating vectors				
Null	Alternative	Rank test	Critical values	
			5 percent	10 percent
0	1	22.312	14.880	12.980
1	2	2.183	8.070	6.500
Cointegrating vector				
	Parameter	Standard Error		
CPt	1.00	0.00		
KPt	-0.75	0.07		
ranger Causality				
No. of lagged DKPt terms	F-Test	Probability value		
0	8.73	0.00		
1	4.82	0.01		
2	5.43	0.00		
3	3.68	0.01		
4	3.34	0.01		
5	3.29	0.00		
6	2.76	0.01		
7	3.38	0.00		
8	3.43	0.00		
9	2.87	0.00		
10	3.87	0.00		
11	3.11	0.00		

12	2.76	0.00			
Error Correction Models					
	Symmetric		Asymmetric		
	Parameter	t ratio		Parameter	t ratio
intercept	0.00	-0.30	intercept	-0.06	-0.46
ECM(-1)	-0.28	-3.54	ECM(-1)+	-0.35	-2.76
DKPt	0.78	5.62	**DKPt**	0.67	4.84
DCPt (-1) CPt	0.02	0.37	**DCPt(-1)**	0.00	0.08
DKPt (-1) KPt	-0.02	-0.05	**DKPt (-1)**	-0.78	-1.00
DCPt (-2) CPt	0.20	2.15	**DCPt(-2)**	0.24	2.86
DKPt (-2) KPt	-0.41	-2.86	**DKPt (-2)**	-0.46	-2.75
DCPt (-3) CPt	-0.17	-1.76	**DCPt(-3)**	-0.07	-0.67
DKPt (-3) KPt	0.24	1.57	**DKPt (-3)**	0.43	2.79
			ECM(-1)-	-0.35	-1.89
			D KPt	0.73	3.36
			DCPt(-1)	0.13	0.64
			D KPt (-1)	0.35	0.75
			DCPt(-2)	0.24	1.24
			DKPt(-2)	-0.67	-2.78
			DCPt(-3)	-0.35	-2.46
			D KPt (-3)	-0.17	-0.35
Test for long run Granger Causality*			Tests for symmetry versus asymmetry		
	Parameter	t ratio	F-value	Prob.	
ECM(-1)	0.067	0.78	1.789	0.165	
			Wald test		
			0.089	0.689	

KPt and CPt are the rubber price of Kottayam and rubber price in Cochin respectively.

- ECM with KCPt as dependent variable.

The results for market integrations are summarized in Table 2. There is strong evidence that the rubber price of Cochin and the rubber price of Kottayam are cointegrated, with the Johansen test rejecting the null of no cointegration, but failing to reject the null of one cointegrating vector. Cointegration suggests that rubber price in Kerala are integrated to the market process and that there is Granger Causality in at least one direction. The Granger causality tests indicate that the Rubber price of Cochin Granger-causes the price of Kottayam. The estimated ECM suggests that the adjustment process is relatively fast with about 28percent of divergence from the notional long run equilibrium being corrected each month. The short run dynamics indicate that changes in the rubber price of Cochin are transmitted to the rubber price of Kottayam contemporaneously, although not fully. This indicates that the markets are well integrated in the short run, with changes in the international prices being partly transmitted to the domestic market. Moreover, the parameter on DWPt is estimated to be 0.78 suggesting that international market shocks affect the Indian (Kerala) market. However, lagged differenced terms are also estimated to be negative, reflecting somewhat complex short run dynamics. Tests for long run Granger causality indicate that the price of Cochin Granger causes the rubber price of Kottayam but not vice versa. Finally, asymmetric adjustments to the long run equilibrium appear to be unlikely, with the F-test failing to reject the null hypothesis of symmetry, suggesting that increases and decreases in the international price is passed-through in a similar and symmetric manner to the domestic market. Overall, there is sufficient evidence to conclude that the Cochin market is well integrated with the Kottayam market in the long run, while the price signals are also being transmitted in the short run.

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