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Research Article

A STUDY ON SPATIAL MARKET INTEGRATION FOR BRINJAL IN GUJARAT

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Abstract- This paper tests the extent of co-integration of wholesale prices of brinjal among the markets (Surat, Bharuch, Vyara, Ahemadabad and Vadodara) of Gujarat by using ADF tests examined the causality by Granger causality tests. Monthly wholesale price data were used for the study. Out of Surat, Bharuch, Vyara, Ahemdabad, and Vadodara integrated were with at least three co-integration vectors. The Pairwise Grangers Causality test for Surat, Bharuch, Tapi, Ahmadabad and Vadodara market was carried out. Out of the five market pairs analyzed, 9th pair had co-integrating relationship, while 11th pair had no co-integrating relationships. The result indicates that Bharuch and Vyara market was the leader market and Surat and Vadodara markets are price influenced to each other and there existed bidirectional causality from Surat market price and Vadodara market price.

Keywords- Market integration, Co-integration, ADF tests, Pairwise Grangers causality test

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Introduction

Horticulture sector provides excellent opportunities in raising the income of the farmers even in the dry tracts. Nature has endowed our country with vast diversity of land, soil and agro climatic conditions, which enabled us to produce varied types of vegetable crops. Gujarat is the fourth major Brinjal producing state in the country and accounts for 11 per cent of the total production of brinjal in the country. Gujarat stands 4th position in area and production of vegetable crops [1]. Brinjal is one of the most commonly grown vegetable crops of the country. India produces about 12994.77 thousand MT of brinjal from an area of 704.96 thousand ha with an average productivity of 18.43 MT/ha. The brinjal producing states are Orissa, Bihar, Karnataka, West Bengal, Andhra Pradesh, Maharashtra and Uttar Pradesh. Brinjal has Ayurvedic medicinal properties and white brinjal is good for diabetic patients. It is also a source of vitamins A, C and minerals. During 2012-13, the area under brinjal in Gujarat was 73.07 thousand hectare with 1270.56 thousand metric tons production, and productivity was observed 17.39 metric tons per hectare[2].

Materials and Methods

For testing market integration is central to the design of any agricultural price policy in many developing countries and has been an area of abiding research interest following Co- integration method are used [3].

Co-integration

Co- integration means that a linear combination of two or more time series can be stationary. The series that satisfy this requirement are said to be co-integrated. Co-integration analysis is mathematical tool to analyze the integration and thereby the efficiency of the marketing system.

Spatial market integration refers to situation in which prices of a commodity in spatially separated markets move together and price signals and information are transmitted smoothly across the markets [4].

Test for unit roots

Before proceed to test the co integration, it need to examine the univariate time series properties of the data and confirm that all the price series are non-stationary and integrated of same order (A stationary series is one whose parameter (mean, variance and autocorrelation) are independent of time). To test the null hypothesis of non-stationary against an alternative of stationary, applied both Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) test. The ADF test is a parametric test (pre-determined parameters) and it has low power [5] whereas PP test statistic is based on a non-parametric modification of the Dickey-Fuller tests [6]. Hence, we are interested to give more importance to PP test than ADF test 7].

Co integration Test

The most utilized co integration test is the Engle-Granger test [8] but here in the study, The multivariate co integration method developed [9,10]. This method treats all the variables as explicitly endogenous and takes care of the endogeneity problem by providing an estimation procedure that does not require arbitrary choice of a variable for normalization. It also allows tests for multiple co integrating vectors [11].

