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Research Article

MARKET INTEGRATION AND PRICE VOLATILITY ACROSS SOYBEAN MARKETS IN CENTRAL INDIA

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Abstract- Madhya Pradesh being the leading soybean producing state of India and is also called the Soybean bowl in India. The aim of this paper is to assess the extent and integration among soybean markets i.e. Astha, Dewas, Indore, Mandsaur and Shajapur and to study price movement of soybean in Madhya Pradesh. The results of the Co-integration analysis showed that the prices of soybean were non-stationary and observed higher in the months from May to August in all the selected markets. Most of the selected markets showed bidirectional influence on soybean prices of each other and function as a satellite market and assimilate information. It is high time that all the agencies concerned with the sector to formulate strategies to bring back the prestigious position Madhya Pradesh had in India's Soybean economy.

Keywords- Time Series, Soybean price volatility, Market integration, Causality.

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Introduction

Madhya Pradesh is leading state in soybean production and claim first position in India constitutes about 50% and 46 % of area and production respectively in India. The soybean has registered significant growth in area and yield during the last decade. Despite this promising growth the import of edible oil were very high hovering between 60-70% of total agriculture import of India [1]. Due to high import dependence, domestics edible oil prices remain highly correlated to the movement in the international prices and this has resulted in volatility in the domestic prices. Therefore, it is primarily the state of Madhya Pradesh which holds the key for any strategy to develop soybean production and trade in the country.

Commodity price volatility is not a new problem but has grown in the wake of liberalization and globalization process. The open trade regime enabled India to capture emerging opportunities in the world market and also exposed the domestic economy to the risks of fluctuating world prices. The government and price sector have tried to stabilize prices through a variety of mechanisms but few of these have been successful.

Against this backdrop the present study attempts to understand the co-movement of the prices among different domestic markets for soybean in Madhya Pradesh. It also estimates the volatility exhibited by the domestic prices in a various markets and provides suitable policy for the sustainability of the soybean sector.

Materials and Methods

Data Sources

The study Area:

The study relies on secondary data compiled from various published sources. The monthly time series data on arrivals and prices of Soybean were collected from five major soybean markets of Madhya Pradesh namely Ashtha, Dewas, Indore, Mandsaur and Shajapur; based on highest arrivals covering a period of more than one decade i.e. from year 2001-02 to 2013-14.

Analysis of Data

Seasonality analysis:

This was studied from the original monthly arrivals and prices data using seasonal indices. There are at least four methods to calculate seasonal indices from the original data. These are the ratio to trend, the ratio to moving average, simple averages and link relative methods. The ratio to moving average method was employed in the present study to compute the seasonal indices. The method used has following procedures.

The centered 12 month moving average should be computed from the original data which contain the trend and cyclical component.

Divide the original data by the centered moving average.

$$Y = TSCI \qquad \text{or} \qquad Y / MA = \frac{TSCI}{TC} = SI$$

After averaging the data, multiply it by hundred then the result is seasonal index for each month.

The sum of the seasonal indices should be 1200. If it is greater or less than 1200 then adjust it using a correction factor.

$K = \frac{1200}{S}$ Where, K = Correction factor S = Sum of seasonal indices

Co-integration analysis

The Soybean prices varied between different markets and regions due to localization, market segmentation, variation in weather and other factors. The monthly prices data used for Co-integration tests start with the promise that for a long-run equilibrium relationship to exist between two variables. Thus, the first step involves testing for stationarity for variables. In econometrics, a time series that has a unit root is known as a random walk which is an example of a non-stationary time series. If the original series is found to be non-stationary, the first

differenced of the series are tested for stationarity.
The most widely used tests for unit roots are the Dickey-Fuller (DF) test (1981) and the Augmented Dickey-Fuller test (ADF). Both will test the null hypothesis that the series has a unit root or in other words, it is not stationary. The DF test was applied by running the regression of the following form.

$$\Delta Y_t = \beta_t + \delta Y_{t-1} + U_t$$

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

The ADF test is run with the following equation,

$$\Delta Y_t = \beta_t + \delta Y_{t-1} + \alpha_i + \sum_{i=1}^{n} \Delta Y_{t-1} + e_t$$

