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ECONOMETRIC MODELING ON RURAL MARKETS: A CASE OF SILK COCOON MARKETS IN KARNATAKA

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Abstract: The key features of agricultural market integration is that entities are able to offer price signals and other services in other jurisdictions on terms similar to those enjoyed by domestic market stakeholders. The study empirically examines the dynamic interrelationships among the prices of major cocoons markets in Karnataka viz. Ramanagaram Siddlaghatta and Kolar in terms of market integration. The monthly average prices of crossbreed mulberry cocoons for a period from January 2004-December 2009 were used. The Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests were employed to find out the stationarity of price series. The results indicated that all the three price series of the markets were stationary after first difference. The test of cointegration among the markets was studied using Johansen's Multivariate cointegration procedure. The tests of Trace and Max Eigen values showed that the markets were cointegrated. The Vector Error Correction Model (VECM) revealed long-run price causality from Ramnagaram to other two markets. The price transmission was also observed across the cocoon markets. The cocoon prices of Ramnagaram market played a crucial role in determining the current prices both in long-run and short-run periods in Siddalaghatta and Kolar markets

Keywords: Silk cocoon markets, Cocoon price, ADF and PP tests, Cointegration, VECM

INTRODUCTION:

Spatial marketing is studying the integration of markets of homogeneous products across regions, where they move together and price signals as well information about the markets are spread smoothly across the markets. Unless agricultural product markets are spatially integrated, producers and consumers will not get the potential gains. High degree of market integration is crucial for higher competiveness among the markets which leads to improved market efficiency. On the other hand, the markets that are not integrated, presents inaccurate picture about price information leading to misallocation of resources, which in turn causes price fluctuations in one market or the other. To put it simply, if markets are not integrated, the correct price signals will not reach the stakeholders. There are several specialized regulated markets being established for agricultural products like paddy, wheat, maize, silk cocoons etc., in the country. In the regulated markets, farmers are able to sell their marketed surplus in the presence of several buyers through open and competitive bidding. In this context, the present study attempts to find out the market integration of major three silk cocoon markets in Karnataka using econometric modeling.

Mulberry Sericulture in India: An Overview: India is the second largest producer of silk after the Republic of China with production of 36,582 metric ton in 2022-23. Silk is produced from both mulberry and non-mulberry plants. Mulberry silk alone accounts for about 90 per cent of total silk production which is largely produced from Karnataka, Andhra Pradesh and Tamil Nadu. Sericulture is an agro-based cottage industry providing regular income and generating potential family employment for marginal and small farm holdings throughout the year. Apart from farmers, the silk industry generates a source of livelihood to many artisans involved in post-cocoon activities including silk removal, spinning, reeling, dying and weaving. It is an integral part of leaf production, silkworm rearing and marketing of silk cocoons by the farmers. Leaf production is being undertaken at farm level by cultivating mulberry plants, which is the food for silkworms that converts leaf into cocoons. Generally, duration of a silkworm cocoon crop period is between 26-28 days.

Technological Intervention and Productivity: Late 1990s, many high yielding mulberry varieties were transferred into the famer's field. It had resulted in an increase of mulberry yield to the extent of 65 ton/ha from 40 ton/ha per year under irrigated conditions. Also, the average cocoon yield had also increased from 45 to 80 kg/100 disease free layings (dfls). A notable development in the silk sector is increasing raw silk recovery from cocoons. Earlier, the production of one kg raw silk required 13 kg of cocoons. At present it needs 6-7 kg cocoon to produce the same quantity of raw silk. Such improvements took place in the industry due to availability of improved silkworm breeds, rearing and reeling technology. It had resulted in increasing farmers' income to a considerable extent.

Marketing of Silk Cocoons in Karnataka:

In Karnataka, sericulture was introduced and patronized during Tipu Sultan period, around 200 years ago, in the erstwhile Mysore State. From there, sericulture has grown steadily and is providing livelihood to many in rural and semi urban areas. At present, the area under mulberry plantation is 1,08,019 hectares with mulberry raw silk production 11,191 MT, sharing around 43.34 % of country's raw silk production in 2022-23. The quality raw silk is produced in silk reeling clusters of Ramanagaram, Siddalaghatta and Kolar. The silk weaving clusters are in Doddaballapur (Bengaluru Rural), Molakalmuru (Chitradurga), Betageri (Gadag), Ilakal (Bagalkot). Ramnagaram is Asia's largest cocoon market in Karnataka where an average of 40-50 tons of cocoons being transacted every day. A total of 55 cocoon markets is functioning in Karnataka. The Department of Sericulture (DOS) has established cocoon markets to facilitate both rearers and reelers to get competitive and fair prices to their cocoons.

