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Price Setting Behavior and Causal Relationships among Major Bivoltine Cocoon Markets in India: An Econometric Analysis

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Abstract

The present study empirically examines the dynamic interrelationships among the prices of major cocoons markets *viz*. Ramanagaram (Karnataka), Sidlaghatta (Karnataka), Hindupura (Andra Pradesh) and Dharmapuri (Tamil Nadu) in terms of market integration. The monthly average prices of bivoltine mulberry cocoons for a period between April 2009 and February 2021 were considered for the present study. The Augmented Dickey-Fuller (ADF) (tau) test indicated that all the price series were non-stationary at level, but were stationary after first difference. The Johansen's multivariate cointegration procedure revealed existence of cointegration among the prices of cocoon markets. The Vector Error Correction Models (VECM) revealed a long run price causality running from Ramanagaram market to all other markets considered under study. The Granger causality test indicated a unidirectional causality running from Ramanagaram market to all markets and not *vice versa*. The prices prevailed in Ramanagaram market controlled and decided the current prices of bivoltine cocoons both in long run and short run in all other markets considered for the study.

Keywords: Augmented Dickey-Fuller test, Cocoon Markets, Granger's Causality tests, Johansen's Cointegration, Vector Error Correction Mechanism

Introduction

Silk is a natural protein fiber, some forms of which can be woven into textiles. Silk is popularly known as "Queen of Textiles", which is the most elegant textile in the world. On the other hand, the silk industry provides livelihood opportunity for millions owing to its high employment generating potential, low capital requirement and remunerative nature of its production. Though silk is produced by more than 60 countries in the world, China and India are the leading producers of silk in the world. India is the second largest producer of silk in the world after China with an annual silk output of 33,770 MT during 2020-21. India has the distinction of being the only country producing all four kinds of commercially exploited natural silks namely, Mulberry, Eri, Muga, and Tasar. However, mulberry silk is dominant one, with an annual output of 23,896 MT during 2020-21, contributes about 71% of the country's raw silk production. Mulberry silk is primarily produced in the states of Karnataka, Andhra Pradesh, Tamil Nadu and West Bengal, which collectively account for 94% of the total mulberry silk production in the country. Further, Tasar silk is practiced majorly in Jharkhand and Chhattisgarh, where as Eri and Muga are predominantly in Assam and other northeastern states, together all vanya silk produces an annual output of 9,874 MT during 2020-21. The total foreign exchange earnings from all silk goods are about Rs. 1,466.60 Crores during 2020-21.

The price transmission analysis measures how changes in one market are transmitted to another, thus it reflecting the extent of market integration as well as the extent to which markets functions efficiently. If markets are perfectly integrated, price signals are transmitted from a selected location to other locations leading to a price adjustment in response to the existence of a supply or demand excess in other locations. Several factors such as trade flows, transactions costs, trade policies, availability of price information across markets and market infrastructure determine the degree of price transmission of a particular commodity in a country. Most of these studies used correlation coefficients to measure the market integration,

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which suffer from the limitation that they use raw price series, which more likely to include the influences of factors such as climatic factors, inflation, policy change or any other shocks that affect the markets (Sekhar, 2012). This is likely to conceal the true degree of integration.

With the advances in time-series and econometric techniques, the recent studies have started using the cointegration methodology. Chaithra (2015) and Halagundegowda *et al.* (2021b) used Vector Error Correction Model (VECM) for analyzing the degree and nature of integration among price series of mulberry cocoons. The former study analyzed cointegration of specially separated cocoon markets in Ramanagaram, Sidlaghatta and Vijayapura in Karnataka; whereas, the later one investigated the vertical integration among price series of Indian and Chinese raw silk and Indian reeling cocoons. A review made on the previous studies conducted on integration of mulberry cocoon and silk markets in India indicates that either they were confined to a limited geographical region or vertical integration of cocoon and raw silk markets or have used less advanced methods like correlation coefficients. There is hardly any study to analyze the integration of cocoon markets across the states and the extent of influence of the most influential market on the other markets across the country.