Where, $\Delta Y_t = (Y_t - Y_{t-1})$; $\Delta Y_{t-1} = (Y_{t-1} - Y_{t-2})$

The extent of integration will determine whether the prices of soybean markets are in parity with the different markets. Co-integration between the prices of the major markets were evaluated by regressing the prices of soybean in different markets. The residual was examined for the order of integration. The basic relationship that is commonly used to test for the existence of market integration is

$$P_{it} = \alpha_0 + \alpha_1 P_{jt} + \varepsilon_t$$

Where,
Pi and Pj = price series of a specific commodity in two markets i and jεt = residual term
Johansen (1988) has developed a multivariate system of equations approach, which allows for simultaneous adjustment of both or even more than two variables. Johansen's approach is also widely used in many bivariate studies as it has some advantages to the single equation approach. First, it allows estimating the co-integration vector with smaller variance. The second advantage of the multivariate approach is that in the simultaneous estimation, it is not necessary to presuppose exogeneity of either of the variables.

Granger causality test:
In order to know the direction of causation between the markets, Granger causality test was employed. Granger causality tests come in pairs, testing whether variable Xt. Granger-causes variable y_t and vice versa. All permutations are possible *viz.*, univariate Granger causality from Xt to y_t or from yt to Xt, bivariate causality or absence of causality. The Granger causality test analyses whether the unrestricted equation,

$$Yt = \alpha_0 + \sum T_j = 1\ \alpha_{1i} y_{t-i} + \sum Tj = 1\ \alpha_{2i}\ X_{t-j} + \varepsilon_t \quad \text{With } 0 < i, j < T$$

Yield better results than the restricted equation.

$Yt = \beta_0 + \sum Ti=1\ \beta_{1i} yt\text{-}i + \varepsilon_t$ with $\sum T_j = 1\ \alpha_{2i}\ X_{t-j} = 0$ (The null hypothesis) i.e, if Ho, in which $\alpha_{21} = \alpha_{22} = \ldots\ldots = \alpha_2 T = 0$, is rejected then one can state variable X_t "Granger causes variable y_t"

Results and Discussion
Movement of the soybean arrivals and prices
Seasonality in arrivals and prices are such changes that occur regularly every year as a result of changes in season. These variations may be primarily due to the seasonal production, poor storage facilities and lack of retention power of Soybean growers.
The seasonal indices computed for Soybean arrivals in different markets of Madhya Pradesh have been presented in [Table-1] and [Fig-1].

Table-1 *Seasonal indices of monthly arrivals of soybean in different markets of Madhya Pradesh (Unit: In Percent)*

Month	Market				
	Ashtha	Dewas	Indore	Mandsaur	Shajapur
January	110.08	98.71	87	112.68	106.55
February	72.5	59.27	58.82	61.38	64.99
March	34.42	36.39	47.48	43.3	30.42
April	36.29	38.61	46.33	42.98	32.89
May	47.47	41.63	52.84	56.26	35.28
June	77.29	56.52	67.86	64.27	50.69
July	73.04	66.51	78.92	78.91	55.13
August	22.76	38.1	40.22	60.88	21.07
September	27.99	56.16	84.71	68.49	55.33
October	241.41	276.45	290.2	225.87	228.57
November	282.23	288.19	207.01	225.93	318.21
December	174.51	143.45	138.6	159.07	200.87

The seasonal indices of soybean arrivals in different markets of Madhya Pradesh inferred that higher indices of market arrivals were noticed immediately after harvest (October to December) in different markets. The lower value of indices of arrivals during the period of February to August indicated lean period in soybean for different markets of Madhya Pradesh [2].

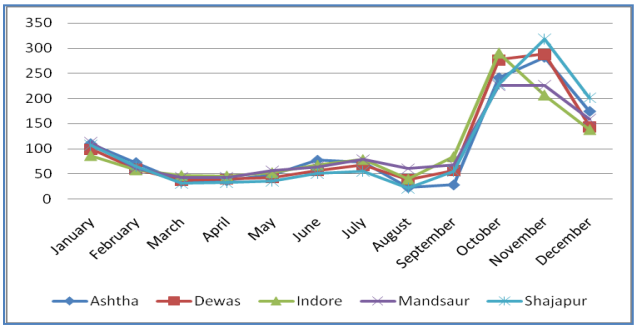

Fig-1 Seasonal indices of soybean arrivals in different markets of Madhya Pradesh

In respect of price indices of Soybean, lower price values were observed during the month of October to March in different markets of Madhya Pradesh which are the post-harvest months of the Soybean crop, where the output comes in the market in large quantity. The highest values of price indices were observed during lean period and lowest arrivals months from May to September in different markets.

