MARKET INTEGRATION OF CHILLI MARKETS IN INDIA

*DR. T. BALAJI

Counselor, Career Counseling Cell, R. S. Vidyapeetha, Tirupati -517502, Andhra Pradesh

ABSTRACT

India is the largest chilli producer and contributes 25 per cent to the total world production. The Augmented Dickey Fuller based unit root test procedure is done to check as to whether the price series of chillies are stationary. After taking first difference, all the series become stationary which is obvious from the calculated values for all the markets which are less than the critical value (1%) and are free from the consequence of unit root. Johansens' Multiple Co- Integration Analysis indicated the presence of at least two integration equations at 5 per cent level of significance. Hence markets are having long run equilibrium relationship. International chilli (S_4, Guntur Sannam) prices in New York market influence the prices at Guntur and Khammam markets but not vice versa. It is very interesting to note that New York chilli market prices in turn are influenced by the prices of Virudhunagar and Nagpur markets. Thus a strong integration of different domestic chilli markets with the international market is confirmed through the results of the study. At domestic level prices in Khammam and Guntur markets exhibited a bidirectional influence .Similar is the case with Nagpur and Khammam markets. On the other hand Virudhunagar market prices influenced prices at Guntur, Khammam and Nagpur but not Vice Versa. Similarly Nagpur market was found to influence prices in Guntur market. Thus a strong co integration was found to exist between domestic and international markets and with in domestic markets. Guntur, Virudhunagar and Nagpur markets came to short run equilibrium as indicated by the level of significance and speed of adjustment is rapid. While Khammam, Virudhunagar and Nagpur markets are influenced by their own monthly lags for long run equilibrium. Guntur prices are influenced in turn by the lagged prices of Khammam and Nagpur markets. Similarly Khammam prices are influenced by the lagged prices of Guntur and Nagpur. Virudhunagar prices are influenced by lagged prices of Nagpur market. Inturn Nagpur prices are influenced by lagged prices of chillies in Guntur and Virudhunagar markets in the long run.

Key Words: *ADF test, Chilli, Integration, Granger causality test, Vector error correction model.*

INTRODUCTION

India is the largest chilli producer and contributes 25 per cent to the total world production. India is the only country rich in many varieties with different quality factors. While consumption of chilli is the highest in India, maximum export is also from this country. Chilli continued to be the major item of export in the world in terms of quantity. Chilli is the major spice contributing 40-42 per cent by volume and 20-22 per cent by value of total spices exported from India. The exports of Indian chillies have grown significantly in the recent years. Yet only 10-15 per cent of total domestic production is meant for exports with domestic consumption of more than 85-90 per cent. Currently, India is the main source of red chilli in the international market.

In India, chillies are grown in almost all the states across the length and breadth of the country. Andhra Pradesh is the largest producer of chilli in India- contributes about 3o per cent to the total area under chilli, followed by Karnataka, Maharastra, Orissa and Tamil Nadu.

In a market driven economy, the pricing mechanism is expected to transmit orders and directions to determine the flow of marketing activities. Pricing signals guide and regulate production, consumption and marketing decisions over time, form and place. Spatial market integration refers to co-movements or a long run relation of prices.

MATERIALS AND METHODS

Monthly modal price data from January, 1997 to 2011 March of chilli were used for the study. Market integration was examined by estimating price linkages among the selected markets. For each market ADF test was conducted to check the stationarity of the price series. Later on Johansen's co-integration test was conducted to find out the long run equilibrium among the markets, Vector Error Correction Model (VECM) to capture the speed of adjustment to deviations in long run equilibrium and Pair wise Granger Causality test to analyse the influence of price of each chilli market on all other chilli markets.

RESULTS AND DISCUSSION

The concept of market integration has important implications of economic welfare for both producer and consumer. Integration between major chilli markets such as Guntur, Khammam, Virudhunagar and Nagpur were studied with time series data collected from APMC markets using different tests.

Augmented Dickey–Fuller Test (ADF) is a test for a unit root in a time series sample.

