INDIAN JOURNAL OF
ARID HORTICULTURE
2018, Vol. 13 (1-2):84-90

Analysis of price variation and market integration of ragi in selected markets of Tamil Nadu and Karnataka

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(Received: 10.08.2018; Accepted: 12.09.2018)

Abstract

Agriculture supply is uncertain and this leads to fluctuations in prices. The study investigates the price details, market integration of ragi in selected markets of Tamil Nadu and Karnataka. The time series data of ragi in wholesale prices were collected for 15 years for the time period of 2003-2017. The results from the analysis of price variations, the seasonal indices of ragi are found to be higher in sowing months and the ragi price trend showing more fluctuation, as the consumption pattern of ragi has widened and demand for Ragi is increasing the years. The unit root test revealed that the four wholesale markets except Vellore market were non stationary at 1 per cent level and become stationary after first differencing. In Johansen co-integration procedure there is three co-integration equations at 5 per cent level of significance among the ragi prices. The VECM estimates in short-run Chintamani market price converged into equilibrium within 6 days. The shock observed by the Tumkur market price will be corrected within 10 days. In the long-run Chintamani and Tumkur markets were influenced by their own monthly lagged price and Hosur markets were influenced by Denkanikottai first month lagged prices of the market.

Key words: Market intelligence, price variation, Tamil Nadu

Introduction

Agricultural commodity prices are well known to fluctuate over time and markets. Price stabilization efforts for various essential agricultural commodities continue to maintain be the major concern for policy makers. Both the producers and consumers are affected by price instability. The increase in the prices of agricultural commodities spills over to other sectors of the economy leading to an increase in the overall rate of inflation. Knowledge of relative price relationships and variability over seasons and trends is important for understanding the patterns of change and resource allocation in the agricultural sector (Byerlee and Iqbal, 1987).

Material and Methods

Five ragi markets from Tamil Nadu and Karnataka were related based on regular availability of data during study period. The selected markets were Chintamani and Tumkur in Karnataka and Denkanikottai, Hosur and Vellore in Tamil Nadu. Data on monthly wholesale prices were collected for 15 years (2003 to 2017). The Wholesale price were collected from Agmarknet, Regulated markets and DEMIC.

Seasonal Variations

Seasonal variations indicated the regularity of upward and downward movements during the year. These price variations resembled the cycle but covered a period of 12 months or less. Moving averages were useful to eliminate periodic movements. An average represented the “middling” value of a set of numbers.

The percentage of actual moving average was calculated by the following formula

Seasonal Index = (Actual data for the month/Cantered moving average for the month) x 100

The percentage of actual moving averages was arranged in the form of monthly patterns and the average of each index was calculated and adjusted their sum value to become 1200. This was done by working out a correction factor and multiplied the average index for each month by this factor.

Correction factor (K)= 1200/S

Where, S = Sum of average index for a year

Seasonal indices were constructed for different months and plotted in a graph to understand the price variations.

Trend analysis

Analysis of long-term movements (trend) for estimating the long run trend of prices, the method of least squares estimate was employed. This method of ascertaining the trend in a series of annual prices involved estimating the coefficient of intercept (a) and slope (b) in the linear functional form. The equation adopted for this purpose was specified as follows.

$$Y=a+bx$$

Where,

Y = Trend values at time t

a = intercept parameter

b = slope parameter, which also indicates the trend rate

X = independent variable- monthly average price of ragi

(Rs/kg).

Market Integration

A relatively unrestricted modeling approach based on the error correction mechanism (ECM) advocated by Banerjee *et al.* (1986), Hendry and Richard (1982), Hendry and Mizon (1990) and Banerjee *et al.* (1993) were utilized to this study. The empirical exercise consists:

Testing for a Unit Root

Testing for stationarity in the time series data is pre requisite since the time series has the presence of trend components (Davidson and Mackinnon, 1993). Augmented Dickey fuller (ADF) test involved in testing stationarity of the variables and if the time series is found to be non-stationary, the first differences of the series are tested for stationarity.

