International Journal of Agriculture Sciences
ISSN: 0975-3710 & E-ISSN: 0975-9107, Volume 11, Issue 10, 2019, pp.-8441-8445.
Available online at https://www.bioinfopublication.org/jouarchive.php?opt=&jouid=BPJ0000217

Research Article

PRICE DYNAMICS OF DOMESTIC AND INTERNATIONAL GROUNDNUT MARKETS: A VECTOR ERROR CORRECTION MECHANISM (VECM) APPROACH

KEERTHIGA A.A., GOPAL S.M.* AND PRIYANKA P.A.
Department of Agricultural Economics, Tamil Nadu Agricultural University, Coimbatore, 641003, Tamil Nadu, India
*Corresponding Author: Email - smuralgo@gmail.com

Received: May 05, 2019; Revised: May 24, 2019; Accepted: May 26, 2019; Published: May 30, 2019

Abstract: Market integration in agricultural commodities is important for both developed and developing countries. If prices are not perfectly transmitted, then it may lead to mismatch and distortions in production and distribution. A sample of six domestic groundnut markets from the traditional groundnut growing states of Karnataka, Rajasthan, Andhra Pradesh, Maharashtra, Gujarat and Tamil Nadu were selected along with one major international groundnut market, namely Rotterdam market, Netherland. Analysis was carried out using the monthly price data between January 2000 and December 2018. Findings revealed that the prices became stationary only upon first differencing. The estimated error coefficients revealed that in Bijapur and Rotterdam markets disequilibrium got corrected within a month by changes in its own prices with speed of convergence at 20 and 76 per cent in the long-run path. But for other markets the speed of convergence ranged from 9 per cent to 69 per cent for short-run price movements to become stable along long-run equilibrium path in one or two-month lagged period.

Keywords: *Stationarity, Market Integration, Co-Integration, Short-Run Disequilibrium*

Citation: Keerthiga A.A., *et al*., (2019) Price Dynamics of Domestic and International Groundnut Markets: A Vector Error Correction Mechanism (VECM) Approach. International Journal of Agriculture Sciences, ISSN: 0975-3710 & E-ISSN: 0975-9107, Volume 11, Issue 10, pp.- 8441-8445.

Copyright: Copyright©2019 Keerthiga A.A., *et al*., This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution and reproduction in any medium, provided the original author and source are credited.

Introduction

Groundnut (*Arachis hypogaea* L.) is an important oilseed and supplementary food crop of the world. In India, it is the fourth most important source of edible oil and third most important source of vegetable protein. Globally, the crop is raised on 26.4 million hectares (M ha) with a total production of 37.1 Million Metric Tonnes (MMT). It is grown in more than 100 countries in the world. Both export and import trade in groundnut is highly concentrated. India ranks first in groundnut acreage with annual all-season coverage of about 7 M ha and second in production with an output of 8.5 MMT. Presently, India along with China accounts for half of the world's groundnut production. As per FAO statistics, India, till 1991 was the largest producer of groundnuts in the world, but by 2011 China overtook India and now holds the first position. India contributes around 19 percent of world production but the yield level is less than the world average yield. The average productivity is 1400 kg/ha. The groundnut exports from India have been continuously decreasing. The quantity of groundnut exported from India has decreased by 38.8 percent from 7.26 MMT in 2016-17 to 5.04 MMT in 2017-18. Consequently, the value of groundnut exports has decreased from Rs.5444.33crore in 2016-17 to Rs.3386.29 crore in 2017-2018. India appears to be one of the largest exporters in the world and competes closely with Argentina, USA and China by commanding a share of 20-25% in global markets. The extent of agricultural market integration is relevant to policy makers. A weak degree of integration indicates that, despite the institutional efforts to achieve a unified market, prices are not perfectly transmitted, and therefore, misallocation of resources and distortions of production and distribution might occur [1]. The greater the degree of integration, the more efficient would be the interacting markets. Evaluation of market integration has usually been undertaken by analyzing price interactions [2]. As markets become more integrated, it is expected that every market employs information from the others when forming its own price expectations. Geographically separated markets are integrated if information and goods flow freely among them and, as a result, prices are linked. When inter-market margins are larger than transfer costs then profitability opportunities are not being exploited and markets are not efficiently connected. In integrated markets, price changes in one region are transmitted to the other regions. The extent and the speed to which changes are passed through, and the strength of the interdependence among markets are indicators of the degree of integration and global efficiency of markets performance. The present study focuses on market integration in different markets of groundnut across India. In recent years several studies relating to market integration have been done with the help of different statistical tools. The usual definition in the literature is that integrated markets are those where prices are determined interdependently. Spatial market integration refers to a situation in which prices of a commodity in spatially separated markets move together and price signals and information are transmitted smoothly across the markets [3]. Previously, the measurement of pricing efficiency in agricultural commodity markets was done through pair-wise comparison or bivariate correlation of price series data. However, it is not a convenient indicator of market integration and found to have methodological flaws. These fail to recognize the possibility of spurious integration in the process of common exogenous trend (e.g., general inflation), common periodicity (e.g., agricultural seasonality) or auto correlated and heteroscedastic residuals in the regression with non-stationarity price data [4].

