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Market integration of selected cotton markets in Haryana

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ABSTRACT

The present study aimed to paper the co-integration among the selected cotton markets in Haryana. The monthly data on prices of cotton were collected for the period from 2005-06 to 2016-17. The advanced econometric tools like ADF test, Johansen co-integration test and Granger Causality test were used to study market integration. The price series of commodity namely cotton in selected markets showed the consequences of unit root and were stationary at first difference. The long run equilibrium relationship among the selected markets indicated that these were integrated with each other. This implies that prices in domestic markets of Haryana move together in response to changes in the demand and supply and cost of a product. Granger Causality test resulted Dabwali market as lead cotton market because it influenced the prices of most of selected cotton markets.

Key words: ADF test, Cotton, Integration, Market.

INTRODUCTION

Cotton is an important cash crop in many developing countries supporting the livelihoods of millions of households. Among the countries in which cotton is an important contributor to rural households are India, China and Pakistan. In world, cotton is cultivated in an area of 30.65 million hectares with a production of 123.36 million bales (170 kg each) and productivity of 683 kgs per hectare (2015-16). As per estimates, the production of cotton in world for the year 2016-17 stood at 136.96 million (Anonymous 2017).

India is the largest producer of cotton accounting for about 27 per cent of the world cotton production, followed by China which accounts for about 23 per cent of the world cotton production.

The cotton in th e country is cultivated in an area of 12.29 million hectares with a production of 30.01 million bales and productivity of 415 kg per ha (2015-16). The main cotton cultivating districts in Haryana are Sirsa, Hisar, Bhiwani, Fatehabad and Jind. These districts contribute almost 90 per cent of the area and production of cotton in Haryana. As per estimates, the production of cotton in Haryana for the year 2016-17 is 2041 thousand bales with productivity of 609 kg per ha (Anonymous 2017).

An efficient market provides remunerative prices for the produce to the farmer sellers. The extent to which markets make the commodity available and keep price stable depend on how the markets are integrated to each other. Stable prices play an important role to determine the farm income (Devi *et al*., 2016). Integrated markets can be defined as markets in which prices of the comparable goods do not behave independently. In an integrated market, price of a commodity is responsive to price changes of the same quality products in other markets. As such price differences for a particular variety of product in different markets of the area as a rule should not exceed the cost involved in the transportation and handling of the produce. The study of market performance by market integration characterizes the degree of co-movement of prices across spatially separated markets. It also guides the producers as to where, when and how much to sell. Therefore, present paper is an effort to understand the co-movement of the prices among different domestic markets for cotton in Haryana.

MATERIALS AND METHODS

Monthly data on prices for the years 2005-06 to 2016-17 were collected from AGMARKNET to study the market integration among selected cotton markets in Haryana. The major cotton producing districts *viz* Hisar, Sirsa, Fatehabad, Jind and Bhiwani were selected purposively for the study. From each district, two markets were selected purposively on the basis of arrivals of cotton in these markets. Thus Adampur and Uklana market from Hisar district, Sirsa and Dabwali market from Sirsa district, Fatehabad and Bhattukalan market from Fatehabad district, Jind and Uchana from Jind district and Bhiwani and Siwani market from Bhiwani district were selected.

The analysis of market co-integration of cotton markets involved the following steps:

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(i) Correlation analysis: One simple method to study market integration is to consider the correlation of price series for different markets. Correlation coefficient is a measure of degree of linear association between two variables. Karl-Pearson's correlation coefficient was used to analyse integration of cotton markets.

Correlation coefficient between two markets' prices X and Y

$$r(X, Y) = \frac{Cov(XY)}{\sqrt{Var(x)}\sqrt{Var(y)}}$$

To test the significance of correlation coefficient (r), t-test was used:

The significance of correlation was tested using the following formula:

$$t = \frac{r}{\sqrt{1-r^2}}\sqrt{n-2} \sim t \text{ (n-2) degrees of freedom}$$

(ii) Augmented Dickey-Fuller (ADF) test to check stationarity: Markets are considered to be integrated when long term equilibrium exists between them. Before analysing such relationship stationarity of price series is pre-requisite. The time series data on cotton prices in selected markets were checked for stationarity by using Augmented Dickey-Fuller (ADF) unit root test. 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 at level, the first differences of the series are tested for stationarity. The number of times (d) a series is differenced to make it stationary is referred to as the order of integration, I(d). The test was applied after running regression of the following form:

$$\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + \sum_{i=1}^{m} a_i \Delta Y_{t-i} + \varepsilon$$

Where, Y_t = Price of cotton in a given market at time t

$\Delta Y_t = Y_t - Y_{t-1}$

β_1 = constant

β_2 = coefficient on a time trend

ε = Pure white noise error term

m = optimal lag which is selected on the basis of Schwartz Information Criterion

Co-integration test: Johansen and Juselius (1990) developed Co-integration test to test the long run relationship among the price series and likelihood ratio test statistics are proposed to test number of co-integrating vectors. Trace-statistic and maximum Eigen values are used to test the null hypothesis of at most 'r' co-integrating vectors against 'more than r' (the alternative hypothesis co-integrating vectors.

