Impact of globalization on Spatial Price Linkages in chillies: Empirical analysis using Cointegration Test

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Introduction

During the last one and half decade India witnessed unprecedented policy changes in almost all the sectors of economy. This essentially involved a move away from import- substitution to outward orientation, which had its beginning in the early years of 1990s, got accentuated with India joining the WTO in 1995. As a result, the highly restricted agriculture trade was replaced by an unprotected bound tariff determined free trade regime. Later, India signed a bilateral free trade agreement with Sri Lanka in December 1998, which had its additional bearing on the agricultural sector more specifically on tropical products for which Sri Lanka also has comparative advantage. Analytically, removal of these trade barriers is likely to have the effect of integrating domestic agricultural commodity market with the world market. This in turn facilitates the transmission of world prices to the domestic market to a greater extent than the pre-reform period thus making the producers more exposed to the ups and downs of world commodity markets.

India is biggest producer as well as consumer of chillies in the world contributing 25 per cent of the total world production. It is the fifth important foreign exchange earner among Indian spices and contributes Rs. Five crore to the national exchequer.

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The major chilli producing states are Karnataka, Orissa, Maharastra, West Bengal, Andhra Pradesh and Tamil Nadu.

Till recently, international trade in chillies was dominated by India. However, the exports from the country has come down considerably as China has emerged as a principal exporter of chillies. Chilli exports from India are mostly to Sri Lanka, USA, Nepal, Mexico and Bangladesh. India has immense potential to grow and export different types of chillies required by various markets around the world. India today faces stiff competition from China and Pakistan who offer their produce in international market at very competitive price. The reason may be that the prices of our chillies are too high for international markets on account of strong domestic demand. Sannam variety of chillies is in demand in importing countries. Buyers expect a high degree of hygiene and sanitation in processing and preparing chillies for export. Aflatoxin and pesticide residues are the two important problems which act as constraints in increasing chilli exports to importing countries. The recent rejection of the consignment of chillies by certain European Union countries and Australia on the grounds of Aflatoxin and pesticide residues poses a serious threat to chilli exports. Though spices form an integral part of Indian food, Indian chilies are yet to enhance their share in total spices export.

Obviously commodity price trends affect the incidence of poverty through their impact on employment opportunities and earnings of producers. At the farm household level, the impact of price change depends on whether global and border price trends are passed through to the producer at local level and whether improvements in productivity and production are able to compensate in a context of falling prices. Hence, the importance of the present study lies in the fact that, the domestic price trends and its movements with world market price of chillies are likely to have profound influence on the levels of living of millions of people (both workers and farmers) who depend either directly or indirectly on the cultivation of this crop.

The central focus of the present paper is to address two interrelated issues of chillies – the extent of co-movement of chilli prices in the domestic and world markets and the bearing of WTO measures on the extent of transmission of world prices to the domestic markets.

II
DATA AND METHODOLOGY

To study integration among markets within the country and also with international market, monthly wholesale prices were collected for the period 1980

through 2004. Seven markets were selected namely Guntur (A.P.), Patna (Bihar), Bangalore (Karnataka), Bombay (Maharashtra), Virudhanagar (Tamilnadu), New Delhi and New York. . The study period was divided into two viz., pre-WTO (1981-82 to 1994-95) and post-WTO (1995-96 to 2003-04) periods. This grouping was done to compare the price integration of chillies during pre-WTO and post-WTO periods. The secondary data pertaining to domestic price and international prices of chillies were gathered from various publications of Spices Board, Ministry of Commerce, Food and Agriculture Organisation trade year books and also from the website of Food and Agriculture □rganization (www.fao.org).

Integration among the selected markets of chillies for the selected period was examined by employing Cointegration model. The market integration concept explains the relationship between the prices in two or more than two markets that are spatially separated. When markets are integrated it implies that the markets in the system operate in unison, as a single market system. Markets that are not integrated may convey inaccurate price information that might distort marketing decisions and contribute to inefficient product movements.

An attempt was made in this study to determine whether chillies prices in a market are in parity with prices in a reference market. So, it is necessary to compare prices of chillies in one market with that of the other markets in the country as well as outside the country. Methodology developed by Engle and Grangler (1987)' has been used to show whether chillies markets are cointegrated or not.