In India, mulberry cocoons are primarily traded in regulated cocoon markets organized by the State Governments. There are 55 cocoon markets functioning in Karnataka, 8 markets in Andhra Pradesh and 23 markets in Tamil Nadu. Government Cocoon Market (GCM), Ramanagaram in Karnataka is the largest cocoon market in the country and is considered as a leader in setting the prices for mulberry cocoons. Therefore, specifically, the study intends to objectively explore the power of Ramanagaram cocoon market to influence the mulberry cocoon prices in other states. Knowledge of the most influential markets would help the policymakers to pay more attention to those markets considering their potential to influence the national price. The study also empirically examines the degree of exchange of market information in terms of market integration among the major bivoltine cocoons markets in the key mulberry silk producing states.

Materials and Methods

Nature and Source of Data

The monthly average prices of bivoltine mulberry cocoons were considered for the present study. The study data comprised 143 sample records of monthly average prices pertaining to a period between April 2009 and February 2021. The cocoon price statistics were collected from two Government Cocoon Markets (GCM) in Karnataka namely, Ramamanagaram and Sidlaghatta and one market each in Andhra Pradesh (Hindupura) and Tamil Nadu (Dharmapuri). The markets were selected on the basis of the transaction of cocoons in the respective states. The statistical software, Eviews-8 used also to construct VECM and cointegration analysis.

Analytical Framework

Time series data consist of observations, which are considered as a realization of random variables that can be described by some stochastic process. The concept of stationarity is related to the properties of these stochastic processes. Data are assumed to be stationary, if the means, variances and covariance of the series are independent of time, rather than the entire distribution. Non-stationarity in a time series occurs when there is no constant mean μ, no constant variance σ_t^2 or both of these properties. It can originate from various sources but the most important one is the unit root.

Augmented Dickey Fuller Test (ADF Test)

Dickey and Fuller made an assumption on residual to be a white noise. But in their usual DF test, this assumption is violated. To correct this, they augmented the DF test by adding the extra lagged terms of the dependent variable, which will eliminate the problem of serial correlation, thus makes the residual a white noise. The optimal lag length on the dependent variable is decided based on the Akaike Information Criterion (AIC) or Schwartz Bayesian Criterion (SBC). The ADF equation can be written as:

$$\Delta P = a_0 + \gamma^{p}_{t-1} + \sum^{p}_{i-1} a_1 \Delta P_{t-1} + \varepsilon_t \qquad \text{........... (1)}$$

This test assumes that there is at most one unit root and the residual to be Gaussian white noise. The test procedure for unit roots is similar to statistical tests for hypothesis, that is:

- Set the null and alternative hypothesis as $H_0: \gamma = 0; H_1: \gamma < 0$.
- Determine the test statistic using $F_\gamma = \frac{\gamma}{SE(\hat{\gamma})}$; where $SE(\hat{\gamma})$ is the standard error of γ.
- Compare the calculated test statistic F_γ with the critical value from Dickey-Fuller table to reject or not to reject the null hypothesis.
- The ADF test is a lower-tailed test. So if F_γ is less than the critical value, the null hypothesis of unit root is rejected and the conclusion is that the variable of the series does not contain a unit root and is non-stationary.

Johansen's Cointegration Procedure

Johansen's cointegration test relies on maximum likelihood method. This procedure is based on the relationship between the rank of a matrix and its characteristic roots. Johansen derived the maximum likelihood estimation using sequential tests for determining the number of co-integrating vectors. He suggested two test statistics to test the null hypothesis that there are at most 'r' co-integrating vectors. This can equivalently be stated as the rank of the coefficient matrix (∏), is at most 'r' for r = 0, 1, 2, 3, … n-1. The two test statistics are based on the trace and maximum Eigen values, respectively.