Trace statistic (λ – trace) = $-T \sum_{i=r+1}^{n} ln\,(1 - \hat{\lambda}_i)$

Maximum Eigen value statistic (λ – max) = $-T \ln (1 - \hat{\lambda}_{r+1})$

λ_i s are the estimated Eigen values (characteristic roots) obtained from the Π markets T is the number of usable observations. The number of co-integrating vectors indicated by the tests is an important indicator of the existence of co-movement of the prices. As the number of co-integrating vectors increases, it implies the strength and stability of price linkages.

Granger Causality test: Granger causality test provides testing whether variable X_t causes variable Y_t and vice versa. All permutations are possible: unidirectional Granger causality from X_t to Y_t or from Y_t to X_t, bidirectional causality or absence of causality. An autoregressive distributed lag (ADL) model for the Granger-causality test is specified as below:

$$X_t = \sum_{i=1}^{n} \alpha_i Y_{t-i} + \sum_{j}^{n} = 1\ \beta_j X_{t-j} + \mu_{1t}$$

$$Y_t = \sum_{i=1}^{n} \gamma_i Y_{t-i} + \sum_{j}^{n} = 1\ \delta_j X_{t-j} + \mu_{2t}$$

Where,

X and Y are the price series of different markets

t is the time period

α, β, γ, δ are coefficients of respective price series

μ_{1t} and μ_{2t} are the error terms

RESULTS AND DISCUSSION

Correlation analysis: The results related to the correlation analysis of monthly wholesale prices of cotton among selected markets in order to check the integration are shown in Table 1. The results revealed that the correlation coefficients of prices were tending towards unity and significant at 1 per cent level of significance indicating that the selected markets in Haryana were integrated with each

Table 1: Correlation coefficients of cotton prices in Haryana markets.

Markets	Adampur	Uklana	Sirsa	Dabwali	Fatehabad	Bhattukalan	Jind	Uchana	Bhiwani	Siwani
Adampur	1.00									
Uklana	0.99***	1.00								
Sirsa	0.99***	0.98***	1.00							
Dabwali	0.98***	0.99***	0.98***	1.00						
Fatehabad	0.99***	0.99***	0.99***	0.99***	1.00					
Bhattukalan	0.99***	0.98***	0.99***	0.98***	0.99***	1.00				
Jind	0.98***	0.98***	0.97***	0.97***	0.98***	0.97***	1.00			
Uchana	0.98***	0.99***	0.98***	0.98***	0.99***	0.98***	0.98***	1.00		
Bhiwani	0.98***	0.98***	0.98***	0.97***	0.98***	0.98***	0.98***	0.98***	1.00	
Siwani	0.99***	0.98***	0.98***	0.97***	0.98***	0.98***	0.98***	0.98***	0.98***	1.00

*** indicates significant at 1 per cent probability level.

other. The markets of Haryana were highly correlated among each other with r value ranging from 0.97 to 0.99.

Augmented- Dickey Fuller test: To establish the long run equilibrium relation among the price series, it is necessary to co-integrate them. The co-integration among the price series in turn requires checking of order of integration in the given price series and it cannot be integrated in the presence of unit root, the same can be examined through conducting a stationarity test. Therefore, Augmented Dickey-Fuller (ADF) test was employed to check whether the time series data on cotton prices in the selected markets are stationary at their level, followed by their differences.

Table 2 indicated that the ADF values for cotton price series of all the selected markets in Haryana were more than critical value (1%) given by MacKinnon statistical table at level in both cases i.e. only intercept and intercept with trend implying the existence of unit root and non-stationarity. At first differences, the ADF values for cotton prices of all markets ranged from -9.25 to -11.04 (only intercept) were less than critical value (1%) of -3.51 and in case of intercept with trend the ADF values ranged from -9.21 to -10.98 were lower than critical value (1%) of -4.07 indicating that all the price series were stationary and free from consequences of unit root. Similar results were observed by Awasthi *et al*. (2016) and Anuja *et al*. (2013).

Johansen Co-integration analysis: The integration among the selected cotton markets in Haryana *viz*. Adampur, Uklana, Sirsa, Dabwali, Fatehabad, Bhattukalan, Jind, Uchana and Bhiwani was analysed using the time series data on price series for the period 2005-06 to 2016-17 by employing Johansen multiple co-integration procedure. The analysis was done using E-Views software. The results of both unrestricted

Table 2: Results of Augmented Dickey-Fuller test (ADF).