The Augmented Dickey Fuller based unit root test procedure is done to check as to whether the price series of chillies are stationary. It could be inferred that Augmented Dickey Fuller test values are above the critical value (1%) given by] Mackinnon statistical tables at levels implying that the series are non-stationary at their levels indicating the existence of unit root. After taking first difference, all the series become stationary which is obvious from the calculated values for all the markets which are less than the critical value (1%) and are free from the consequence of unit root. (Table-1)

Table-1: ADF test results of chilli prices

Markets	First difference	Critical value (1%)
GNT	-15.1801	-4.013274
KMM	-10.30857	-4.013274
VDN	-12.80613	-4.013274
NGP	-12.51912	-4.013274

* MacKinnon critical values for rejection of hypothesis of a unit root.
(GNT- Guntur chilli prices   KMM- Khammam chilli prices
VDN- Virudhunagar chilli prices   NGP-Nagpur chilli prices)

Johansen's Multiple Co-integration Test is employed to determine the long run relationship between two price series. Co-integration is used instead of regular regression methods because of its capacity in dealing with non-stationary variables. The most popular co-integration test method, developed by Johansen (1988) and Johansen and Juselius (1990), is applied.

Johansens' Multiple Co- Integration Analysis

Based on the Johansen's multiple co-integration procedure the integration between the markets is analyzed using E-views software which indicated the presence of at least two integration equations at 5 per cent level of significance. Hence markets are having long run equilibrium relationship. The results are presented in Table-2.

Table-2: Results of Johansens' Multiple Co- Integration Analysis

Eigen value	L.R Ratio	Critical Value (5%)	No. of CE(s)	Prob.**
0.243948	105.0973	63.87610	None *	0.0000
0.211278	58.39641	42.91525	At most 1 *	0.0007
0.073743	18.76045	25.87211	At most 2	0.2951
0.035104	5.967657	12.51798	At most 3	0.4644

Granger Causality Test

When a co integration relationship is present for two variables, a Granger Causality test (Granger, 1969) can be used to analyze the direction of this co-movement relationship.

Theoretically, a variable is said to Granger-cause another variable, if the current value is conditional on the past value of (1 Y 2 Y 2 Y Y1 1,t 1 $Y-$, , …)

Granger Causality Test for Domestic and International Markets

From Table-3 it is inferred that international chilli (S_4, Guntur Sannam) prices in New York market influence the prices at Guntur and Khammam markets but not vice versa. It is very interesting to note that New York chilli market prices in turn are influenced by the prices of Virudhunagar and Nagpur markets. Thus a strong integration of different domestic chilli markets with the international market is confirmed through the results of the study. At domestic level prices in Khammam and Guntur markets exhibited a bidirectional influence .Similar is the case with Nagpur and Khammam markets. On the other hand Virudhunagar market prices influenced prices at Guntur, Khammam and Nagpur but not Vice Versa. Similarly Nagpur market was found to influence prices in Guntur market. Thus a strong co integration was found to exist between domestic and international markets and with in domestic markets.

Table-3: Granger causality test for domestic and international markets

Null Hypothesis:	Obs	F-Statistic	Prob.
GNT does not Granger Cause NYK	69	1.71309	0.1885
NYK does not Granger Cause GNT		3.22517	0.0463
KMM does not Granger Cause NYK	69	0.53291	0.5895
NYK does not Granger Cause KMM		6.57464	0.0025
VDN does not Granger Cause NYK	69	10.0254	0.0002
NYK does not Granger Cause VDN		0.37193	0.6909
NGP does not Granger Cause NYK	69	6.44223	0.0028
NYK does not Granger Cause NGP		1.83935	0.1672
KMM does not Granger Cause GNT	69	6.03218	0.0040
GNT does not Granger Cause KMM		7.94965	0.0008
VDN does not Granger Cause GNT	69	6.75967	0.0022
GNT does not Granger Cause VDN		1.40874	0.2519
NGP does not Granger Cause GNT	69	8.11238	0.0007
GNT does not Granger Cause NGP		0.09120	0.9130

VDN does not Granger Cause KMM	69	8.49654	0.0005
KMM does not Granger Cause VDN		0.07150	0.9311
NGP does not Granger Cause KMM	69	10.8476	9.E-05
KMM does not Granger Cause NGP		4.45355	0.0155
NGP does not Granger Cause VDN	69	0.63681	0.5323
VDN does not Granger Cause NGP		7.47215	0.0012

Note: (NYK- Chilli prices in NewYork market   GNT- Chilli prices in Guntur market