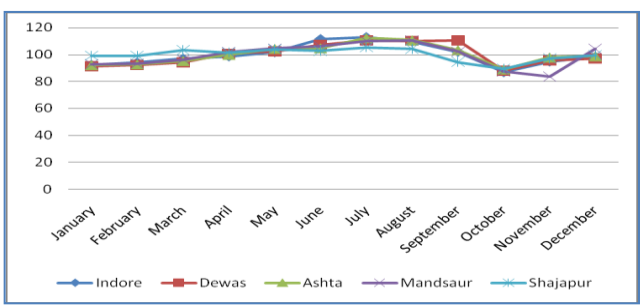

Fig-2 Seasonal indices of soybean prices in different markets of Madhya Pradesh

Table-2 *Seasonal indices of monthly prices of soybean in different markets of Madhya Pradesh (Unit: In Percent)*

Month	Market				
	Indore	Dewas	Ashta	Mandsaur	Shajapur
January	92.39	91.39	92.03	93.01	99.09
February	94.14	92.30	92.66	93.45	99.06
March	96.92	94.25	95.16	96.41	103.30
April	98.65	100.68	99.80	101.95	101.46
May	101.74	102.29	104.29	104.57	104.04
June	111.50	107.00	104.71	106.05	102.77
July	113.00	110.51	112.24	110.28	105.30
August	109.59	110.20	110.73	110.55	104.22
September	102.04	110.48	103.25	102.21	94.54
October	86.88	87.97	88.70	87.62	89.60
November	94.78	95.69	97.76	83.73	96.99
December	98.37	97.25	98.67	104.16	99.64

Volatility in Soybean prices

The evaluation of market efficiency by Co-integration analysis recognizes that the time series of prices for various markets are usually non-stationary variables and if these series are found to be non-stationary then it becomes necessary to test them for co-integration, Augmented Dickey Fuller (ADF) based unit root test procedure test was applied at level and first difference to check whether the price series of Soybean were stationary or not [3]. The results of unit root test for soybean in selected markets are presented in [Table-3].

Table-3 *Augmented Dickey Fuller unit root test for prices of soybean in selected markets of Madhya Pradesh*

Market	Augmented Dickey-Fuller (ADF)		Critical value (1%)
	Level	1st difference	
Ashtha	-0.045812 (0.0782)	-1.205706 (0.0000)	-3.478547
Dewas	-1.168691 (0.0000)	-1.168691 (0.0000)	-3.478547
Indore	-0.044582 (0.0847)	-0.882095 (0.0000)	-3.478547
Mandsaur	-0.055646 (0.0974)	-1.273261 (0.0000)	-3.478547
Shajapur	-0.058520 (0.0418)	-1.189553 (0.0000)	-3.478547

***significant at 1% level*

Note: Figures in parentheses indicate Mackinnon (1996) p-value

From [Table-3], it could be inferred that Augmented Dickey Fuller test values are above the critical (1%) given by MacKinnon statistical table at levels implying that the series are non- stationary and indicating the existing of unit root. After taking the first difference, all the series become stationary which means that the calculated values for all the markets are less than the critical value (1%) and free from the consequence of unit root. The results of the Augmented Dickey-Fuller (ADF) unit root test for Soybean showed that the level data were non-stationary but their first differences were stationary. Hence, all market price series were integrated of the order 1 i.e. I(1).

Johansen Co-integration test

The co-integration was examined for price series of soybean in major markets of the Madhya Pradesh. The trace test and the Eigen value statistics obtained from the Johansen Co-integration rank test are presented in [Table-4]. The trace test results for Soybean price showed that trace statistics value was greater than the critical value at 5 per cent level of significance of five markets selected for soybean in Madhya Pradesh and suggest that even if there is geographical dispersion of markets the prices are integrated. Hence, we obtained at least three co-integrating equation(s) at 5 per cent level of significance. This indicated that the model variables had a long-run equilibrium/co-movement among the Indore, Dewas, Astha, Mandsaur and Shajapur market price series during the period under study. The existence of co-integration is necessary for long-term market efficiency.

Table-4 *Johansen's co-integration test results for Soybean markets of Madhya Pradesh*

Unrestricted Co integration Rank Test (Trace)				
Hypothesized No. of CE(s)	Eigen value	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.301157	117.3722	69.81889	0.0000
At most 1 *	0.227076	68.63953	47.85613	0.0002
At most 2 *	0.131766	33.60943	29.79707	0.0173
At most 3	0.093750	14.39343	15.49471	0.0728
At most 4	0.007366	1.005549	3.841466	0.3160

Trace test indicates 3 co-integrating equation(s) at the 5% level

** denotes rejection of the hypothesis at the 0.05 level*

***MacKinnon-Haug-Michelis (1999) p-values*

The foregone discussion suggests that even though the markets are integrated, there could still be disequilibrium in the short run due to the price adjustments across the markets, which might not happen instantaneously or simultaneously.