Markets	Particulars	At level	0.01Critical Value	At first difference	0.01Critical Value
Adampur	Intercept	-1.51	-3.51	-11.04***	-3.51
	Intercept + Trend	-3.27	-4.07	-10.97***	-4.07
Uklana	Intercept	-1.49	-3.51	-10.92***	-3.51
	Intercept + Trend	-3.27	-4.07	-10.86***	-4.07
Sirsa	Intercept	-1.63	-3.51	-10.90***	-3.51
	Intercept + Trend	-3.18	-4.07	-10.84***	-4.07
Dabwali	Intercept	-1.59	-3.51	-9.79***	-3.51
	Intercept + Trend	-2.82	-4.07	-9.73***	-4.07
Fatehabad	Intercept	-1.68	-3.51	-10.36***	-3.51
	Intercept + Trend	-3.35	-4.07	-10.29***	-4.07
Bhattukalan	Intercept	-1.47	-3.51	-10.97***	-3.51
	Intercept + Trend	-2.91	-4.07	-10.90***	-4.07
Jind	Intercept	-1.15	-3.51	-10.60***	-3.51
	Intercept + Trend	-3.17	-4.07	-10.54***	-4.07
Uchana	Intercept	-1.11	-3.51	-9.47***	-3.51
	Intercept + Trend	-2.79	-4.07	-9.42***	-4.07
Bhiwani	Intercept	-1.15	-3.51	-10.03***	-3.51
	Intercept + Trend	-2.89	-4.07	-9.97***	-4.07
Siwani	Intercept	-0.99	-3.51	-9.25***	-3.51
	Intercept + Trend	-2.73	-4.07	-9.21***	-4.07

Null Hypothesis: Series has a unit root
*** indicate significance at 1 per cent probability level

Table 3: Results of Johansen co-integration analysis, Haryana markets.

Co-integrating Equations	Max-Eigen Statistic	0.05 Critical Value	Trace Statistic	0.05 Critical Value
None	145.86**	64.50	592.82**	239.24
At most 1	135.11**	58.43	446.96**	197.37
At most 2	115.56**	52.36	311.85**	159.53
At most 3	73.79**	46.23	196.29**	125.62
At most 4	51.43**	40.08	122.50**	95.75
At most 5	24.66	33.88	71.07**	69.82
At most 6	18.59	27.58	46.41	47.86
At most 7	16.13	21.13	27.81	29.80
At most 8	7.31	14.26	11.68	15.49
At most 9	4.34**	3.84	4.37**	3.84

** denotes rejection of the hypothesis at the 0.05 level

co-integration rank tests i.e. Maximum Eigen statistic and Trace statistic is indicated in Table 3. The table indicated the presence of at least five co-integrating equations at 5 per cent level of significance (Maximum Eigen statistic) and six co-integrating equations at 5 per cent level of significance (Trace statistic). The strength of co-integration depends upon the number of co-integrating equations. Thus all the selected cotton markets in Haryana are having long run equilibrium relationship.

The above findings are in line with findings of Khatkar *et al*. (2013), Paul and Sinha (2015), Sundaramoorthy (2012) and Suresh (2017).

Granger Causality test: The direction of causation or causal relationship between the price series of selected markets in Haryana *viz*. Adampur, Uklana, Sirsa, Dabwali, Fatehabad, Bhattukalan, Jind, Uchana and Bhiwani were estimated through Granger Causality test and results are represented in Table 4. Among the selected cotton markets in Haryana, the bidirectional causality relationship in price transmission were found in between Uklana and Sirsa markets, Uklana and Siwani markets, Sirsa and Uchana markets, Dabwali and Bhattukalan markets, Fatehabad and Siwani markets and Jind and Siwani markets. The Dabwali market had influenced the cotton prices of Adampur, Uklana, Sirsa, Fatehabad, Uchana and Siwani markets in one way. While Fatehabad market had influenced the prices of Sirsa and Bhattukalan markets, Bhattukalan market had influenced the prices of Sirsa market, Jind market had influenced the prices of Adampur, Bhattukalan and Uchana markets and Siwani market had influenced the prices of Bhiwani market in unidirectional manner.

Table 4: Results of Pair-wise Granger Causality test of cotton in selected domestic markets of Haryana.