The test mentioned above consider the null hypothesis of a time series has a unit root (non-stationary). The test is applied by running the regression of the following form:

$$\Delta y_t = (\rho - 1) y_{t-1} + u_t = \delta y_{t-1} + u_t$$

This model can be evaluated and testing for a unit root is proportional to testing d= 0 (where d = ? - 1) and Augmented-Dickey Fuller (ADF) unit root test are used. The null hypothesis of non-stationary is tested using a t-test. The null hypothesis is rejected if estimated variable is significantly negative.

Once the time series data checked for stationary and are of same order, integration between them tested using the models as ADF test @ Johansen co-integration test in a bivariate as well as multivariate framework of the estimated value of the error exceeds critical values at 1, 5 and 10 per cent of level of significance and the conclusion would be that the residual term is stationary and hence the time series, through the non-stationary are co-integrated in the long run.

Johansen's multiple co-integration frameworks

The individual time series of the prices may be non-stationary on levels, but a linear combination of them may be stationary indicating a long-run equilibrium relationship between them (Engle and Granger, 1987). The linear combination of co-integration regression as follows

$$Y_t = \beta_1 + \beta_2 X_1 + Z_t$$

Where Y_1 and X_1 are two price series in levels and Z_t is the residual term testing for co-integration

Estimation of price adjustment-Vector error correction mechanism

Regression is one random walk on the other has a stationary error term. Subsequently building up that a relationship exists between unit root factors, That relationship is called the co-integrating vector, which for our example is (Abbasa and Foreman-Peck, 2007) since the sum is stationary.

$$X_t = \alpha_1(\beta_1 Y_{t-1} + \beta_2 X_{t-1} + \varepsilon_t + \vartheta_t$$

$$\boxed{\Delta Y_t = \alpha_2(\beta_1 Y_{t-1} + \beta_2 X_{t-1} + \mu_t + \vartheta_t}$$

Whereas alpha contains speed of adjustment and beta contains co-integrating equation. These time series analyses of econometric models are carried out using Eviews 7.0.0.1.rar.

Results and Discussion

Ragi - Area, production and productivity

` In India, Karnataka and Tamil Nadu are the principle ragi growing states, besides Andhra Pradesh, Maharashtra, Uttar Pradesh and Bihar (TNAU Agritech Portal). Karnataka is the largest Ragi growing state and it has seen a steady rise in production. Between 2011 and 2014, Ragi production in the state grew 12.7 per cent while the total area under ragi cultivation grew 4.1 per cent. Yield per hectare has also risen steadily. Ragi yield across the country rose 8.34 per cent from 1,534 kg per hectare in 2005-06 to 1,662 kg per hectare in 2014-15 (Directorate of Economics and Statistics, 2016).

The tables below indicate the selected state wise average normal area, production and productivity of ragi in India (Average of 2011-12 to 2015-16).

Table 1. State-wise Normal Area, Production and Yield of Ragi

State	(Average of 2011-12 to 2015-16)		
	Area (in 000 Hectare)	Production (in 000 Tonnes)	Productivity (In Tonnes/Hectare)
Karnataka	681.8	1182.7	1.73
Tamil Nadu	93.2	269.3	2.88

Source: Ministry of Agriculture and Farmers Welfare, Govt. of India (2017).

Ragi Prices

In the decade to December 2016, ragi prices increased 270 per cent compared with a 113 per cent rise in the wholesale price index for all cereal, (Centre for Monitoring Indian Economy). The domestic and international export market for ragi was estimated to be $4.5 billion, “If the policies of the government are right, given this demand, the area under ragi cultivation can grow 30 per cent in the next few years”, (Indiastat). Minimum support prices for Ragi was Rs.1650/- and above per quintal as on November 2016. (Source: Directorate of economics and statistics, 2017).