Johansen co integration Test

Following Johansen and Juselius (1990), the ML method of co integration may be briefly outlined here. If P_t denotes an (n×1) vector of I(1) prices, then the k-the order vector autoregressive (VAR) representation of P_t may be written as:

$$P_t = \sum_{i=1}^{k} \Pi P_t + \mu + \beta t + \varepsilon t \; ; (t = 1,2,3,.....,T)$$

The procedure for testing co integration is based on the error correction representation of P_t given by

$$\Delta P_t = \sum_{i=1}^{k=1} \Gamma_i \Delta P_{t-1} + \Pi P_{t-k} + \mu + \beta t + \varepsilon_t$$

Where $\Gamma_i = -(I - \Pi_1 - \dots - \Pi_t)$; $i = 1,2,\dots,k-1$; $\Pi = -(I - \Pi_1 - \dots - \Pi_k)$; Each of Π_1 is an n× n matrix of parameters; ε_t is an identically and independently distributed n dimensional vector of residuals with zero mean and variance matrix, Ω ε; 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), equation (2) will be balanced if ΠP_{t-k} is I(0). So, it is the Π matrix that conveys information about the long run relationship among the variables in P_t.

Data

The data on monthly wholesale prices for five Brinjal markets i.e. Surat, Bharuch, Vyara, Ahemadabad and Vadodara for the period 2003-2013 were used in the co-integration analysis. The market selection was done on highest concentration of Brinjal arrivals in the market.

Results and Discussion

Market integration

Result of Augmented Dickey Fuller (ADF) unit root Test the Augmented Dickey Fuller (ADF) based unit root test procedure was done to check whether the price series of brinjal in Ahmedabad, Surat, Bharuch, Vadodara, Tapi market of Gujarat are stationary or not. The result is given in [Table-1] from the Table it could be inferred that the Augumented Dickey Fuller (ADF) test values were above the critical value (1 per cent) given by MacKinnon statistical Tables at levels implying that the series were non-stationery at their levels indicating the existence of unit root. After taking the first difference, all the series becomes stationery, where the critical value is less than one percent for all the markets and free from consequence of unit root.

Table-1 *Augmented Dickey-fuller (ADF) unit test of brinjal market in Gujarat*

Markets	At level		First differences	
	Constant	Constant+ linear trend	Constant	Constant+ linear trend
AHE	-4.3066 (-2.8839)	-8.1419 (-3.4447)	-19.0848 (-2.8839)	-19.0251 (-3.4447)
BHA	-5.5257 (-2.8839)	-6.4549 (-3.4447)	-4.9175 (-2.8839)	-4.9990 (-3.4447)
SUR	-5.0839 (-2.8839)	-6.1069 (-3.4447)	-7.7268 (-2.8839)	-7.8817 (-3.4447)
VAD	-6.0156 (-2.8839)	-6.7689 (-3.4447)	-8.8893 (-2.8839)	-8.8019 (-3.4447)
VAY	-3.7662 (-2.8839)	-5.7635 (-3.4447)	-18.6582 (-2.8839)	-18.5801 (-3.4447)

(**AHE**- Ahmadabad, **BHA**- Bharuch, **SUR**- Surat, **VAD**- Vadodara, **VAY**- Vyara)

Johansen's Multiple Co-integration Analysis

After checking the stationary of series Johansen's multiple Co-integration test was done to find out whether there exists integration between different Brinjal markets in Gujarat. The test [Table-2] revealed that, the presence of at least three integration equations at 5 per cent level of significance, hence the markets are having long run equilibrium relationship.

The unit root tests established that all brinjal price series are integrated of order 1. As such, the variables could potentially be co-integrated meaning that there exist long run relationships among them. Therefore, the study conducted the Johansen Co-integration test to ascertain this. Each market pair was subjected to the test with both trend term and an intercept. P-values were used to evaluate the test statistics at a 5 percent significance level.