$$\Delta P_t = \alpha + \beta_t + (p-1)P_{t-1} + \theta_1 \Delta P_{t-1} + \ldots + \theta_{k-1} \Delta P_{t-k+1} + W_t \qquad \text{............ (2)}$$

$$\lambda_{trace} = -T \sum^{n}_{i=r+1} \ln(1-\lambda_i) \qquad \text{........... (3)}$$

$$\lambda_{max} = T \ln(1-\lambda_{r-1}) \qquad \text{........... (4)}$$

In testing for efficiency of two spatially separated markets (which is the necessary condition for market integration), the null hypothesis should be tested for r = 0 and r = 1. If r = 0 cannot be rejected, it can be concluded that there is no cointegration. On the other hand, if r = 0 is rejected and r

= 1 cannot be rejected, it can be concluded that there is a co-integrating relationship. Cointegration implies existence of a co-integrating vector β. The hypothesis in market efficiency can be tested by imposing restrictions on the co-integrating vector β. Then the standard likelihood ratio test can be applied in this case. Specifically, the test statistics can be expressed by the canonical correlations as stated by Johansen (1988).

$LR= T \sum rt=1 \ln(1-\lambda^*_t)-\ln(1-\lambda^*_t)$ .... (5)

Where, are the largest squared canonical correlations under the null hypothesis, the restricted model, the test statistics follows an asymptotic Chi-square distribution with the degree of freedom equaling the number of restrictions imposed.

Vector Error Correction Models (VECM)

The vector autoregressive (VAR) model is a general framework used to describe the dynamic interrelationship among stationary variables. So the first step in time series analysis should be to determine whether the levels of the data are stationary. If not, take the first differences of the series and try again. Usually, if the levels (or log-levels) of your time series are not stationary, the first differences will be. If the time series are not stationary, the VAR framework needs to be modified to allow consistent estimation of the relationships among the series. The vector error correction (VEC) model is just a special case of the VAR for variables that are stationary in their differences [*i.e.*, I(1)]. The VEC can also take into account any cointegrating relationships among the variables. Consider two time-series variables, y_t and x_t. Generalizing the discussion about dynamic relationships to these two interrelated variables yields a system of equations:

$Y_t=\beta_{10}+\beta_{11}Y_{t-1}+ \beta_{12}X_{t-1}+E_{Yt}$ .... (6)

$X_t=\beta_{20}+\beta_{21}Y_{t-1}+ \beta_{22}X_{t-1}+E_{Xt}$ .... (7)

The equations describe a system in which each variable is a function of its own lag and the lag of the other variable in the system. In this case, the system contains two variables y and x. Together the equations constitute a system known as a vector auto regression (VAR). In this example, since the maximum lag is of order one, we have a VAR (1).

If y and x are stationary, the system can be estimated using least squares applied to each equation. If y and x are not stationary in their levels, but stationary in differences [*i.e.*, I(1)], then take the differences and estimate using least squares:

$\delta X_t=\beta_{21}+\delta Y_{t-1}+ \beta_{22}\delta X_{t-1}+E_{\delta Xt}$ .... (8)

$\delta X_t=\beta_{21}+\delta Y_{t-1}+ \beta_{22}\delta X_{t-1}+E_{\delta Xt}$ .... (9)

If y and x are I(1) and cointegrated, then the system of equations is modified to allow for the cointegrating relationship between the I(1) variables. Introducing the cointegrating relationship leads to a model known as the Vector Error Correction (VEC) model.

Granger Causality Test

Causality test is considered as a potential technique to investigate price leadership in the market (Deb *et al.*, 2020). If the two variables are integrated of order one, *i.e.*, I(1), Granger causality test proposed by Granger (1969) is the most accepted way to know the causal relation between them (Ahmed and Singla, 2017). Therefore, Granger causality test was used in the present study, which is based on premise that the prices in market X causes the price in market Y if and only if the past values of market X provide additional information for the forecast of market Y.

A time series X is said to Granger cause Y, if it can be shown, usually through a series of t-tests and F-tests on lagged values of X (and with lagged values of Y also included), that those X values provide statistically significant information about future values of Y. We say that a variable X that evolves over time Granger-causes another evolving variable Y if predictions of the value of Y based on its own past values and on the past values of X are better than predictions of Y based only on Y's own past values.