Materials and Methods

Generally, large variation was observed in the prices of groundnut while we consider both domestic and international markets for the study. In the case of domestic markets, six markets *viz*., Bikaner, Kurnool, Mumbai, Rajkot and Villupuram from the traditional groundnut growing states of Karnataka, Rajasthan, Andhra Pradesh, Maharashtra, Gujarat and Tamil Nadu respectively were selected for the present study on the basis of volume of transactions, experts' opinion and availability of data.

The Rotterdam groundnut market of Netherland is also included to study the impact of international prices. The domestic market prices of groundnut were collected from the portal of Agmarknet. The price series for the international markets were obtained from various issues of USDA reports. Time-series data of monthly duration covering the period between January 2000 and December 2018 were obtained. The price series were deflated to form real price trends. The US$ deflator was used to deflate the international groundnut market prices. Then the prices were converted into domestic currency using official foreign exchange rates. The econometric analysis was carried out using the E-Views 7.0 software package.

Establishing Stationarity

Before analyzing any time series data testing for stationarity is necessary [5] since the data has the presence of trend components. If the series was found to be non-stationary, then the first differences of the series were to be tested for stationarity. The number of times (d) a series was differenced to make it stationary is referred as the order of integration, I (d). The Augmented Dickey Fuller (ADF) test was applied by running the regression of the following formula:

$$\Delta Y_t = B\beta_1 + \delta Y_{t-1} + \alpha \sum \Delta Y_{t-1} + e_t$$

Where, Y_i denoted price series of domestic and international markets andi= 1, 2...7 (1-Bijapur, 2-Bikaner, 3-Kurnool, 4-Mumbai, 5-Rajkot, 6-Villupuram and 7-Rotterdam. If the co-efficient d was not statistically different from zero, it implied that the series have unit roots, and therefore, the series was non-stationary. Once the variables were checked for stationarity and were of same order, integration between them could be tested using Johansen maximum likelihood test.

Johansen's multiple co-integration frameworks

It is possible that individual time series of the commodity prices may be non-stationary in levels, but a linear combination of them may be stationary indicating a long run equilibrium relationship between them [6]. If a linear combination of two non-stationary series is stationary, then the two series are considered to be co-integrated. Co-integrated prices do not drift apart in the long-run and tend to move towards a shared equilibrium path [7]. To test whether or not the residual run of the regression between the two time series is stationary, co-integration tests start with the premise that for a long-run equilibrium relationship to exist between two variables it is necessary that they should have the same inter temporal characteristics. The ADF test was supplemented by Johansen-Juselius Maximum Likelihood Method. This test addresses the issues of endogeneity and simultaneity problems in the data series. By this technique, the hypothesis of presence of co-integration vector was formulated on a group of non-stationary series, as the hypothesis of reduced rank of the long-run impact matrix. Likelihood ratio and maximum likelihood tests were applied to derive test statistics for the hypothesis of given number of co-integration vectors and their weights. Inference concerning linear restrictions on the co-integration vectors and their weights was performed using usual chi square methods [8]. Only variables of the same order of integration qualify for the pair wise co-integrating relationships. The specific linear combinations tested are the residuals from a static co-integrating regression such as:

$$Y_{ti} = \beta_i + \beta_i X_{ti} + Z_{ti}$$

Where Y_{ti} and X_{ti} are (i=1,2,.,7) price series in levels and is Z_{ti} the residual term. Testing for co-integration implies testing stationarity of the residual term Z_{ti}. In the current study, the dependent variable Y_{ti} are (i=1,2,.,7)prices of different groundnut markets (i=1,2,.,7)and the independent variables are X_{ti} (i= 1,2,.,6) prices of other six groundnut markets.