REVIEW OF LITERATURE ON INTEGRATION IN SILK COCOON MARKETS:

The availability of literature on market integration in mulberry silk cocoon markets is limited. The studies by Nagaraj et al., Devaiah et al., Prabhakara and Bharathi were confined to market integration and price transmission in spatially separated cocoon markets in Karnataka for different periods. Naik and Babu, Arunkumar et al., and Parameshwarappa examined the prices of Indian silk integrated with the international prices. Prabhakara and Arunkumar et al., analyzed vertical price transmission between silk prices at Bangalore Silk Exchange and cocoon markets in Karnataka. Most of these studies used correlation coefficients to measure the market integration and they did not reveal the true degree of integration. A study by Goundan and Tankari reveled that 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.

Data and Methodology: The empirical study is based on secondary data of silk cocoon prices of three major cocoon markets, namely, Ramnagaram, Siddlaghatta and Kolar in Karnataka. These three markets together contributed about 60 per cent of total cocoon transactions in the state. The monthly average crossbreed cocoon price data were collected from Indian Silk and Annual Reports of Central Silk Board, Bangalore. A total of 72 months data (January 2004 to December 2009) were used for the study. The Eviews software -12 student elite version was used to analyze the data.

Analytical Framework: Generally, price data series are in non-stationary form. Non-stationarity in a time series occur when there is no constant mean μ, and variance σ^2 of the data. It can originate from various sources but the most important one is the unit root. Stationarity is the necessary condition for estimation and forecasting of time series.

Test of Stationarity: Various methods have been proposed to test of stationarity of time series data. These are based on the fact that a non-stationary data series is characterized by unit root. Two commonly used methods are Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests. The results of unit root test analysis proved that the spot price series data are non-stationary at its level and stationary in its first difference. It can be stated as spot prices follow I(1) process. In short, the ADF test checks if the mean of the time series is constant over time while PP test checks if the variance of the time series is constant over time. The PP test is like the ADF test but allows for the residuals to be serially correlated. However, in the ADF test, we need to make sure the residuals are not serially correlated.

Augmented Dickey-Fuller Test: The ADF test assumes that there is at most one-unit root and its error term is a Gaussian white noise. The null-hypothesis is that unit root exists. As the error term is unlikely to be white noise, Dickey and Fuller extended their test procedure suggesting an augmented version of the test which includes extra lagged terms of the dependent variable to eliminate autocorrelation. The lag length on these extra terms is either determined by Akaika Information Criterion (AIC) or Schartz Bayesian Criterion (SBC). The ADF equation can be written as follows:

P_t and P_{t-1} indicate the price of cocoon in a market during period t and t-1. The difference between P_t and P_{t-1} may be denoted by ΔP_t.

The following three equations may be used to test unit root by ADF test

$\Delta P_t = \delta P_{t-1} + a_i \Sigma \Delta P_{t-1} + e_t$ ----------- (1) Without drift

$\Delta P_t = \beta_1 + \delta P_{t-1} + a_i \Sigma \Delta P_{t-1} + e_t$ ------------ (2) With drift

$\Delta P_t = \beta_1 + \beta_2 t + \delta P_{t-1} + a_i \Sigma \Delta P_{t-1} + e_t$ ------- (3) With drift around stochastic trend

Where P_t = Prices of cocoons in markets during period t

ΔP_t = First difference price series

t = Trend variable (1,2,….72) being the length of data series in months

e_t = Error term

δ, β_1, β_2 and a_i estimated parameters

Phillips-Perron Test: Phillips and Perron (1988) developed a generalization of the ADF test procedure that allows for fairly mild assumption containing the distribution of errors. The test of regression for Phillips-Perron test is AR(1) process.

$\Delta P_{t-1} = \beta_1 + \delta P_{t-1} + e_t$ --------------(4)

The ADF test corrects for higher order autocorrelation by adding lagged differenced terms on the right hand side, and makes a correlation to the t-statistic of the coefficient δ from the AR(1) regression to account for the serial correlation in e_t. In this test also the null hypothesis is that unit root exists.

