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 the 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:

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

(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, d.

The test was applied after running regression of the following form:

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

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

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

$\beta_1$ = constant

$\beta_2$ = coefficient on a time trend

$\epsilon$ = 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 ($\lambda_n$ - trace) = $-T \sum_{i=1}^{r} \ln (1 - \lambda_i)$

Maximum Eigen value statistic ($\lambda_n$ - max) = $-T \ln (1 - \lambda_n)$

$\lambda_i$ 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 causes variable Y and vice versa. All permutations are possible: unidirectional Granger causality from X to Y or from Y to X, bidirectional causality or absence of causality. An autoregressive distributed lag (ADL) model for the Granger-causality test is specified as below:

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

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

Where,

X and Y are the price series of different markets

t is the time period

$\alpha$, $\beta$, $\gamma$, $\delta$ are coefficients of respective price series

$\mu_{it}$ and $\mu_{jt}$ 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

| Markets     | Adampur | Uklana | Sirsa | Dabwali | Fatehabad | Bhattukalan | Jind | Uchana | Bhiwani | Siwani |
|-------------|---------|--------|-------|---------|-----------|-------------|------|--------|---------|--------|
| Adampur     | 1.00    | 0.99***| 0.98***| 0.98***| 0.98***   | 0.98***     | 0.98***| 0.98***| 0.98***| 0.98***|
| Uklana      | 0.99***| 1.00   | 0.98***| 0.98***| 0.98***   | 0.98***     | 0.98***| 0.98***| 0.98***| 0.98***|
| Sirsa       | 0.99***| 0.98***| 1.00   | 0.98***| 0.98***   | 0.98***     | 0.98***| 0.98***| 0.98***| 0.98***|
| Dabwali     | 0.98***| 0.98***| 0.98***| 1.00   | 0.98***   | 0.98***     | 0.98***| 0.98***| 0.98***| 0.98***|
| Fatehabad   | 0.99***| 0.98***| 0.98***| 0.98***| 1.00      | 0.98***     | 0.98***| 0.98***| 0.98***| 0.98***|
| Bhattukalan | 0.99***| 0.98***| 0.98***| 0.98***| 0.98***   | 1.00        | 0.98***| 0.98***| 0.98***| 0.98***|
| Jind        | 0.98***| 0.98***| 0.98***| 0.98***| 0.98***   | 0.98***     | 1.00   | 0.98***| 0.98***| 0.98***|
| Uchana      | 0.98***| 0.98***| 0.98***| 0.98***| 0.98***   | 0.98***     | 0.98***| 1.00   | 0.98***| 0.98***|
| Bhiwani     | 0.98***| 0.98***| 0.98***| 0.98***| 0.98***   | 0.98***     | 0.98***| 0.98***| 1.00   | 0.98***|
| Siwani      | 0.99***| 0.98***| 0.98***| 0.98***| 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 | 0.01 Critical Value | At first difference | 0.01 Critical 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               | 446.95**        | 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
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***     | 0.02  | DAB → ADA       |
| ADA does not Granger Cause DAB         | 78   | 2.90***     | 0.02  | ADA → JIN       |
| JIN does not Granger Cause ADA         | 78   | 2.55**      | 0.04  | JIN → UKL       |
| UKL does not Granger Cause SIR         | 78   | 2.22*       | 0.06  | UKL → DAB       |
| UKL does not Granger Cause DAB         | 78   | 2.33*       | 0.05  | UKL → SIW       |
| UKL does not Granger Cause SIW         | 78   | 2.19*       | 0.05  | SIW → UKL       |
| DAB does not Granger Cause SIR         | 78   | 2.61**      | 0.03  | DAB → SIR       |
| SIR does not Granger Cause FAT         | 78   | 1.94*       | 0.09  | SIR → BHA       |
| SIR does not Granger Cause BHA         | 78   | 2.72**      | 0.03  | SIR → UCH       |
| UCH does not Granger Cause BHA         | 78   | 0.100.21*   | 0.99  | UCH → FAT       |
| FAT does not Granger Cause DAB         | 78   | 2.08*       | 0.07  | FAT → DAB       |
| DAB does not Granger Cause FAT         | 78   | 0.93377***  | 0.47  | DAB → UCH       |
| DAB does not Granger Cause SIW         | 78   | 1.09375***  | 0.38  | DAB → SIW       |
| BHA does not Granger Cause SIW         | 78   | 1.552.61**  | 0.19  | BHA → FAT       |
| BHA does not Granger Cause BHA         | 78   | 2.15*       | 0.07  | BHA → SIR       |
| JIN does not Granger Cause BHA         | 78   | 2.13*       | 0.07  | JIN → BHA       |
| BHA does not Granger Cause JIN         | 78   | 2.01*       | 0.08  | BHA → SIW       |
| SIW does not Granger Cause SIW         | 78   | 1.151.94*   | 0.34  | SIW → UCH       |
| UCH does not Granger Cause JIN         | 78   | 2.05*       | 0.08  | UCH → JIN       |
| JIN does not Granger Cause UCH         | 78   | 2.44*       | 0.08  | SIW → JIN       |

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