Research and Reviews: Journal of Agriculture and Allied Sciences e-ISSN: E 2347-226X
p-ISSN: P 2319-9857

Market Integration and Causality of Major Garlic Markets in Uttar Pradesh State

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Research Article

Received: 04/09/2021
Accepted: 18/09/2021
Published: 24/09/2021

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Keywords: Augmented Dickey-Fuller; Cointegration; Granger causality test; Market integration; Stationarity

ABSTRACT

Market integration of agricultural products gained importance in developing countries due to its potential application to develop the national economy. Garlic is one of the important bulb crops cultivated in most of the states in India, Uttar Pradesh is the third largest garlic producer state in India. Garlic prices shows were volatile in the past few years, it exposing the growers to more risk, as well as a consumer paying more money to purchase produce, the reason for lack of market intelligence about the potential markets and the pattern of arrivals and prices further add to the distresses of the garlic growers. This paper aims to assess the extent and integration among garlic major markets and to study price movement of garlic major markets in Uttar Pradesh by using different tests, *Viz.*, Augmented Dickey-Fuller (ADF) unit root test, Johansen co-integration test, Granger causality test was carried out. For study purposes, monthly wholesale prices of garlic were collected from major markets in Uttar Pradesh for the period from January 2010 to December 2019. The selections of the markets were based on the maximum quantity of arrivals of garlic among the markets of Uttar Pradesh state. The study found that all major markets were well integrated and at least two co-integrating equations were confirmed by the Johansen test. The Granger causality test indicates there was bi-directional causality observed in Garlic prices between Etah and Lucknow. The remaining all market pairs exhibited unidirectional causality and affects.

INTRODUCTION

Garlic (Allium sativum) is one of the important bulb crops belonging to the family Alliaceous, it grown and used as a spice or condiment throughout India. It is also an important foreign exchange earner for India. Garlic is cultivated in

most of the states in India, Uttar Pradesh is the third largest garlic producer state in India, with a total production of 227.34 ('000 tonnes), an area under cultivation is 34.31('000 ha). The productivity level of 6.62 tonnes per hectare during the year 2018-2019.

Garlic prices shows were volatile in past few years, it exposing the growers to more risk, moreover, due to their perishable nature garlic crop require immediate marketing to ensure quality produce to the consumer and remunerative prices to the growers [1]. The lack of market intelligence about the potential markets and the pattern of arrivals and prices further add to the distresses of the garlic growers.

Therefore, the need for proper market efficiency helps the farmer to decide where or in which markets to sell their produce to earn more profit. The efficient functioning of the markets is the existence of a high degree of integration among the markets. The market integration concept explains the inter-relationship between price movements in the two markets that are spatially separated. The higher the marketing efficiency higher is the profit earned. In such a situation the present study was undertaken to the study extent of integration in major markets of garlic in Uttar Pradesh.

MATERIALS AND METHODS

This study was based on secondary data and the data was collected from AGMARK.NET. The monthly time series data of prices of four major garlic markets of Uttar Pradesh were collected from the Period of January 2010 to December 2019. The selection of the markets was based on the maximum quantity of arrivals of garlic among the markets of Uttar Pradesh state. So, the selected markets were Varanasi, Lucknow, Faizabad, and Etah respectively.

Analysis of market integration

The market integration concept explains the inter-relationship between price movements in the two markets that are spatially separated. When the markets are integrated, it implies that the markets in the system operate as a single market system. The markets that are not integrated may convey inaccurate price information that might distort market decisions and contribute to inefficient product movement. For examining integration between two market prices, we were used the Cointegration technique. Johansen's multivariate cointegration test was used to measure the market integration among four selected garlic markets in India. To check stationarity, the Augmented Dickey-Fuller test was employed. The number of lags was selected by using the Akaike Information Criterion (AIC), Sequential modified LR test statistic (LR). To know the direction of causation between the selected markets Granger causality test was used EViews software was used to conduct the whole of the analysis.

Co-integration

The concept of co-integration provides a framework for estimating and testing the long-run equilibrium relationships between the non-stationary integrated variables. If p1t and p2t are the prices in two spatially separated markets (or different levels of the supply chain), if they possess the stochastic trends and are integrated of the same order, say I (d), the prices are said to be co-integrated. It can be expressed as below, The above relationship can be estimated by using either the Ordinary Least Squares OLS or a Full Information Maximum Likelihood method developed.