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

Hypothesized No of CE (s)	Eigen value	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.252300	99.32331	76.97277	0.0004
At most 1*	0.196761	64.14219	54.07904	0.0049
At most 2*	0.152120	37.63077	35.19275	0.0268
At most 3	18180.113618	17.66384	20.26184	0.1096
At most 4	0.025056	3.070410	9.164546	0.5676

Trace test indicates 3 co integrating eqn (s) at the 0.05 level, *denotes rejection of the hypothesis at the 0.05 level, ** Mackinnon- Haug- Michelis (1999) p- value

Table-3 *Unrestricted Co-integration rank test (Maximum Eigen value)*

Hypothesized No of CE (s)	Eigen value	Max- Eigen statistic	0.05 critical Value	Prob.**
None *	0.252300	35.18112	34.80587	0.0451
At most 1	0.196761	26.51142	28.58808	0.0900
At most 2	0.152120	19.96693	22.29962	0.1025
At most 3	0.113618	14.59343	15.89210	0.0791
At most 4	0.025056	3.070410	9.164546	0.5676

Granger Causality Tests

In order to know direction causation between the markets Granger causality test was carried out. The Pair wise Grangers Causality Test for Surat, Bharuch, Tapi, Ahmadabad and Vadodara market was significant at 5 % level. The results shown in [Table-4] indicate that, out of the five market pairs, 9th had one co-integrating relationship, while 11th had no co-integrating relationships. Whereas unidirectional influence was exhibited by Bharuch market on Ahemadabad, Surat and Vadodara markets.

The results of the test pointed out that Bharuch and Vyara market the leader market. Also the results indicated that Surat and Vadodara market price influenced each other and there existed bidirectional causality from Surat market price and Vadodara market price.

Table-4 *Pair wise Granger Causality Test Results*

Observations: 130

Null Hypothesis	F-statistics	Probability
BHARUCH does not Granger Cause AHEMDABAD	**3.6984**	**0.0275**
AHEMDABAD does not Granger Cause BHARUCH_PRICES	0.2028	0.8167
SURAT does not Granger Cause AHEMDABAD	**2.9436**	**0.0563**
AHEMDABAD does not Granger Cause SURAT	2.3799	0.0967
VYARA does not Granger Cause AHEMDABAD	1.5697	0.2123
AHEMDABAD does not Granger Cause VYARA	0.7744	0.4632
VADODARA does not Granger Cause AHEMDABAD	1.7225	0.1828
AHEMDABAD does not Granger Cause VADODARA	2.7366	0.0687
SURAT does not Granger Cause BHARUCH	2.7493	0.0678
BHARUCH does not Granger Cause SURAT	**4.7915**	**0.0099**
VYARA does not Granger Cause BHARUCH	**3.4920**	**0.0335**
BHARUCH does not Granger Cause VYARA	1.0935	0.3383
VADODARA does not Granger Cause BHARUCH	0.0575	0.9441
BHARUCH does not Granger Cause VADODARA	**3.3729**	**0.0374**
VYAR does not Granger Cause SURAT	**7.2885**	**0.0010**
SURAT does not Granger Cause VYAR	0.6911	0.5029
VADODARA does not Granger Cause SURAT	0.4482	0.6398
SURAT does not Granger Cause VADODARA	**10.5130**	**6.E-0.5**
VADODARA does not Granger Cause VYAR	**4.5173**	**0.0128**
VYAR does not Granger Cause VADODARA	**6.9937**	**0.0013**

Conclusion

The market integration is examined by estimating price linkages among major Brinjal market of Gujarat. The data used for the analysis are monthly modal price in five major markets of Gujarat. Thus, the results of Johansen's multiple co-integration testes revealed that the brinjal markets of Surat, Bharuch, Vyara, Ahmadabad, and Vadodara integrated were with the three co-integration vectors. The Pair wise Grangers Causality Test for Surat, Bharuch, Tapi, Ahmadabad and Vadodara market was carried out. Out of the five market pairs analyzed, 9th had one co-integrating relationship, while 11th had no co-integrating relationships. The results of the test pointed out that Bharuch and Vyara market was the leader market.Also the result indicates that the Surat and Vadodara market price influenced each other and there existed bidirectional causality from Surat market price and Vadodara market price.

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Conflict of Interest: None declared

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