Vector error correction mechanism (VECM)

It may take some time for the spatial price adjustments. Thereby, the last step in co-integration analysis involved application of VECM. This approach focuses on the strength of interrelationships and the speed and magnitude of reactions in one price after a price in the system is shocked [9]. The residuals obtained from the linear equation were introduced as explanatory variable into the system of variables in levels. Thus the error correction run would capture the adjustment towards long-run equilibrium. Advantage of error correction methodology is that it incorporates variables both in their levels and first differences. This would in-turn result in stronger integration accompanied by greater interdependence among prices in the short-run, such that every price would contribute to explain the evolution of the others. A generalized VECM formulation to understand both the short run and long run behaviour of prices can be considered by first taking the autoregressive distributed lag (ADL) equation as follows:

$$Y_t = a_{01}X_t + a_{11}X_{t-1} + a_{12}Y_{t-1} + \varepsilon_t$$

By adding and deleting, Y_{t-1}, $a_{01}X_{t-1}$ rearranging terms, and using the difference equator, the above equation can be written in the ECM format as follows:

$$\Delta Y_t = a_{01}\Delta X_t + (1-a_{12})\left[\frac{(a_{01}+a_{11})}{(1-a_{12})}X_{t-1} - Y_{t-1}\right] + \varepsilon_t$$

The generalized form of this equation for k lags and an intercept term is as follows:

$$\Delta Y_t = a_{00} + \sum_{i=0}^{k-1} a_{i1}\Delta X_t + \sum_{i=1}^{k-1} a_{i2}\Delta Y_{t-1} + m_0\left[m_1 X_{t-1} - Y_{t-1}\right] + \varepsilon_t$$

Where, $m_0 = \left(1 - \sum_{i=1}^{k} a_{i2}\right)$ and $m_1 = \frac{\sum_{i=0}^{k} a_{i1}}{m_0}$

If all the variables are I (1), i.e., they are integrated of order 1, they are stationary in first difference. Therefore, all the summations in the above equations are also stationary. Moreover, if the variables are co-integrated, the ECM term, *i.e*., the linear combination of variables represented in parentheses is also stationary. The a_{ij} coefficients capture the short run effects and m_j coefficients represent the stationary long run impacts of the right hand side variables. The parameter measures m_0 the rate of adjustment of the short run deviations towards the long run equilibrium. Theoretically, this parameter lies between 0 and 1. The value 0 denotes no adjustment and 1 indicates an instantaneous adjustment. A value between 0 and 1 indicates that any deviations will have gradual adjustment to the long run equilibrium values. So the Vector Error Correction Mechanism is used to distinguish short term from long term association of the variables included in the model. When the variables are not integrated, then in the short term deviation from this long term equilibrium would feed back to the changes in the dependent variable in order to force the movement according to the long run equilibrium relationship. The long term causal relationship among the groundnut auction markets is implied through the significance of the 't' test of the lagged error correction term as it contains the long term information because it is derived from the long term relationship. The coefficient of the lagged error correction term is a short term adjustment coefficient and represented the proportion by which the groundnut auction markets market adjusted in response to the long run disequilibrium. Before computing the error correction mechanism, the order of lag for the variables to be included in the models is to be ascertained. The orders of lag for the variables are chosen by the smallest Akaike Information Criterion (AIC)/ Schwartz Bayesian Criterion (SBC) of the groundnut auction markets price series. In the present study, all the variables are found to have minimum AIC/ SBC values at the first lag. Hence throughout the analyses, first lag of the variables are included wherever necessary. In the present study, all the variables were found to have minimum AIC/ SBC values at their first lag.

Results and Discussion

The null hypothesis of non-stationarity was tested based on the critical values [10]. The estimated test statistics from the ADF test for the groundnut market prices in levels and first-difference were reported in Table 1. All the price series were transformed to natural logarithm. The lag length was selected using the Akaike Information Criterion (AIC). It can be seen that the null hypothesis of non-stationarity cannot be rejected for the prices in levels but can be rejected in first-differences. Therefore, the prices were found to be non-stationary in their levels but stationary in first- differences. This implied that the price series of all the markets were stationary at their first differences. Hence, the value of d was taken as 1 *i.e.* I (1) for all the markets.