Empirical model of multiple cointegration

The study empirically evaluates spatial integration of domestic and international spice markets. Using the maximum likelihood (ML) method of cointegration developed by Johansen (1988) and extended by Johansen and Juselius (1990), the study specifically examines whether the domestic and international chilli markets are integrated and linked together into a single economic market. This method treats all the variables as explicitly endogenous and takes care of the endogenity problem by providing an estimation procedure that does not require arbitrary choice of variable for normalization. It also allows test for multiple cointergrating vectors.

Testing stationarity

To ensure appropriate model specification and to reduce the possibility of arriving at misleading results, it is important to examine the time series characteristics of the data. This involves tests for the order of integration of the variables. If a variable contains a unit root then it is non-stationary and unless it combines with other non-stationary series to form a stationary cointegration

relationship, regression involving the series can falsely imply the existence of a meaningful economic relationship. Before conducting cointegration tests, it needs to examine the univariate time series properties of the data and confirm that all the price series are non- stationary and integrated of the same order.

The most widely used tests for unit roots are the Dickey Fuller (DF) and Augmented Dickey Fuller (ADF) tests. In both the tests the null hypothesis is that the time series has a unit root or in other words, it is non-stationary. The DF test was applied by running the regression of the following form,

$$\Delta Y_t = \beta_1 + \delta Y_{t-1} + u_t \qquad \text{..... (1)}$$

where, $\Delta Y_t = (Y_t - Y_{t-1})$; $Yt = \ln Y_t$

The ADF test was run with the equation,

$$\Delta Y_t = \beta_1 + \delta Y_{t-1} + \alpha_I \sum_{i=1}^{p} \Delta Y_{t-I} + \in_t \qquad \text{..... (2)}$$

$$\Delta Y_t = \beta_1 + \delta Y_{t-1} + \beta_2 t + \alpha_I \sum_{i=1}^{p} \Delta Y_{t-I} + \in_t \qquad \text{.....(3)}$$

where, $\Delta Y_{t-1} = (Y_{t-1} - Y_{t-2})$

$\in_t$ for t = 1, ... , N is assumed to be Gaussian white noise i.e., $\in_t \sim (0, \sigma^2)$. The first equation in ADF is with constant term and no trend whereas the second one is with constant and trend. The number of lagged terms p is chosen to ensure that the errors are uncorrelated. In all the tests the null hypothesis was $\delta=0$ which implied that the time series Y_t was non-stationary.

The critical values of the test statistic (tau) of the lagged terms have been tabulated by Dickey and Fuller (1979). They have also been considerably extended by Mackinnon through Monte Carlo simulations (Mackinnon, 1991).

In the present study Dickey-Fuller test was used to test the stationarity of the price series. The data set used in the cointegration exercise consists of monthly prices of chillies for the period from 1980 to 1994 (pre-WTO period) and 1995 to 2004 (post-WTO period).

Testing for cointegration

The test for the order of integration of each variable in the model was to establish whether the time series was non-stationary and how many times the variable needs to be differenced to result in a stationary series. However, first differencing is not an appropriate solution to the non-stationarity problem and it prevents detection of the

long-run relationship that may be present in the data, i.e. the long-run information is lost, which is precisely the main question being addressed.

If a series must be differenced d times before it becomes stationary, then it is said to be integrated of order d, denoted I (d). Consider two time series Y_t and X_t, which are both I (d). In general, if X_t and Y_t are not cointegrated, any linear combination of the two series will also be I(d); i.e., the residuals, u_t obtained from regressing Y_t on X_t are I (d).

The economic interpretation of cointegration is that if two (or more) series are linked to form an equilibrium relationship spanning the long-run, then even though the series themselves may contain stochastic trends (ie., be non-stationary) they will nevertheless move closely together over time and the difference between them will be stable (i.e., stationary). The concept of cointegration mimics the existence of a long-run equilibrium to which an economic system converges over time, and u_t defined above can be interpreted as the disequilibrium error (ie., the distance that the system is away from equilibrium at time t). Thus following directly from the identification of cointegration with equilibrium it is possible to make sense of regressions involving non-stationary variables. If these are cointegrated then regression analysis imparts meaningful information about long-run relationships, whereas if cointegration is not established we return to the problem of spurious correlation.