Augmented Dickey-Fuller test

Before analyzing any time series data testing for stationarity is a pre-requisite. The stationarity of time series data on garlic prices was tested by applying the Augmented Dickey-Fuller test (ADF). The ADF test is the test for the unit root in a time series sample. A stationary series is one whose parameters are independent of time, exhibiting constant mean and variance and having autocorrelations that are invariant through time. If the series is found to be non-stationary, the first differences of the series are tested for stationary. The number of times (d) a series is differenced to make it stationary is referred to as the order of integration, I (d). cointegration is investigated for a set of integrated series however if all of the series are stationary therefore type I (0) the cointegration does not exist by definition in this case, its exit series are at stationary.

Lag length selection criteria

The number of lags was selected by using different lag length selection criteria *viz*., Akaike information criterion (AIC), Schwarz information (SC), and Hanna n-Quinn information criterion (HQ), Sequentially modified LR test statistic (LR) and Final Prediction Error (FPE).

Johansen's Multiple Co-integration test

A multivariate system of equations approach, which allows for simultaneous adjustment of both or even more than two variables. The multivariate systems of equations approach are more efficient than the single-equation approach since it allows estimating the co-integration vector with smaller variance [2]. The second advantage of the multivariate approach is that in the simultaneous estimation it is not necessary to presuppose heterogeneity of either of the variables.

It is a robust technique for testing the long-run equilibrium relationship between stationary price series. It relies on the Maximum Likelihood method and based on the relationship between the rank of a matrix and its characteristics roots. This cointegration test is based on two test statistics *viz*., trace statistic, and maximum eigen value estimated to test the null hypothesis of 'r' cointegrating vectors against the alternative hypothesis of 'r+1' cointegrating vectors.

Granger causality test

The Granger causality test was applied to study the price integration and to know the direction of causation between the selected markets. It is named after the first causality tests performed. It analyses the extent to which the past variations of one variable explain (or precede) subsequent variations of the other. When a cointegration relationship is present for two variables, a Granger Causality Test can be used to analyze the direction of this co-movement relationship. Granger causality between prices of two markets P_1t and P_2t Is specified as:

RESULTS AND DISCUSSION

Correlation coefficient for prices of Garlic at selected Markets in Uttar Pradesh state

The bivariate correlation coefficient among the price series of the selected market pairs in the state was reported. The bivariate correlation coefficients were calculated using price series for garlic in major markets of Uttar Pradesh state, the correlation coefficients range 0.903 to 0.958. The strong associations were observed for two market pairs namely Varanasi-Lucknow, Varanasi-Faizabad, and Faizabad – Lucknow. A weak association was observed for the market pairs Etah-Lucknow. There is a high and positive significant relation between Varanasi, Lucknow, Faizabad, and Etah markets.

Testing stationary in price series

The Augmented Dickey-Fuller (ADF) based unit root test is carried out to check the stationary of the time series price data from three representative Garlic markets [3]. The test was applied for Varanasi, Lucknow, Faizabad, and Etah markets. From 2010 to 2019 and the results are presented in (Table 1). At level with lag one, the ADF values of Varanasi (-2.20), Lucknow (-2.42), Faizabad (-1.64), and Etah (-2.47) more than the critical value at one per cent level of significance indicating the nonexistence of unit root implied that the price series of four markets non-stationary. After taking the first difference with lag one, the Augmented Dickey-Fuller (ADF) values of Varanasi (-7.79), Lucknow (-8.78), Faizabad (-7.88), and Etah (-11.76) are lower than that of the critical value at one per cent level i.e., this implied that the prices series become stationary at first difference level and are free from the consequence of unit root (Table 1).

Table 1. Correlation coefficient of prices for selected garlic markets in Uttar Pradesh state.

Markets	Varanasi	Lucknow	Faizabad	Etah
Varanasi	1	0.9586	0.9501	0.9219
Lucknow	0.9586	1	0.9388	0.9036
Faizabad	0.9501	0.9388	1	0.9261
Etah	0.9219	0.9036	0.9261	1

Lag length selection criteria

To test the cointegration next step is to calculate optimum numbers of lags of endogenous variables in the model [4]. This is done by using vector auto regressive (VAR) lag order selection criteria presented in Table 2. There are five criteria of selection; all are efficient and equally important. Out of five criteria, two i.e., SC and HQ criteria are showing the use of one lag for a model. On the other hand, AIC, FPE, and LR suggest lag of two for study. An optimum Lag of one was selected for the analysis to avoid complexities (Table 2).