Pair wise Granger Causality test

The co-integration tests performed indicate only the existence of long run relationship among the prices of the soybean in the five markets. The direction of the relationship among price series and markets is equally important for which Granger Causality Tests are performed which identifies the direction of causation of price between two markets occur in two ways- bidirectional (where shocks in either market of a market pair are transmitted to the other market) and unidirectional (where shocks in one market affect other market, but not the reverse) [4].

Granger Causality test was employed to know the direction between the markets. Theoretically, a variable, if the current value is conditional on the past data. The results of Pair wise Granger Causality test showed that there was a bidirectional influence on prices of Mandsaur and Astha, Shajapur and Astha & Mandsaur and Dewas. The prices of Mandsaur market also influenced Astha and Dewas markets and the prices of Shajapur market influenced Dewas market.

The prices of Mandsaur market also influenced the Astha and Dewas markets and the price of Shajapur market influenced the Astha market. There was a unidirectional influence on prices of Astha and Dewas, Indore and Astha, Indore and Dewas, Shajapur and Dewas, Indore and Mandsaur, Shajapur and Indore & Shajapur and Mandsaur markets. Thus, Out of ten markets pairing seven market pairs are related to a unidirectional way while only three markets is related in a bidirectional manner.

Table-5 *Pair wise Granger Causality Tests for Soybean markets of Madhya Pradesh*

Null Hypothesis:	F-Statistic	Prob. Direction	Relationship
DEWAS does not Cause ASHTHA	0.76735	0.4663 Unidirectional	Ash → Dew
ASHTHA does not Cause DEWAS	21.2299**	1.E-08	
INDORE does not Cause ASHTHA	11.5426**	2.E-08 Unidirectional	Ind → Ash
ASTHA does not Cause INDORE	2.29824	0.1044	
MANDSAUR does not Cause ASHTHA	7.52919**	0.0008 Bidirectional	Man ↔ Ash
ASHTHA does not Cause MANDSAUR	11.5297**	2.E-05	
SHAJAPUR does not Cause ASHTHA	3.52195*	0.0323 Bidirectional	Sha ↔ Ash
ASHTHA does not Cause SHAJAPUR	3.58627*	0.0304	
INDORE does not Cause DEWAS	26.0376**	3.E-10 Unidirectional	Ind → Dew
DEWAS does not Cause INDORE	0.04032	0.9605	
MANDSAUR does not Cause DEWAS	17.8083**	1.E-07 Bidirectional	Man ↔ Dew
DEWAS does not Cause MANDSAUR	5.50106**	0.0051	
SHAJAPUR does not Cause DEWAS	10.7460**	5.E-05 Unidirectional	Sha → Dew
DEWAS does not Cause SHAJAPUR	1.19958	0.3045	
MANDSAUR does not Cause INDORE	1.35586	0.2612 Unidirectional	Ind → Man
INDORE does not Cause MANDSAUR	14.5783**	2.E-06	
SHAJAPUR does not Cause INDORE	3.98724*	0.0208 Unidirectional	Sha → Ind
INDORE does not Cause SHAJAPUR	2.71740	0.0697	
SHAJAPUR does not Cause MANDSAUR	7.06986**	0.0012 Unidirectional	Sha → Man
MANDSAUR does not Cause SHAJAPUR	2.67546	2.0726	

** indicates significant at 5 per cent probability level.*
*** indicates significant at 1 per cent probability level.*
Ash – Ashtha; Dev – Dewas; Ind – Indore; Man – Mandsaur; Sha - Shajapur

Conclusion

The study concluded that the prices of soybean were higher in the months from June to August and cyclical variation observed in all selected markets. The price series showed the consequences of unit root and were stationary at first difference. Most of the markets showed significant statistically bidirectional influence on soybean price of each other, which was indicative of mutual influence exerted by the markets on each other. On the other hand Dewas Ashtha, Indore, Shajapur, Mandsaur markets exhibited unidirectional influence. Thus, there is need to improve on provision of market information on price dissemination to all actors in order to fully understand the flow of soybean from the domestic to regional markets.

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Conflict of Interest: None declared

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