Table-1 *Results of unit root test for groundnut prices at different markets*

Groundnut Market	Augmented Dickey –Fuller(ADF)		
	Level	1st difference	Critical Value
BIJ	-0.021766 (0.1194)	-1.014645*(0.0000)	-3.507394(0.01 level) -2.895109(0.05 level)
BKR	-0.029821 (0.0713)	-1.265114*(0.0000)	
KNL	-0.021041 (0.1243)	-1.061867*(0.0000)	
MI	-0.034600* (0.0423)	-1.050995*(0.0000)	
RJK	-0.019511 (0.0928)	-0.837016*(0.0000)	
VM	-0.052170 (0.1168)	-1.739006*(0.0000)	
RTD	-0.020729 (0.1139)	-1.772065*(0.0000)	

Note: *Significant at 1 % level, Values in parenthesis indicate MacKinnon (1996) p-values

BIJ- Bijapur, BKR- Bikaner, KNL- Kurnool, MI- Mumbai, RJK- Rajkot,VM- Villupuram, RTD- Rotterdam

Having confirmed that the price series were stationary in their first differences, co-integration between the markets was tested using Johansen-Juselius maximum likelihood procedure for the presence of short run and long run relationship between the domestic and international groundnut markets. The procedure consisted of two tests *viz.* trace statistic and maximum Eigen-value statistic and the results of which are shown in Table 2 and 3, respectively. As it could be seen from the Table 5.17, the trace test procedure indicated that the domestic groundnut markets of Bijapur, Bikaner, Kurnool, Mumbai and Rajkot markets were integrated with other markets each with five co-integrating equations. At the same time, co-integration between the markets was also confirmed with Maximum-Eigen value test. It was found that Bijapur, Bikaner, Kurnool, Mumbai and Rajkot markets were integrated with other markets each with five co-integrating equations (Table 3). The existence of co-integration between markets confirms that there was a long run relationship between markets.

Table-2 *Unrestricted co-integration rank test (trace) between groundnut markets*

Groundnut Markets	Eigen value	Trace statistic	Critical value	Prob.**	Hypothesized No. of CE(s)
BIJ	0.230109	217.1003	125.6154	0.0000	None *
BKR	0.193112	158.2612	95.75366	0.0000	At most 1 *
KNL	0.177137	109.9830	69.81889	0.0000	At most 2 *
MI	0.119319	66.11573	47.85613	0.0004	At most 3 *
RJK	0.095380	37.52724	29.79707	0.0053	At most 4*
VM	0.051514	14.97317	15.49471	0.0598	At most 5
RTD	0.013566	3.073263	3.841466	0.0796	At most 6

Note: * Significant at 1 % level.

Table-3 *Unrestricted co-integration rank test (Maximum Eigen-value) between groundnut markets*

Groundnut Markets	Eigen value	Max-Eigen Statistic	Critical value	Prob.**	Hypothesized No. of CE(s)
BIJ	0.230109	58.83902	46.23142	0.0014	None *
BKR	0.193112	48.27822	40.07757	0.0048	At most 1*
KNL	0.177137	43.86728	33.87687	0.0023	At most 2*
MI	0.119319	28.58849	27.58434	0.0371	At most 3 *
RJK	0.095380	22.55407	21.13162	0.0313	At most 4*
VM	0.051514	11.89990	14.26460	0.1145	At most 5
RTD	0.013566	3.073263	3.841466	0.0796	At most 6

Note: * Significant at 1 % level.