The price variations of selected markets were shown in the fig. 1 to fig. 5. It is observed from the graphs that, in the case of all above markets (Chintamani, Tumkur, Denkanikottai, Hosur, and Vellore) the monthly average price of ragi in the year 2017 is showing a declining trend over the months. During the year 2013 the price series of ragi in Vellore and Tumkur market were found to be decreasing and in other markets the trend was found to increasing. For the year 2008 and 2003, all the markets were showing a slight increasing and stable price trend. During early years the ragi price trend was observed to be stable, this may be due to the demand for ragi was low but in case of recent years (2013-17) the ragi price trend is showing more fluctuation, as the consumption pattern of ragi has widened and demand for ragi is increasing the years.

Seasonal index for the selected markets

Seasonal index for the selected markets are given in the table 2. From the table highest seasonal indices were played in the months are represented in the table. In these months the price had a higher realization over the years (2003-2017). In Chintamani wholesale market highest seasonal indices were found October-April, Tumkur market found that February-April, June-August and October, Denkanikottai wholesale market found that November, December and May-July, Hosur wholesale market found to be January, March-June and September, and Vellore wholesale market found that December-April have been played the highest seasonal indices over the years (2003-2017).

Comparison of Seasonal Index in Selected Markets of Tamil Nadu and Karnataka

Comparison of seasonal index in selected markets of Tamil Nadu and Karnataka with their harvesting seasons was given in the table 3 and 4. From the tables the results could be inferred that Chintamani market seasonal price index was less than one during July to September since it was the harvesting period and the arrivals were very high. In the case of Tumkur and Hosur market the seasonal indices value than one were observed during October to January which was their harvesting period. The seasonal indices were high during other months. In the case of Vellore market the seasonal index value less than one was observed during September which comes immediately after the harvesting period of ragi. In the all above markets seasonal index value less than one coincides with the harvesting season of ragi because of huge amount of arrivals in the market.

From this comparison farmer in Tumkur market catchment area harvest their ragi in November, December and January months, were advised to link the Chintamani markets for their high price realization due care must be taken additional transaction cost involved. Similarly farmers in Denkanikottai market catchment area can exploit the Hosur market during the harvesting period for higher price realization. Farmers in Chintamani market catchment area were link to the Tumkur, Denkanikottai and Hosur for higher realization. Farmers in Vellore catchment area for better price realization they can store and sell later rather than link with other market because distance with high realization market distance were more than 160 kilometers.

Market Integration

In general, market integration usually conceived in terms of the co-movements or long run relationship between the spatial prices, Fackler and Goodwin (2001) and Goodwin and Schroeder (1991). Several distinct methodologies for econometric analysis have been developed in recent years.

Unit Root Test (Augmented Dickey-Fuller Test)

The estimated test statistics from ADF tests for wholesale in levels and first differences are reported in Table 5. From the table the results could be revealed that the unit root test suggest that all the four wholesale markets except Vellore market were non-stationary at one per cent level. Vellore market has stationary property but other four market price series has non-stationary property. Hence in this study Chintamani, Tumkur, Hosur and Denkanikottai were included in Johansen co-integration test.

Testing for the Number of Co-integrating Vectors in the System

Johansen multiple co-integration tests were carried out to study long run relationship between the selected markets. In this study, co-integration were examined for Chintamani, Hosur, Denkanikottai and Tumkur ragi price using the maximum Eigen value procedure as well as trace test suggested by Johansen and Juselius (1990) and Johansen (1991).

Both trace test and Maximum-Eigen value test of Johansen co integration test are presented in Table 6 and 7. Both trace test and Maximum-Eigen value test of Johansen co integration gave the same conclusion that there were three co integrating equations existing among the selected markets. There are three co-integration relationships among the Chintamani, Hosur, Denkanikottai and Tumkur markets.