If a time series is a stationary process, the test is performed using the level values of two (or more) variables. If the variables are non-stationary, then the test is done using first (or higher) differences. The number of lags to be included is usually chosen using an information criterion, such as the Akaike information criterion (AIC) or Schwarz information criterion (SIC). Any particular lagged value of one of the variables is retained in the regression if (1) it is significant according to a t-test and (2) it and the other lagged values of the variable jointly add explanatory power to the model according to an F-test. Then the null hypothesis of no Granger causality is not rejected if and only if no lagged values of an explanatory variable have been retained in the regression.

For a bivariate system of stationary time series $\{x_t\}$ and $\{y_t\}$, the variable x is said to Granger cause y if we can better forecast y using lagged values of x, even after lagged y variables are taken into account. Following Alexander (2001), consider a VAR (p) model for x and y which can be represented as:

$Y_t=a_0+a_1Y_{t-1}+.....+a_pY_{t-p}+b_1X_{t-1}+......+b_pX_{t-p}+U_t$ ....(10)

$X_t=c_0+c_1X_{t-1}+.....+c_pX_{t-p}+d_1Y_{t-1}+......+d_pY_{t-p}+U_t$ .... (11)

Results and Discussion

This graphical analysis on the pattern of price movement is generally used as a primer to perform the formal tests of price integration. A plot of distinct bivoltine price series of GCM Ramangaram, Sidlaghatta, Hindupura and Dharmapuri for the entire study period is depicted in figure 1. The graph shows thatall market prices were moving togetherin the long run albeit certain amount of disequilibrium or fluctuations in the shorter run. All market prices flew at the middle of the chart across the time with the Ramanagaram market prices guiding the flow and the remaining market prices mimicking the flow with same level of infancy, expansion and other fluctuations. The Dharmapuri market prices showed some outward shifts and swings at initial part of flow, which might be due to demand and supply in equilibrium. But in the later period, it followed the same trend and pattern of other markets.

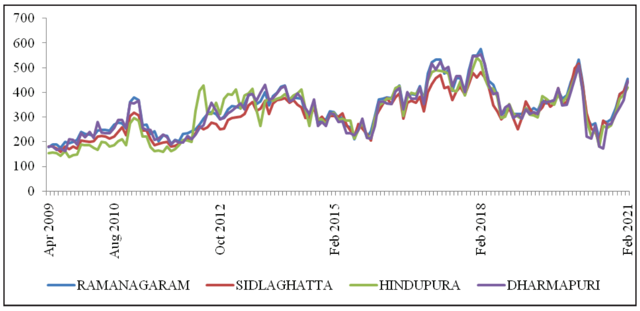

Figure 1: Flow of Bivoltine Cocoon Prices in GCM Ramangaram, Sidlaghatta, Hindupura and Dharmapuri from April 2009 to February 2021

Stationary Test

The first and foremost step for any time series analysis is checking the viability of the data by employing stationary test to assess the constant mean and variance across the time period for all the price series considered for the study. The results of the unit root test for all the series at both levels (original raw series) and the first differenced form are shown in table 1. The null hypothesis set for ADF test was that there is unit root or non-stationarity in the respective series. The t-statistic of original series of all the four market prices for ADF test was lower than the critical values. So this result does not allow us to reject the null hypothesis of non-stationarity in any of the price series.

Table 1: Augmented Dickey-Fuller test results for level series and differenced series

Model	Ramanagaram		Sidlaghatta		Hindupura		Dharmapuri	
	t-test	Prob*	t-test	Prob*	t-test	Prob*	t-test	Prob*
I. Level Series								
Constant	-2.698	0.076	-2.610	0.093	-3.656	0.067	-2.032	0.094
Constant, Linear trend	-3.212	0.086	-4.120	0.068	-3.428	0.062	-2.447	0.086
None	-0.118	0.641	-0.081	0.653	-0.369	0.549	-0.339	0.561
II. Differenced Series								
Constant	-11.691	0.000	-11.497	0.000	-12.187	0.000	-12.662	0.000
Constant, Linear trend	-11.648	0.000	-11.455	0.000	-12.146	0.000	-12.615	0.000
None	-11.706	0.000	-11.509	0.000	-12.209	0.000	-12.685	0.000