An approach to testing for cointegration is to construct test statistics from the residuals of a cointegrating regression in levels mostly using Engle Granger and Augmented Engle Granger tests. However, in the case of a system of variables Johansen Maximum likelihood procedure (Johansen and Juselius, 1990) is the most applicable method, since it permits the existence of cointegration between the system of variables without imposing any bias on the estimates. The Johansen test for cointegration is a multivariate unit root test which estimates the cointegrating rank 'r' in the multivariate case and is also able to estimate the parameters β of these cointegrating relationships. This test procedure is most efficient because it identifies the number of cointegrating vectors between the non-stationary level variables in the context of a Vector Error Correction Model (VECM). Basically, this is a Vector Auto Regression (VAR) model in error correction form. In a system with two or more variables, a VECM, like the VAR model, treats each variable as potentially endogenous and relates the change in one variable to past equilibrium errors and to past changes in all variables in the system.

Following Johansen and Juselius (1990), the maximum likelihood method of cointegration is explained as follows:

If Pt denotes (nx1) vector of I(1) prices, then the k-th order vector autoregressive (VAR) representation of Pt may be written as

$$Pt = \sum_{i=1}^{k} \Pi_i Pt - I + \mu + \beta t + et \quad (t=1, 2\ldots..t) \qquad \ldots\ldots\ldots\ldots\ldots\ldots\ldots(4)$$

The procedure for testing cointegration is based on the error correction (ECM) representation of Pt given by

$$\Delta P_t = \sum_{i=1}^{k-1} \acute{\Gamma}i \, \Delta Pt - I + \Pi i \, Pt - k + \mu + \beta t + et \quad \ldots\ldots\ldots\ldots\ldots\ldots..(5)$$

where, $\acute{\Gamma}i = -(1- \Pi_1 - \ldots\ldots - \Pi t)$; i= 1,2, …. K-1; $\Pi = -(1-\Pi_1-\ldots. - \Pi k)$. Each of the Π_i is an n x n matrix of parameters; e_t is an identically and independently distributed n-dimensional vector of residuals with zero mean and variance matrix. Ώe; μ is a constant term and t is trend. Since, P_{t-k} is I(1), but ΔP_t and ΔP_{t-1} variables are I(0). So, it is the Π matrix that conveys information about the long run relationship among the variables in Pt. The rank of Π, r, determines the number of cointegrating vectors, as it determines how many linear combinations of Pt are stationary. If r = n, the prices are stationary in levels. If r = 0, no linear combination of Pt is stationary. If 0< rank (Π) = r<n, and there are n x r matrices ά and β such that Π = άβ, then it can be said that there are r cointegrating relations among the elements of Pt. The cointegrating vector β has the property that βPt is stationary even though Pt itself is nonstationary. The matrix ά measures the strength of the cointegrating vectors in the ECM as it represents the speed of adjustment parameters. Two likelihood ratio test statistics are proposed. The null hypothesis of at most r cointegrating vector against a general alternative hypothesis of more than r cointegrating vectors is given by

$$\text{Trace statistic } (\lambda\text{-trace}) = -T \sum \ln (1- \lambda i). \ldots\ldots\ldots\ldots\ldots\ldots \quad (6)$$

The null hypothesis of r cointegrating vectors against the alternative of r + 1 is tested by

$$\text{The maximum eigen value statistic } (\lambda \max) = -T \ln (1- \lambda r+1) \ldots\ldots\ldots..\ldots\ldots(7)$$

λi are the estimated eigen values (characteristics roots) obtained from the Π matrix. T is the number of usable observations (Johansen and Juselius, 1990).The number of cointegrating vectors indicated by the tests is an important indicator of co-movement of the prices. An increase in the number of cointegration vectors implies an increase in the strength and stability of price linkages.

III
RESULTS AND DISCUSSION

The recent move towards market reforms in most developing countries has renewed interest in the working of agricultural markets as a source of income, employment and food security. The success of the reform process in promoting equity and efficiency is constrained by numerous structural deficiencies in local markets. One of the main consequences of these structural deficiencies is poor market integration, the difficulty with which information and trade flows among spatially separated markets. The market integration is a precondition for the success of liberalization and globalization. Unless the markets are spatially integrated, producers and consumers will not realize the gains from liberalization and globalization. If the markets are not integrated, the correct price signals will not be transmitted through the marketing channels, the farmers will not be able to specialize according to long term comparative advantage and the gains from trade will not be realized. Therefore, among other things, the reform process needs to take into account the extent of agricultural market integration.