Estimation of long-run wholesale price integration of ragi

Co-integration implies that the transitory components of the series can be given a dynamic error correction representation; one that allows for flexibility in short-run dynamics but constraints the model to return to long-run equilibrium, Engle *et al.* (1987). If there is evidence of a co-integrating relationship, casual inferences can be made by estimating the parameters of the following vector error correction model (VECM) equation.

The reduced forms of vector error correction estimates were given in the table 8 and 9. From the table the results could be inferred that any shock in the price of Chintamani market would be return back to original equilibrium price within 6 days. Whereas Tumkur market, any shock in price of ragi, bounce back to the original position within 10 days. From that it was concluded that any shock were adjusted quickly in Chintamani rather than Tumkur. This may be due to large volume of trade in Chintamani.

In the long run, positive and negative coefficients exhibited in the Vector Error Correction estimates of selected ragi markets. VECM concluded that in the long run, Chintamani market price was influenced by two month (-0.238) lagged own market price and also by one month (0.172) lagged Tumkur market price. Tumkur market price was guided by its one month (-0.422) lagged own market price and also by two month (-0.220) lagged Chintamani marker price. In case of Hosur market in the long run, price was influenced by one month (0.318) lagged Denkanikottai market price. Denkanikottai was not influenced by any other market. Hence it is considered as independent market.

Co-integration Analysis through Vector Error Correction Mechanism is consolidated in the table 10. From that table it is inferred that both the markets in Tamil Nadu linked together, similarly both markets in Karnataka linked together. There is no linkage between Tamil Nadu and Karnataka markets.

The study revealed that Chintamani and Tumkur markets were influenced by their own monthly lagged price and Hosur markets were influenced by Denkanikottai first month lagged market prices. Denkanikottai market acts as an independent market. The VECM conclude that Chintamani market price converged into equilibrium within 6 days. The shock observed by the Tumkur market price will be corrected within 10 days.