Johansen's Co integration Test: Johansen is used to test co-integrating relationships between several non-stationary time series data. Compared to Engle-Granger test, the Johansen test allows for more than one co-integrating relationship. The Johansen test says that if data series are co-integrated, they exhibit a long-run relationship. It implies the series are related and can be combined in a linear form. That is, even if, there are shocks in the short-run, which may affect movement in the individual series, they would converge with time (in the long-run). Hence, it may be estimated both short-run and long-run models. Appropriate estimation techniques are the Vector Autoregressive (VAR) and Vector Error Correction Mechanism (VECM) models. In case the series are not co-integrated, that is, they do not exhibit a long-run relationship, we may estimate only short-run models with VAR and not VECM. Following Johansen and Juselius, The Maximum Likelihood (ML) method of co-integration may be described. If P_t denotes an (nx1) vector of I91) prices, then the k^{th} order Vector Auto-Regressive (VAR) representation of P_t may be written as :

$P_t = \Sigma \Pi_i P_{t-1} + \mu + \beta t + \varepsilon_t$ ------------------ (5)

The procedure for testing co-integration is based on Error Correction Mechanism (ECM) representation of P_t given in equation (6).

$\Delta P_t = \Sigma \Gamma_i \Delta P_{t-1} + \Pi_i P_{t-k} + \mu + \beta t + \varepsilon_t$ --------------- (6)

Where $\Gamma_i = -(1-\Pi_1-\ldots\ldots.-\Pi_t)$; i= 1,2, …k-1;

Each Π_1 is an n x n matrix of parameters

$\varepsilon_t \sim iid\ (0,\Omega)$ is an identically distributed n dimensional vector f residuals with mean zero and variance matrix Ω.

μ is a constant term

t is a trend.

Since P_{t-k} is I(0), the equation (6) will be balanced if $\Pi_i\ P_{t-k}$ is I(0). So, it is the Π matrix that conveys information about long-run relationship among the variables in P_t. The rank of Π, r determines the number of co-integrating vectors, as it determines how many linear combinations of P_t are stationary. If r=n, the prices are stationary at levels. If r=0, no liner combination of P_t is stationary. If $0<\text{rank}(\Pi) = r<n$, and there are n x r matrices, then it can be said that there are r co-integrating relations among the elements of P_t. The co-integrating vector β has the property that $\beta\ P_t$ is stationary even though P_t is itself non-stationary. The coefficient β represents long-term equilibrium, so that $\Pi = \mu\beta$; and α is the importance of the co-integrating relationships in the individual equations of the system and the speed of the adjustment to disequilibrium.

Likelihood Ratio Test: Johansen's co-integration 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 ($\prod$), 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

Trace statistic (λ-trace) = $-T\ \Sigma\ln(1-\lambda_i)$

Maximum eigen value statistic (λ-max) = $-T\ \ln(1-\lambda_{r+1})$

λ_is are the estimated eigen values (characteristic roots) obtained from the matrix ($\prod$); T is the number of observations. The number of cointegrating vectors indicated by the tests is an important indicator of the extent of movement of the prices. An increase of cointegrating vectors implies in the strength and stability of price linkages.

(c) Error Correction Model (ECM): An Error Correction Model (ECM) is the best way of combining the long-run, co-integrating relationship between the levels variables and the short-run relationship between the first differences of the variables. It also has the advantage that all the variables in the estimated equation are stationary; therefore, there is no problem with spurious regression. Engel and Granger [7] proved that the variables are found to be co-integrated, then there existed a corresponding error correction representation which implies that the changes in the dependent variable are a function of the level of equilibrium in the co-integration relationship (captured by the error correction term) as well as changes in other variables.

A special feature of the ECM is that even if one demonstrates market integration through co-integration, there could be disequilibrium in the short run, i.e., price adjustment across markets may not happen simultaneously. It may take some time for the spatial price adjustments. ECM can incorporate such short-run and long-run changes in the price movements. The long-term causal relationship among the cocoon markets is implied through the significance of t-tests of the lagged error correction term as it contains the long-term information because it is derived from the long-term relationship. The coefficient of the lagged error correction term is a short-term adjustment coefficient and represented the proportion by which the cocoon market adjusted in response to the long-term disequilibrium.