In the present context, an attempt is made to understand the nature and extent of market integration among various domestic and international markets of chillies during pre and post-WTO periods. To analyse the market integration among prices of chillies, Johansen's multiple cointegration technique test was used.

Testing for unit roots

The results of various stationarity tests with respect to different market prices of chillies in pre-WTO as well as the post-WTO periods, at levels and first differences are reported in table 1.

The null hypothesis of non-stationarity was accepted for all the prices in levels but could be rejected after first differencing. As the prices of chillies in different markets namely Guntur, Patna, Bangalore, Mumbai, Virudhanagar, Delhi and New York are stationary after differencing once, it could be inferred that they are all I (i) processes.

Testing for cointegration

The test for cointegration was done using Johansen and Juselius Maximum Likelihood test procedure as the entire price series were integrated of the same order. The results of the multivariate cointegration tests for chillies in the pre-WTO and pest-WTO periods are presented in table 2.

Table 1.Results of the stationarity tests for Chillies

Pre- WTO (1981-1994)							
	Market	Constant, No trend		Constant, trend			Inference
		A(1)=0	A(0)=A(1)=0	A(1)=0	A(0)=A(1)=A(2)=0	A(1)=A(2)=0	
Levels	Guntur	-2.82	4.02	-3.91	5.15	7.69	Accept H_0
	Patna	-2.11	2.31	-3.55	4.25	6.28	Accept H_0
	Bangalore	-1.03	0.79	-3.99	5.79	8.40	Accept H_0
	Bombay	-2.40	2.91	-3.85	5.02	7.53	Accept H_0
	Virudhanagar	-2.53	3.32	-4.97	8.32	12.37	Accept H_0
	New Delhi	-1.79	1.73	-4.35	6.39	9.46	
	Newyork	-2.44	2.99	-2.21	1.98	2.94	Accept H_0
First difference	Guntur	-4.72	11.14	-4.72	7.44	11.15	Reject H_0
	Patna	-4.32	9.33	-4.31	6.19	9.29	Reject H_0
	Bangalore	-4.26	9.07	-4.29	6.12	9.18	Reject H_0
	Bombay	-4.03	8.12	-4.04	5.44	8.16	Reject H_0
	Virudhanagar	-4.29	9.19	-4.28	6.10	9.15	Reject H_0
	New Delhi	-4.33	9.39	-4.32	6.22	9.34	
	Newyork	-5.76	10.31	-5.26	7.31	11.24	Reject H_0
Post- WTO (1995-2004)							
	Market	Constant, No trend		Constant, trend			Inference
		A(1)=0	A(0)=A(1)=0	A(1)=0	A(0)=A(1)=A(2)=0	A(1)=A(2)=0	
Levels	Guntur	-2.46	3.31	-3.09	2.43	3.32	Accept H_0
	Patna	-2.32	2.98	-2.79	1.69	3.43	Accept H_0
	Bangalore	-1.98	2.56	-2.31	1.80	2.14	Accept H_0
	Bombay	-2.11	3.69	-1.04	1.74	2.48	Accept H_0
	Virudhanagar	-2.39	2.71	-1.38	1.83	3.53	Accept H_0
	New Delhi	-1.91	2.88	-1.44	2.46	2.51	
	Newyork	-1.88	2.46	-1.99	1.88	2.49	Accept H_0
First difference	Guntur	-5.67	9.76	-5.69	6.39	8.61	Reject H_0
	Patna	-4.32	7.54	-4.74	5.88	8.58	Reject H_0
	Bangalore	-3.98	6.24	-5.25	5.63	8.41	Reject H_0
	Bombay	-3.44	4.90	-6.92	5.49	8.42	Reject H_0
	Virudhanagar	-3.59	4.59	-5.31	5.22	7.76	Reject H_0
	New Delhi	-2.89	6.24	-5.46	5.13	6.93	
	Newyork	-2.99	4.99	-3.05	3.15	4.73	Reject H_0

Ταβλε 5 Significant at one per cent level

The results revealed that the null hypothesis of r = 0 and r ≤ 1 could be rejected at one per cent level of significance whereas the null hypothesis of r ≤ 2 could be rejected at five per cent level, both in the pre-WTO and post-WTO periods. The null hypothesis of r < 3 was accepted for both the periods confirming that there are three cointegrating vectors among the different price series in the pre and post-WTO periods.