Fig. 1: Price trend over the years of Vellore wholesale market

Fig. 2: Price trend over the years of Denkanikottai wholesale market

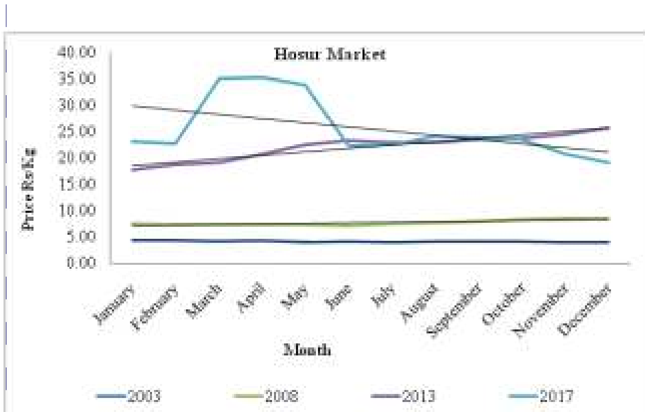

Fig. 3: Price trend over the years of Hosur wholesale market

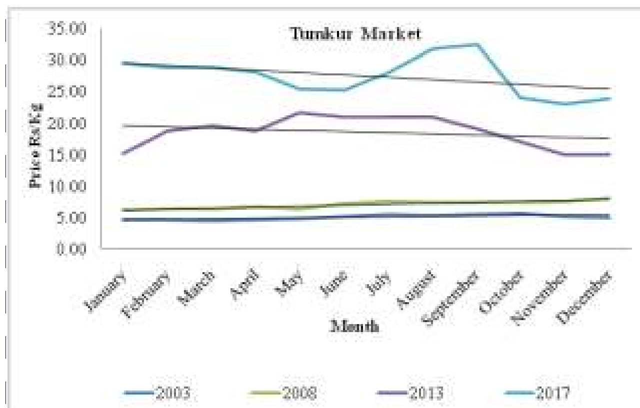

Fig. 4: Price trend over the years of Tumkur wholesale market

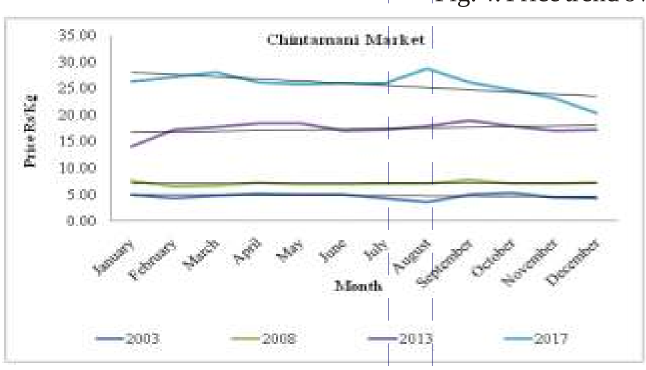

Fig. 5: Price trend over the years of Chintamani wholesale market

Table 2. Seasonal index for the selected markets

Period (in months)	Chintamani	Tumkur	Denkanikottai	Hosur	Vellore
January	1.00064	0.97430	0.99544	1.00299	1.05213
February	1.02718	1.00235	0.97054	0.98196	1.08418
March	1.01348	1.00764	0.99522	1.00405	1.07591
April	1.01334	1.00587	0.99837	1.01354	1.03922
May	0.98842	0.99989	1.01745	1.01693	0.99847
June	0.99043	1.01124	1.04513	1.01752	0.96416
July	0.98427	1.01626	1.01694	0.99956	0.95582
August	0.99040	1.01506	0.97016	0.99947	0.92509
September	0.98464	0.99193	0.99998	1.00172	0.92109
October	1.00476	1.00660	0.97464	0.98454	0.95055
November	1.00126	0.99117	1.00010	0.98265	0.99270
December	1.00117	0.97768	1.01605	0.99506	1.04068

Table 3. Seasonal indices for the selected markets

Markets	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Chintamani	✓	✓	✓	✓						✓	✓	✓
Tumkur		✓	✓	✓		✓	✓	✓		✓		
Denkanikottai					✓	✓	✓				✓	✓
Hosur	✓		✓		✓	✓			✓			
Vellore	✓	✓	✓	✓								✓

Table 4. Harvesting Seasons of ragi

Markets	Harvesting seasons	Lowest Seasonal Index	Highest Seasonal Index
Chintamani	June-September	July	February
Tumkur	October -January	January	July
Denkanikottai	January-April	August	June
Hosur	October-January	February	June
Vellore	May-July	September	February

Table 5. Results of the ADF test for the order of integration

Wholesale price of tomato markets	Augmented Dickey-Fuller Test statistics		
	Level	First difference	Critical value
Chintamani	-2.665846 (0.2522)	-11.80854 (0.0000)	- 4.010143 (0.01 level) -3.435125 (0.05 level) -3.141565 (0.10 level)
Tumkur	2.928157 (0.1562)	-10.73642 (0.0000)	
Hosur	-3.237719 (0.0805)	-12.41547 (0.0000)	
Denkanikottai	-3.143840 (0.0995)	-9.914883 (0.0000)	
Vellore	-4.399886 (0.0028)	-15.49381 (0.0000)	

Note: *Significant at 1 per cent level.
*Mackinnon critical values for rejection of hypothesis of a unit root.