When the data series were differenced once, the t-statistics for all four market series became greater than the critical value for ADF test. Therefore, the results let us to reject the null hypothesis of non-stationarity and accept the alternative hypothesis. In a nutshell, the facts revealed by the unit root test was that when all the series were in the level form, the null hypothesis of the unit root could not be rejected but in case of first difference form, null hypothesis could be rejected. This indicates that all the series were integrated of order one. This is a necessary but not sufficient condition for cointegration.

Cointegration Analysis

After ensuring from unit root test that all the variables considered for the study were stationary at same level I(1), Johansen cointegration test was carried out to check long run relationship among the price variables and the results of Johansen's maximum likelihood tests (maximum Eigen value and trace test) are reported in table 2. In both cases, the null hypothesis of no cointegration could be rejected, if the test statistic is greater than the critical value. It is clear that there were at most one long run cointegrating relationship existing among four market price series. This implies that the four price series converged towards equilibrium in the long run even though they might deviate in the short run.

Table 2: Joint Johansen cointegration test results for the cocoon prices

Hypothesized Number of CE(s)		Trace Statistics	Max Eigen
r=0 (None)	Test Stat	65.384	38.633
	Critical Value	63.876	32.118
	Prob.	0.032*	0.006*
r≤1 (at most one)	Test Stat	46.750	28.440
	Critical Value	42.915	25.8232
	Prob.	0.041*	0.013*
r≤2 (at most two)	Test Stat	25.651	24.563
	Critical Value	29.872	28.387
	Prob.	0.125	0.264

Note: *Significant at 5% level

The empirical results implied that the price series were cointegrated and there was a stable equilibrium relationship between them. The results are in confirmation with the findings of the studies conducted by Nagaraj *et al.* (1987), Devaiah *et al.* (1988), Prabhakara (1988), Bharathi (2009) and Chaithra (2015), in which reported that the selected cocoon markets in Karnataka were spatially integrated. However, this situation prevailed in the markets while prices were tied together in the long run, but it might drift apart in the short run because of scarceness of availability of information and lack of quicker dissemination of available information. Further, the test statistics was significant at 5% level for two hypotheses for none to at most one cointegrating equation. The results let us to reject the null hypotheses for none to at most one cointegrating equation, but there is acceptance of the null hypothesis for at most two cointegrating equations (test statistics was no significant at 5% level), which means that there was a long run association and possible of at least one cointegrating equation among four market prices for study period.

Vector Error Correction Model

There are four stages to develop the VECM. The first stage is confirmation of stationarity of the data, followed by finding lag length, then checking cointegration of variables and finally, construction of the model. Augmented Dickey-Fuller test was used to confirm stationarity of variables by checking the presence of unit root and the cointegration analysis was carried out by using Johansen test of cointegration. The results of both the tests are presented and discussed in previous sections.

Table 3 provides the criteria for deciding the lag length of the dependent variable for constructing the VECMs. The quantified value for Akaike information criteria, Schwarz information criteria and Hannan-Quinn information criteria are enlisted in the table for various lag lengths of the variable. Here, lower values of AIC, BIC and HQ indicate better model fit and *vice versa*. in present study, AIC, SIC and HQ tests posed the lowest value for the lag 2. Hence, lag 2 was selected for constructing the VEC Model.

Table 3: Lag selection based on AIC, BIC and HQ criteria

Lag	AIC	SC	HQ
0	39.667	39.752	39.702
1	36.936	37.360	37.109
2	37.018*	37.781*	37.328*
3	37.035	38.138	37.483
4	37.067	38.510	37.653
5	37.155	38.936	37.879

Note: * Indicates the lag order selected by criteria

Restricted VAR model indicates the speed of adjustment from the short run equilibrium to the long run equilibrium state. A VECM is a restricted VAR that has cointegration restrictions built into the specification, so that it is designed for use with nonstationary series that are known to be cointegrated. If the variables are not cointegrated, the model can be an unrestricted VAR model but not VECM.