Table 2. ADF test results of garlic prices for selected markets.

variables	level		First difference	
	t-statistics	p-value	t-statistics	p-value
Varanasi	-2.2033	0.2064	-7.798205	0.0001
Lucknow	-2.4252	0.1371	-8.786603	0.0001
Faizabad	-1.6401	0.4589	-7.885665	0.0001
Etah	-2.4711	0.1251	-11.76008	0.0001

Johansen's Multiple Co-integration test was employed to determine the long-run relationship between the price series. The test shows whether the selected Garlic markets are integrated or not [5]. The results of the co-integration test, at least two co-integration equations at 5% level of significance indicating that the selected garlic markets are having a long-run equilibrium relationship and there exists co-integration between them.

Causality among prices

After confirming the integration of prices series, in the next step, to know the direction of causation between the markets Granger Causality test was employed. Theoretically, a variable is said to Granger-cause another variable, if the current value is conditional on the past value. The casual relationship between the price series of selected garlic markets was approached through the Granger Causality technique.

The results of the analysis showing the relationship between selected garlic markets are presented. It was observed that there is unidirectional causality affected on garlic prices of Varanasi-Lucknow, Faizabad-Varanasi, Etah-Varanasi, Faizabad-Lucknow, and Faizabad-Etah, it means that a price change in the former market in each pair granger cause the price formation in the latter market, whereas the price change in the latter market is not feed backed by the price change in the former market [6]. There is bidirectional causality affected on garlic prices of Etah-Lucknow, which indicates that Etah and Lucknow prices are depending upon each other, in this case the former market in each pair granger causes the wholesale price formation in the latter market, which in turn provides the feedback to the former market as well (Table 3).

Table 3. VAR lag order selection criteria results.

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-3740.5	NA	1.29E+24	66.8664	66.9635	66.9058
1	-3560.4	344.241	6.87E+22	63.9349	64.42035	64.13186
2	-3539.1	39.08008	6.26e+22	63.84120	64.715	64.1957
3	-3531.7	13.1799	7.31E+22	63.9938	65.2559	64.5059
4	-3521.9	16.6001	8.21E+22	64.1048	65.7553	64.7744
5	-3507	24.2176	8.45E+22	64.1243	66.1632	64.9516
6	-3496.3	16.555	9.41E+22	64.2198	66.647	65.2046
7	-3483.8	18.493	1.02E+23	64.2827	67.0983	65.4251
8	-3474.3	13.414	1.17E+23	64.3986	67.6025	65.6985

CONCLUSION

The present study analyzed market integration and causality of major garlic markets in Uttar Pradesh state, using Johansen's cointegration, Granger causality test. The selected Garlic markets having a long-run equilibrium relationship for the prices of Garlic and there exists cointegration among them as indicated by the results of Johansen's Multiple Co-integration Test. The Granger causality test indicates there was bi-directional causality observed in Garlic prices between Etah and Lucknow. The remaining all market pairs exhibited unidirectional causality and affects. It has been observed from the study that there is a strong association among the markets, thereby influencing the prices from one market to another market. This helps to transfer the price signals from one market to another and thereby help in the stabilization of prices and create a healthy competitive environment. This would also a long way to help to protect the interest of the producer, sellers. It is recommended that the long-term procurement policy should be adopted to maintain price stability throughout the year by declaring the MSP and procurement by Nodal agencies at least for major markets of the state.

REFERENCES

1. Beag FA, et al. Cointegration, causality, and impulse response analysis in major apple markets of India. J Agri Res Rev. 2014;27:291-298.
2. Granger CJ. Investigating causal relationships by econometrics models and cross spectral methods. J Econometrica. 1969;37:425-435.
3. Johansen S, et al. Statistical Analysis of Cointegration Vectors. J Econ Dyn Control. 1988;12:231-254.
4. Reddy BS, et al. Price trend and integration of wholesale markets for onion in metro cities of India. J Eco Sustain Dev. 2012;3:120-130.
5. Sekhar CSC, Agricultural market integration in India: An analysis of select commodities. Food Policy. 2012;37:309-322.
6. Benagi VI, et al. Present status of pomegranate bacterial blight and its management. Acta Horticulturae. 2011;890:475-80.