The last step in co-integration analysis involves the application of Vector Error-Correction Mechanism (VECM) for the domestic groundnut markets which have long-run association with the global markets. Accordingly, the VECM results were presented in [Table-4]. The findings revealed the existence of short-run disequilibrium. It was also found that how much the short-run disequilibrium in a given market got corrected by changes in its own prices and with changes in prices of other markets. The co-efficient of the error correction term indicated the speed of convergence to the long-run growth path as a result of shock in their own prices and shock in the prices of other domestic and international markets. But it is still to be seen whether such effects are uni-directional or bi-directional. As it could be seen from the Table 4, the estimated error term coefficients revealed that in the Bijapur and Rotterdam markets 20 and 76 percent of disequilibrium got corrected within a month by changes in its own prices and the remaining was influenced by other internal and external market forces. The coefficients of the error correction term also indicated the speed of convergence to the long run growth path as a result of shock in its own prices. In case of Bijapur market, about 12 and 38 percent of short run disequilibrium in Rajkot market and villupuram markets got corrected with one-month lag period. On the other hand, with relation to Bijapur market about 30 percent of short run disequilibrium in Mumbai market got corrected with two months lag period. For the Bikaner groundnut market, the short run disequilibrium in Bijapur, Mumbai and Rajkot markets had adjusted at one-month lag period was found to exist with the speed of convergence at 15, 37 and 13 percent respectively. In case of Bijapur and Bikaner markets, the coefficient of its own lagged price was found significant at two months lag period. The speed of convergence for the short run disequilibrium to get corrected was at marginal (15 and 30 percent) respectively. On the other hand, with relation to Kurnool market about 30 percent of short run disequilibrium in Bijapur, 15 percent in Kurnool and 52 percent got corrected in one-month lag period. Similarly, 49 percent short run disequilibrium in Mumbai market with respect to Kurnool market got adjusted in 2 months' time period. For the Mumbai market, it was also observed that 11 and 14 percent of short run disequilibrium in Bijapur and Mumbai markets got corrected with one-month lag in the Mumbai market respectively. Similarly, the short run disequilibrium in Rajkot, Rotterdam and Villupuram had adjusted at two-month lag period with the speed of convergence of 5, 67 and 14 percent respectively. In case of Rajkot market, the coefficient of its own lagged price was found significant at one month lag period. The speed of convergence for the short run disequilibrium to get corrected with relation to Mumbai market was about 68 percent and it got corrected in one-month lag period. For the Rotterdam market, Bikaner and Kurnool markets about 4 and 5 percent of short run disequilibrium in Adilabad market got corrected with two-month lag period. Findings also show that the price movements of Villupuram market were influenced by the price changes in other domestic markets. The effect of all the domestic markets except that of Bijapur and Bikaner markets were observed causing short run disequilibrium in the prices of Villupuram market. It was also observed that 12 percent of short run disequilibrium got corrected with one-month lag in the Villupuram market with relation to Kurnool and Rajkot markets each. On the other hand, with relation to Mumbai market about 9 percent of short run disequilibrium in Villupuram market got corrected with two-month lag period.

Conclusion

The findings provided empirical evidence about the efficiency of domestic and international groundnut markets. It was found that the prices of domestic and international groundnut markets were stationary only at their first differences. With the advent of globalization as the trade barriers and import tariffs were considerably removed, this has resulted in price changes in one market getting passed on to another distant market. Integration of markets is a good indicator of efficiency in the marketing system. In this study a higher degree of market integration in terms of price transmission has been observed among major groundnut markets. Co-integration tests were also applied to study such long-run relationships of price movements. Also, Bijapur, Bikaner, Kurnnol, Mumbai and Rajkot markets were found to be integrated with other markets with maximum five co-integrating equations. Moreover, VECM approach confirmed the existence of short-run disequilibria with the speed of convergence ranging between 9 percent and 69 percent for short-run price movements to become stable along the long-run equilibrium path. To summarize, it has been found that the prices in groundnut markets moved together and were well integrated with each other in state as well as country. However integration was stronger in case of closely situated markets as compared to that having long distances between them. International markets, specifically Rotterdam groundnut market did not directly influence the prices of domestic groundnut markets.

Application of research: Analyzing the integration between various groundnut markets helps to study long run relationships of price movements between the markets and it indicates the degree of efficiency in the marketing system.