The VECM helps to assess the causality in all possible combinations among four price variables. Here the relation can be quantified in terms of both long run causality and short run causality. It can be inferred from table 4 that the model fitness criteria show that the F statistics is significant for all models at 5% level of significance and R^2 and adjusted R^2 values are sufficient for all model to indicate goodness of fit (Barathi *et al.* 2009).

The coefficient C(1) indicates the error correction term, which means the speed of adjustment towards equilibrium. The coefficient C(1) for Sidlaghatta (-0.847), Hindupura (-0.656) and Dharmapuri (-0.933) was negative in sign and statistically significant at 5% level. A negative and statistically significant C(1) coefficient confirms that there was a long run causality running from Ramanagaram market towards all other markets (Sidlaghatta, Hindupura and Dharmapuri). The studies conducted by Nagaraj *et al.* (1987) and Devaiah *et al.* (1988) indicated along run causality running from the Ramanagaram market towards other markets in Karnataka.

The prices of cocoons in all markets were also determined by their respective lag, which indicates the current price of all market mainly depended on their past prices. Further, in long run, the prices of Dharmapuri were determined by

Table 4: Least square Estimates of VECM

Error Correction	Ramanagaram	Sidlaghatta	Hindupura	Dharmapuri
C(1) Cointn Eqn	0.163 (0.567)	-0.847* (-2.304)	-0.656* (-2.904)	-0.933* (-3.081)
C(2) Constant	1.744 (0.520)	1.942 (0.627)	1.800 (0.475)	1.731 (0.491)
C(3) $Ramanagaram_{t-1}$	0.833* (2.826)	0.846* (2.850)	0.927* (3.922)	0.896* (2.980)
C(4) $Ramanagaram_{t-2}$	0.972* (3.169)	0.179 (0.694)	0.006 (0.019)	-0.117 (-0.398)
C(5) $Sidlaghatta_{t-1}$	0.256 (1.204)	0.995* (3.028)	0.292 (1.217)	0.490* (2.194)
C(6) $Sidlaghatta_{t-2}$	0.124 (0.615)	-0.166 (-0.887)	0.205 (0.896)	0.359 (1.686)
C(7) $Hindupura_{t-1}$	-0.190 (-1.527)	-0.2188 (-1.897)	0.852* (2.695)	0.332* (2.537)
C(8) $Hindupura_{t-2}$	0.053 (0.425)	-0.0183 (-0.157)	0.720* (2.541)	-0.043 (-0.331)
C(9) $Dharmapuri_{t-1}$	-0.181 (-0.892)	-0.001 (-0.010)	-0.156 (-0.682)	0.866* (2.714)
C(10) $Dharmapuri_{t-2}$	-0.079 (-0.460)	0.008 (0.052)	-0.040 (-0.206)	0.199 (1.102)
Fitness Statistics				
R^2	0.346	0.398	0.452	0.501
Adj. R^2	0.219	0.263	0.329	0.406
F Statistics	3.667	4.127	4.873	5.028
Prob. Value	0.023	0.035	0.018	0.001

Note: * Significant at 5% level; Figures in parentheses indicate t-statistics the past prices of all markets, because lags of all markets were significant at 5% level. The prices of Sidlaghatta and Hindupur markets were determined by the past prices of their respective lags and the past prices of Ramanagaram market. The Ramanagaram market is the leader market for bivoltine cocoons, because of the following reasons, Ramanagaram market central location for all reeling clusters and also proximity in space with all other major markets of south India. Further, the largest mulberry cocoon market in India, in which one or other way the policy work, market oriented implementations and price determination mainly depends upon this market.

Granger Causality

In order to evaluate the nature of relationship between the prices of different markets Grangers causality tests were employed. The purpose of this test is to evaluate the relations in pair-wise by considering two variables at a time in order to assess the relations in terms of unidirectional relation or bidirectional relations. The results of the test are shown in table 5.