Table 6. Trace test (Unrestricted co-integration rank test)

Hypothesized no. CE(s)	Eigen Value	Trace statistic	Critical value	Probability
None *	0.201274	82.83435	47.85613	0.0000
At most 1 *	0.132047	43.05592	29.79707	0.0009
At most 2 *	0.095998	17.98961	15.49471	0.0206
At most 3	0.000712	0.126072	3.841466	0.7225

Table 7. Maximum Eigen value test (Unrestricted co-integration rank test)

Hypothesized no. CE(s)	Eigen Value	Max-Eigen statistic	Critical value	Probability**
None *	0.201274	39.77843	27.58434	0.0009
At most 1 *	0.132047	25.06631	21.13162	0.0132
At most 2 *	0.095998	17.86354	14.26460	0.0129
At most 3	0.000712	0.126072	3.841466	0.7225

Note: Max-eigenvalue test indicates 3 co-integrating eqn(s) at the 0.05 level
*denotes rejection of the hypothesis at 5% significance level
**mackinnon-Haug-Michelis (1999) p-values

Table 8. Estimation of long-run wholesale price integration of ragi

Co integrating Eq:	Coint Eq1
CHINTAMANI(-1)	1.000000
TUMKUR(-1)	-0.916433 (0.04618) [-19.8452]
DENKANIKOTTAI(-1)	0.416617 (0.14381) [2.89691]
HOSUR(-1)	-0.431572 (0.14319) [-3.01400]
C	0.044658

Table 9. Reduced forms of Vector Error Correction Estimates

Error Correction:	D(CHINTAMANI)	D(TUMKUR)	D(DENKANIKOTTAI)	D(HOSUR)
CointEq1	-0.203377 (0.08355) [-2.43422]	0.339441 (0.10933) [3.10475]	-0.228512 (0.17418) [-1.31195]	-0.021039 (0.17779) [-0.11833]
D(CHINTAMANI(-1))	-0.076847 (0.09306) [-0.82582]	0.051613 (0.12177) [0.42386]	0.235229 (0.19399) [1.21256]	0.242042 (0.19802) [1.22230]
D(CHINTAMANI(-2))	-0.238872 (0.08553) [-2.79277]	-0.220682 (0.11192) [-1.97170]	0.308393 (0.17831) [1.72952]	0.240782 (0.18201) [1.32289]
D(TUMKUR(-1))	0.172841 (0.07259) [2.38116]	0.422501 (0.09499) [4.44807]	0.160445 (0.15132) [1.06027]	0.232893 (0.15447) [1.50774]
D(TUMKUR(-2))	0.116590 (0.07383) [1.57919]	-0.066959 (0.09661) [-0.69308]	-0.224902 (0.15391) [-1.46123]	-0.089423 (0.15711) [-0.56918]
D(DENKANIKOTTAI(-1))	0.110879 (0.07363) [1.50586]	-0.081050 (0.09635) [-0.84119]	0.008643 (0.15350) [0.05630]	0.318691 (0.15669) [2.03392]
D(DENKANIKOTTAI(-2))	0.001020 (0.07216) [0.01413]	-0.031847 (0.09442) [-0.33728]	-0.128484 (0.15043) [-0.85411]	0.047262 (0.15355) [0.30779]
D(HOSUR(-1))	-0.133072 (0.07315) [-1.81927]	0.017601 (0.09572) [0.18389]	0.069826 (0.15249) [0.45791]	-0.232822 (0.15565) [-1.49576]
D(HOSUR(-2))	-0.056239 (0.07104) [-0.79170]	-0.095701 (0.09296) [-1.02953]	0.054125 (0.14809) [0.36548]	-0.078518 (0.15117) [-0.51942]
C	0.099687 (0.06521) [1.52863]	0.110948 (0.08534) [1.30013]	0.031677 (0.13595) [0.23300]	0.013436 (0.13877) [0.09682]

Note: All the values in square brackets are t-values.

Table 10. Results from Co -integration Analysis through Vector Error Correction Mechanism are consolidated in the table below

1	2	3	4
CHINTAMANI	TUMKUR	DENKANIKOTTAI	HOSUR
CHINTAMANI (-2)	CHINTAMANI (-2)		
TUMKUR (-1)	TUMKUR (-1)		
			DENKANIKOTTAI (-1)

( ) indicates lagged time period in terms of monthly: each columns under specific headings indicate the markets co integrated with the boldly indicated markets.

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