Table 2 .Results of the Multiple Cointegration for Chillies

Pre-WTO period(1981-1994)				
Eigen Value	**Trace test**		**Maximum Eigen value test**	
	Null	**trace**	**Null**	**λ-max**
0.2118	r =0	66.98*	r =0	28.98*
0.1439	r < =1	41.29*	r =1	18.42*
0.1224	r < =2	19.54*	r =2	14.22*
0.0546	r < =3	5.98	r =3	5.97
Post-WTO period(1995-2004)				
Eigen Value	**Trace test**		**Maximum Eigen value test**	
	Null	**trace**	**Null**	**λ-max**
0.3143	r =0	84.34*	r =0	41.94*
0.2898	r < =1	40.86*	r =1	27.91*
0.0911	r < =2	14.22**	r =2	10.92**
0.0423	r < =3	5.13	r =3	5.13

The trace and λ-max tests showed the presence of three cointegrating vectors in the pre-WTO and post-WTO periods. Since the number of price series included in the cointegration test for chillies was four (n=4), the number of common stochastic trends turned out to be one in both periods. The finding that there were three cointegrating vectors in both the periods implied that all the prices contain the same stochastic trend and therefore, are pair-wise cointegrated. It could be seen that, the number of markets that were cointegrated in the pre-WTO period was same as that in post-WTO period. This suggests that WTO has not played a major role in the transmission of price signals among various markets within the country as well as between the domestic and international markets in the case of chillies. The strength and stability of price linkages among various markets has not increased even after globalization. The reason may be attributed to the high cost of production of chillies in India when compared to other competing countries.

IV

CONCLUSIONS AND POLICY IMPLICATIONS

Against the backdrop of unprecedented globalization changes, which were expected to have significant impact, among others, on integrating the hitherto protected domestic commodity markets with world market; the present paper explored the dynamics of integration of domestic market of chillies with the world market. While there are number of studies on the transmission of international prices to domestic markets in the case of food crops, there have been hardly any studies exploring the behaviour of chillies which are important not only as a source of foreign exchange but also as a source of employment. Hence the present paper focuses on chilli crop.

This paper has adopted the cointegration and error-correction model to analyse the extent of integration among domestic markets of chillies in India as well as transmission of world price to the domestic market. Period wise analysis was carried out with a view to capture the effect of globalization that has certain results to offer. The results find that markets of chillies were integrated with the world market even before the initiation of WTO. However, with the initiation of WTO also, the extent of market integration does not get accentuated as is evident from the analysis that the number of markets that were cointegrated in the pre-WTO period was same as that in post-WTO period. This suggests that WTO has not played a major role in the transmission of price signals among various markets with in the country as well as between domestic and the international markets in the case of chillies. Given these findings, there are some issues of great importance to enhance the price integration among the chilli markets.

In the context of the present thrust towards agri-exports in the wake of economic liberalization and globalization, the small growers find it difficult to participate actively in the market economy. In many developing countries such farmers could become marginalized because economies of scale do not operate. These poor farmers therefore give up their traditional occupation of agriculture. One of the options to arrest this migration from rural to urban areas is to establish market linkages. An organized contract farming system would provide such linkages, which could enable small producers reap the maximum benefits and make production and processing competitive since this ensures improved inputs, better technologies and an assured market. As a policy initiative the necessary legal frame-work needs to be developed in individual states.

In order to make sure that the violent fluctuations in chilli prices are evened out to some extent, future trading should be focused as organic chillies have a market in most countries. Value addition of chillies in the country is practically limited to the production and supply of chilli oils and oleoresins, chilli powders, chilli mixes and blends. The exports of value added spices are mainly to Middle East and ethnic populations. Value addition demands the development of new products and new uses for spices. This requires research and development, establishment of export linkages, empowerment of rural communities, especially of women, in areas of production, on-farm quality management and marketing.

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