The F-statistics is found to be significant at 5% level for the Granger causality between markets majorly from Ramanagaram market with all other markets such as Sidlaghatta Hindupura, and Dharmapuri, which confirms the short run unidirectional price transmission from Ramanagaram market to remaining all other markets. On the other hand, the Granger causality between Sidlaghatta and Ramangaram, Hindupura and Ramangaram, Dharmapuri and Ramangaram was not significant at 5% level, which means no short run causality running in this direction. Chaithra (2015) reported speed of adjustment of price signals among in Ramanagaram, Shidlaghatta and Vijayapura in Karnataka co-integrated with unidirectional feedback mechanism. Halagundegowda *et al.* (2021a) assessed the price transmission for mulberry cross breed cocoon markets, the result shows that, the Granger causality between markets mainly from Ramanagaram and Sidlaghatta markets with all other markets such as Hindupur and Dharmapuri, which confirms the short run unidirectional price transmission from both Ramanagaram and Sidlaghatta markets towards other markets.

Table 5: Market pair wise results of the Granger casualty test

Market Pair	F-Statistic	Prob.	Decision of null hypothesis	Result
Ramanagaram - Sidlaghatta	4.624	0.024	Reject	Causality
Sidlaghatta - Ramanagaram	0.296	0.744	Accept	No Causality
Ramanagaram - Hindupura	3.359	0.037	Reject	Causality
Hindupura - Ramanagaram	1.751	0.177	Accept	No Causality
Ramanagaram - Dharmapuri	10.534	0.000	Reject	Causality
Dharmapuri - Ramanagaram	0.934	0.395	Accept	No Causality
Sidlaghatta - Hindupura	3.561	0.031	Reject	Causality
Hindupura - Sidlaghatta	1.185	0.116	Accept	No Causality
Sidlaghatta - Dharmapuri	4.149	0.017	Reject	Causality
Dharmapuri - Sidlaghatta	0.358	0.699	Accept	No Causality
Hindupura - Dharmapuri	3.266	0.041	Reject	Causality
Dharmapuri - Hindupura	5.851	0.002	Reject	Causality

Further, there was unidirectional relationship existing between Sidlaghatta and Hindupura and Sidlaghatta and Dharmapuri but not *vice versa*. However, the F statistics was found to be significant in both direction of causality between Hindupura and Dharmapuri markets. Thus the result depicts the evidence of bidirectional relation exists between these markets.

Conclusion

The purpose of this paper is to investigate the degree and direction of integration of the prices of the cocoons markets. The vector error correction model assess the causality in all possible combination among four price variables, the integrations are quantified in terms of both long run causality and short run causality. The results of VECM guide that there is long run causality running from the price of the Ramanagaram market to the prices of all other markets considered for the study. Further, the prices of all markets are determined by the prices of their previous period (Lags) and the prices prevailing in Ramanagaram market.

The study also evaluates the short run causality among prices of the cocoon markets by employing Granger causality test, The results depict that there is unidirectional causality running from Ramanagaram market to all markets and not *vice versa*. Further, there is unidirectional relationship existing between Sidlaghatta and Hindupura, Sidlaghatta and Dharmapuri but not *vice versa*. There is bidirectional causality between Hindupura and Dharmapuri markets. Finally, both in long run and short run, the prices prevailing in Ramanagaram market control and decide the current prices of bivoltine cocoons in all markets of south India. The price transmission happens majorly from Ramanagaram market to remaining markets, Hence, Ramanagaram market can be considered as leader of all markets with respect to price transmission.

The price transmission happens mainly from Ramanagaram markets to remaining markets. The bivoltine cocoon producing farmers are highly congregated in and around Ramanagaram areas in Mysore, Tumakuru, Mandya, Ramanagaram, Chikkaballapur and Kolar districts. Besides, the farmers from other neighboring states also bring cocoon to Ramanagaram market for fetching better price. Further, this market is central location for all reeling clusters and also proximity in space with all other major markets of south India. Thus Ramanagaram markes are ideally located logistically to emerge as major markets and act as leaders of all markets with respect to price transmission of bivoltine cocoons.

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