Research Category: Agricultural marketing

Table-4 *Short-run disequilibrium of price movements in the domestic and international groundnut markets*

Error Correction:	D(BIJ)	D(BKN)	D(KNL)	D(MI)	D(RJK)	D(RTD)	D(VM)
CointEq1	-0.20376*	0.040133	0.044345	0.015631	0.198796*	-0.762233*	0.020666
	(0.05666)	(0.05554)	(0.05462)	(0.11247)	(0.04164)	(1.82637)	(0.08542)
	[-3.59641]	[0.72262]	[0.81187]	[0.13897]	[4.77466]	[-4.17349]	[0.24192]
D(BIJ(-1))	-0.04269	0.137303	0.085234	0.230998	-0.12471**	0.1677403	0.377385*
	(0.07677)	(0.07525)	(0.07401)	(0.15240)	(0.05642)	(2.47475)	(0.11575)
	[-0.55611]	[1.82452]	[1.15163]	[1.51569]	[-2.21046]	[0.67781]	[3.26030]
D(BIJ(-2))	-0.02513	-0.04999	-0.00394	0.301553**	-0.02798	0.2283682	-0.12807
	(0.07292)	(0.07148)	(0.07030)	(0.14476)	(0.05359)	(2.35059)	(0.10994)
	[-0.34464]	[-0.69931]	[-0.05610]	[2.08315]	[-0.52220]	[0.97153]	[-1.16489]
D(BKR(-1))	0.151183**	-0.13801**	0.021452	-0.37893*	0.134086**	0.4383865	0.151252
	(0.07338)	(0.07193)	(0.07074)	(0.14567)	(0.05392)	(2.36537)	(0.11064)
	[2.06038]	[-1.91867]	[0.30326]	[-2.60128]	[2.48660]	[1.85335]	[1.36712]
D(BKR(-2))	0.158976**	-0.29767*	-0.01908	-0.02003	0.047210	0.1756059	0.070726
	(0.07519)	(0.07370)	(0.07248)	(0.14926)	(0.05525)	(2.42370)	(0.11336)
	[2.11445]	[-4.03890]	[-0.26329]	[-0.13417]	[0.85443]	[0.72454]	[0.62389]
D(KNL(-1))	0.303255*	0.099050	-0.15367**	0.048016	0.075126	0.5253409**	0.196661
	(0.08174)	(0.08013)	(0.07880)	(0.16227)	(0.06007)	(2.63500)	(0.12325)
	[3.70998]	[1.23617]	[-1.95009]	[0.29590]	[1.25065]	[1.99371]	[1.59567]
D(KNL(-2))	0.135977	0.003225	-0.04725	-0.49376*	0.031724	0.3797070	0.062786
	(0.08322)	(0.08158)	(0.08023)	(0.16521)	(0.06116)	(2.68275)	(0.12548)
	[1.63392]	[0.03953]	[-0.58889]	[-2.98860]	[0.51872]	[1.41537]	[0.50037]
D(MI(-1))	-0.11716*	-0.00808	0.041958	-0.14914**	-0.00288	-0.14444	-0.05355
	(0.03442)	(0.03374)	(0.03318)	(0.06833)	(0.02529)	(1.10953)	(0.05190)
	[-3.40389]	[-0.23940]	[1.26446]	[-2.18267]	[-0.11384]	[-0.13018]	[-1.03186]
D(MI(-2))	0.041725	0.021272	-0.04183	-0.12345	-0.05564**	-0.669946*	-0.14727*
	(0.03507)	(0.03437)	(0.03381)	(0.06961)	(0.02577)	(1.13039)	(0.05287)
	[1.18989]	[0.61883]	[-1.23743]	[-1.77331]	[-2.15918]	[-5.92668]	[-2.78532]
D(RJK(-1))	0.047771	0.141195	0.071116	0.679682*	0.048527	-0.335553	0.080078
	(0.09330)	(0.09146)	(0.08995)	(0.18522)	(0.06857)	(3.00765)	(0.14068)
	[0.51201]	[1.54381]	[0.79063]	[3.66955]	[0.70775]	[-1.11567]	[0.56924]
D(RJK(-2))	0.157225	0.133996	0.018597	0.306907	-0.01826	-0.236906	0.124971
	(0.09130)	(0.08950)	(0.08802)	(0.18125)	(0.06710)	(2.94320)	(0.13766)
	[1.72205]	[1.49718]	[0.21128]	[1.69325]	[-0.27217]	[-0.80493]	[0.90781]
D(RTD(-1))	-0.00421**	-0.00356	-0.00365	-0.00331	-0.00066	0.051436	-0.00401
	(0.00202)	(0.00198)	(0.00194)	(0.00400)	(0.00148)	(0.06503)	(0.00304)
	[-2.08420]	[-1.80102]	[-1.87694]	[-0.82632]	[-0.44531]	[0.79095]	[-1.31744]
D(RTD(-2))	-0.00346	0.004350**	0.004962*	0.002442	-0.00066	0.028747	0.002019
	(0.00205)	(0.00201)	(0.00197)	(0.00406)	(0.00150)	(0.06599)	(0.00309)
	[-1.69214]	[2.16763]	[2.51418]	[0.60093]	[-0.43901]	[0.43561]	[0.65405]
D(VM(-1))	0.019906	0.088614	0.122875**	0.107421	0.123031*	-0.272842	-0.09329
	(0.05346)	(0.05241)	(0.05154)	(0.10614)	(0.03929)	(1.72343)	(0.08061)
	[0.37234]	[1.69087]	[2.38397]	[1.01212]	[3.13144]	[-1.58313]	[-1.15733]
D(VM(-2))	-0.03776	-0.05354	5.40E-06	0.171864	0.097658*	-0.73803	0.096023
	(0.04981)	(0.04883)	(0.04802)	(0.09889)	(0.03661)	(1.60572)	(0.07510)
	[-0.75801]	[-1.09643]	[0.00011]	[1.73799]	[2.66784]	[-0.45962]	[1.27853]
C	5.253709	6.37939	7.214453	1.473605	6.050531	19.51643	11.60917
	(15.8235)	(15.5112)	(15.2551)	(31.4132)	(11.6285)	(510.090)	(23.8584)
	[0.33202]	[0.41128]	[0.47292]	[0.04691]	[0.52032]	[0.03826]	[0.48659]