KMM- Chilli prices in Khammam market   NGP- Chilli prices in Nagpur market

Vector Error Correction Model

Since different domestic chilli markets are integrated in the long run, it is important to study the short run and long run association for equilibrium among markets. Hence Vector Error Correction Model (VECM) is employed to know the speed of adjustments among the markets for long run equilibrium. From the results presented in Table-4, it is clearly known that Guntur, Virudhunagar and Nagpur markets came to short run equilibrium as indicated by the level of significance and speed of adjustment is rapid. While Khammam, Virudhunagar and Nagpur markets are influenced by their own monthly lags for long run equilibrium. Guntur prices are influenced in turn by the lagged prices of Khammam and Nagpur markets. Similarly Khammam prices are influenced by the lagged prices of Guntur and Nagpur. Virudhunagar prices are influenced by lagged prices of Nagpur market. Inturn Nagpur prices are influenced by lagged prices of chillies in Guntur and Virudhunagar markets in the long run.

Table-4: Results of Vector error correction model

Error Correction:	D(GNT)	D(KMM)	D(VDN)	D(NGP)
CointEq1	-0.20843	-0.14261	0.169282	-0.21326
	-0.0671	-0.08371	-0.0719	-0.04399
	[-3.10610]	[-1.70367]	**[2.35447]**	**[-4.84842]**
D(GNT(-1))	-0.15916	0.310478	-0.06492	0.280912
	-0.09384	-0.11705	-0.10054	-0.06151
	[-1.69617]	**[2.65246]**	[-0.64573]	**[4.56702]**
D(GNT(-2))	0.121983	0.126678	-0.06233	0.198646
	-0.09986	-0.12457	-0.107	-0.06546
	[1.22151]	[1.01692]	[-0.58258]	**[3.03468]**
D(GNT(-3))	0.105213	0.152659	-0.11384	-0.04655
	-0.08923	-0.11131	-0.09561	-0.05849
	[1.17906]	[1.37146]	[-1.19065]	[-0.79589]
D(KMM(-1))	0.020268	-0.16916	-0.06382	0.068947

	-0.06446	-0.08041	-0.06907	-0.04226
	[0.31441]	**[-2.10360]**	[-0.92399]	[1.63166]
D(KMM(-2))	0.122094	-0.27843	0.073627	-0.01047
	-0.07366	-0.09189	-0.07892	-0.04828
	[1.65751]	**[-3.03019]**	[0.93289]	[-0.21691]
D(KMM(-3))	-0.16708	-0.09226	-0.13044	0.022845
	-0.07545	-0.09411	-0.08084	-0.04946
	[-2.21448]	[-0.98033]	[-1.61358]	[0.46193]
D(VDN(-1))	0.006475	-0.14753	0.138307	-0.05405
	-0.09552	-0.11915	-0.10234	-0.06261
	[0.06779]	[-1.23818]	[1.35145]	[-0.86320]
D(VDN(-2))	-0.14177	-0.03279	0.102418	-0.19366
	-0.09205	-0.11483	-0.09863	-0.06034
	[-1.54006]	[-0.28555]	[1.03842]	**[-3.20948]**
D(VDN(-3))	0.103006	0.092262	0.261066	0.047088
	-0.09047	-0.11285	-0.09693	-0.0593
	[1.13862]	[0.81758]	**[2.69339]**	[0.79407]
D(NGP(-1))	0.287362	0.308655	0.067005	-0.18164
	-0.11935	-0.14888	-0.12788	-0.07823
	[2.40774]	[2.07322]	[0.52399]	**[-2.32184]**
D(NGP(-2))	0.107404	0.074197	0.026086	-0.11907
	-0.12372	-0.15433	-0.13256	-0.08109
	[0.86814]	[0.48078]	[0.19680]	[-1.46832]
D(NGP(-3))	0.062388	0.262784	0.283091	0.014169
	-0.11948	-0.14904	-0.12802	-0.07832
	[0.52214]	[1.76312]	**[2.21131]**	[0.18091]
R-squared	0.262465	0.201954	0.118214	0.311748

(N.B: GNT-Guntur market chilli price KMM - Khammam market chilli prices VDN-Virudhunagar market chilli pricesNGP-Nagpur market chilli prices)

CONCLUSIONS:

All the series become stationary at first difference. Which is obvious from the calculated values for all the markets which are less than the critical value (1%) and are free from the consequence of unit root. Johansens' Multiple Co- Integration Analysis indicated the presence of at least two integration equations at 5 per cent level of significance. Hence markets are having long run equilibrium relationship.

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