Null Hypothesis	Obs.	F-Statistic	Prob.	Relationship
DAB does not Granger Cause ADA	78	2.87** 1.86	0.02 0.11	DAB →ADA
ADA does not Granger Cause DAB				
JIN does not Granger Cause ADA	78	2.90** 1.29	0.02 0.28	JIN →ADA
ADA does not Granger Cause JIN				
SIR does not Granger Cause UKL	78	2.55** 2.20*	0.04 0.06	SIR → UKL
UKL does not Granger Cause SIR				
DAB does not Granger Cause UKL	78	2.22* 0.34	0.06 0.89	DAB → UKL
UKL does not Granger Cause DAB				
SIW does not Granger Cause UKL	78	2.33 * 4.19***	0.05 0.00	SIW → UKL
UKL does not Granger Cause SIW				
DAB does not Granger Cause SIR	78	2.30* 1.69	0.05 0.15	DAB →SIR
SIR does not Granger Cause DAB				
FAT does not Granger Cause SIR	78	2.61** 2.05	0.03 0.08	FAT → SIR
SIR does not Granger Cause FAT				
BHA does not Granger Cause SIR	78	1.94* 1.88	0.09 0.11	BHA →SIR
SIR does not Granger Cause BHA				
UCH does not Granger Cause SIR	78	2.72** 2.23*	0.03 0.06	UCH →SIR
SIR does not Granger Cause UCH				
FAT does not Granger Cause DAB	78	0.10 2.01*	0.99 0.09	DAB → FAT
DAB does not Granger Cause FAT				
BHA does not Granger Cause DAB	78	2.08* 3.07**	0.07 0.01	BHA → DAB
DAB does not Granger Cause BHA				
UCH does not Granger Cause DAB	78	0.93 3.77***	0.47 0.00	DAB → UCH
DAB does not Granger Cause UCH				
SIW does not Granger Cause DAB	78	1.09 3.75***	0.38 0.00	DAB → SIW
DAB does not Granger Cause SIW				
BHA does not Granger Cause FAT	78	1.55 2.61**	0.19 0.03	FAT → BHA
FAT does not Granger Cause BHA				
SIW does not Granger Cause FAT	78	2.15* 2.72**	0.07 0.03	SIW → FAT
FAT does not Granger Cause SIW				
JIN does not Granger Cause BHA	78	2.13* 1.13	0.07 0.35	JIN → BHA
BHA does not Granger Cause JIN				
SIW does not Granger Cause BHA	78	2.01* 0.99	0.08 0.43	SIW → BHA
BHA does not Granger Cause SIW				
UCH does not Granger Cause JIN	78	1.15 1.94*	0.34 0.09	JIN → UCH
JIN does not Granger Cause UCH				
SIW does not Granger Cause JIN	78	2.05* 2.44**	0.08 0.04	SIW → JIN
JIN does not Granger Cause SIW				

***, ** and * indicates significant at 1, 5 and 10 per cent probability level

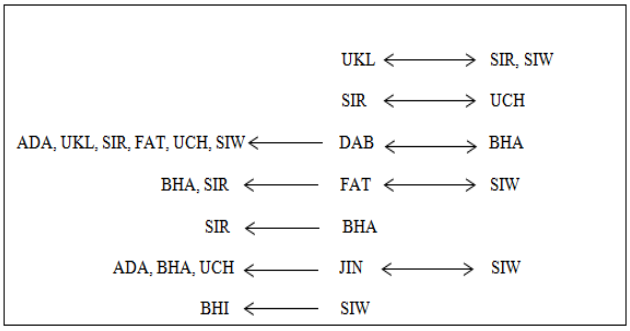


Fig 1: Relationship between the cotton price series of Haryana markets. ADA – Adampur, UKL – Uklana, SIR – Sirsa, DAB – Dabwali, FAT – Fatehabad, BHA – Bhattukalan, JIN – Jind, UCH – Uchana, BHI – Bhiwani and SIW – Siwani

Fig 1 revealed that the Dabwali market influenced the prices of most of selected cotton markets i.e. Adampur, Uklana, Sirsa, Fatehabad, Uchana, Siwani and Bhattukalan market. Therefore, Dabwali market was considered as lead cotton market among all the selected cotton markets. Present finding is in conformity with finding of Devi *et al*. (2016) and Suresh (2017).

CONCLUSION

The correlation analysis indicated that the price series of selected markets were highly correlated among each other. The long run equilibrium relationship provides a clear evidence of the integration of selected cotton markets. This implies that prices in domestic markets of Haryana move together in response to changes in the demand and supply and cost of a product. Granger Causality test resulted Dabwali market as lead cotton market because it influenced the prices of most of selected cotton markets i.e. Adampur, Uklana, Sirsa, Fatehabad, Uchana, Siwani and Bhattukalan market. As the domestic markets are integrated with each other in long run, adequate market support with fair price for producers of cotton leads to higher production of cotton. The study also suggests that the market integration and forecasts of prices in different markets will be a guiding principle for selecting the most efficient market and accordingly the policy makers and the producers will find it most useful.

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