**indicates significance of 1 percent Level* * indicates significance of 5 percent Level; Supporting results have also been obtained [1,2,10,11].*

Abbreviations: VECM – Vector Error Correction Mechanism
ADF test - Augmented Dickey Fuller test
ADL - Autoregressive Distributed Lag
AIC - Akaike Information Criterion
SBC - Schwartz Bayesian Criterion

Acknowledgement / Funding: Authors are thankful to Tamil Nadu Agricultural University, Coimbatore, 641003, Tamil Nadu.

***Research Guide or Chairperson of research: Dr S. Murali Gopal**
University: Tamil Nadu Agricultural University, Coimbatore, 641003, Tamil Nadu
Research project name or number: MSc Thesis, An Economic Analysis of Indian Groundnut Economy-A Commodity Model Approach

Author Contributions: All authors equally contributed
Author statement: All authors read, reviewed, agreed and approved the final manuscript. Note-All authors agreed that- Written informed consent was obtained from all participants prior to publish / enrolment

Study area / Sample Collection: Bikaner, Kurnool, Mumbai, Rajkot and Villupuram from the traditional groundnut growing states of Karnataka, Rajasthan, Andhra Pradesh, Maharashtra, Gujarat and Tamil Nadu

Cultivar / Variety name: Groundnut (*Arachis hypogaea* L.)

Conflict of Interest: None declared
Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.
Ethical Committee Approval Number: Nil

References

[1] Gopal S. Murali, Govindarajan K., Shanmugam T.R. and Raveendran N. (2008) *Evaluating market and price integration among International Tea Markets, Productivity*, 49(2-3), 117-125.
[2] Jordan K.H. and Vansickle J.J. (1993) *Journal of Agricultural & Applied Economics*, 27, 127-137.
[3] Ghosh M. (2000) *Indian Journal of Agricultural Economics,* 55(4), 616-625.

[4] Palaskas T.B. and Harriss White B. (1993) *The Journal of Development Studies,* 1, 1-57.
[5] Davidson Russel and Mackinnon James (1993) *Working Paper, Queen's University, Kingston, Canada*.
[6] Engle R.F. and Granger C.W.J. (1987) *Econometrica*, 55(12), 251-276.
[7] Zanias G.P. (1993) *Journal of Agricultural Economics*, 44, 418-427.
[8] Johansen Soren and Juselius K. (1990) Oxford *Bulletin of Economics & Statistics*, 52(2), 169-210.
[9] Schroeder T.C. and Goodwin B.K. (1990) *Western Journal of Agricultural Economics*, 15, 111-122.
[10] Mackinnon J.G. (1991) *Readings in Co-integration, Oxford University Press, New York, U.S.A.*
[11] Selvi R., Pangayar Gopal, Murali S. and Swaminathan B. (2014) *International Research Journal of Agricultural Economics & Statistics*, 5 (2), 272-277.