Model Specification: For the present analysis, Johansen's Vector Error Correction Model (VECM) has been used. It permits the testing of co-integration as a system of equations in one step. Another added advantage of this approach is that we do not carry over an error from one step into the rest. It does not require the prior assumption of endogeneity or exogenity of variables. All the variables are transformed into log values and taking first differenced for VECM. The model is specified with one lag period for all the series.

$$\Delta Ramnagaram_t = \alpha_0 + \phi_1 ECT_{t-1} + \alpha_{11}\Delta Ramanagarm_{t-1} + \alpha_{21}\Delta Siddalaghatta_{t-1} + \alpha_{31}\Delta Kolar_{t-1} + e_{1t} \quad \text{-----(7)}$$

$$\Delta Siddalaghatta_t = \alpha_0 + \phi_2 ECT_{t-1} + \alpha_{11}\Delta Siddalaghatta_{t-1} + \alpha_{21}\Delta Ramnagaram_{t-1} + \alpha_{31}\Delta Kolar_{t-1} + e_{2t} \quad \text{----- (8)}$$

$$\Delta Kolar_t = \alpha_0 + \phi_3 ECT_{t-1} + \alpha_{11}\Delta Kolar_{t-1} + \alpha_{21}\Delta Ramnagaram_{t-1} + \alpha_{31}\Delta Siddalaghattat_{-1} + e_{3t} \quad \text{---(9)}$$

Where ϕ_1, ϕ_2 and ϕ_3 = Price transmission

ECT = Error Correction Term
α_{ij} = Degree of association between selected markets
e_{1t}, e_{2t} and e_3 = White noise residuals
Δ = Difference operator
Price = log transformed price

Results and Discussion:

Graphical display: The graphical display (Figure1) on crossbreed cocoon price of three selected markets of Karnataka indicates that the pattern of price movements from Ramnagaram to other two markets (Siddalaghatta and Kolar). This formal analysis helps to know whether three markets are integrated in price. The prices were moving together in the long run, in spite of some changes in short-run period. Although Ramnagaram is the leading market in the state due to its price leadership as compared to Siddalaghatta and Kolar markets, the same trend and pattern of the other markets were observed. The Kolar market price was found to be down between other two markets and swung at lower part of all market prices. This may be attributed to demand and supply position.

Stationary Test: A pre-requisite for time series analysis is to determine whether the series should be stationary or non-stationary. A stationary time series is desirable as its mean and variance would be constant over a time period. Therefore, the price data of three markets were subjected to unit root test. The results are presented in Table 1

Figure 1 : Crossbreed cocoon prices of Karnataka markets (Jan 2004-Dec 2009)

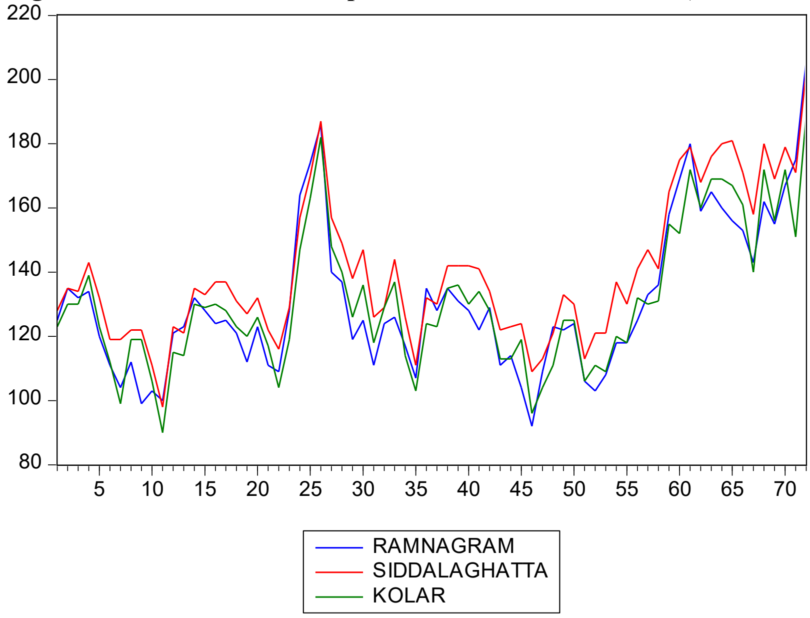

Table 1: Results of ADF and PP Unit Root Test of Cocoon Markets in Karnataka

Model	Name of Cocoon Markets						
		ADF Test			PP Test		
	Parameters	Ramnagaram	Kolar	Siddalaghatta	Ramnagaram	Kolar	Siddalaghatta
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Intercept	P_t	-1.7100	-2.8226	-1.8585	-1.9408	-2.7357	-1.7254
	ΔP_t	-8.5614**	- 8.8403**	-9.1299**	-8.5629**	- 11.5797**	-9.5412**
	Critical value at 1% level	-3.5270	-3.5270	-3.5270	-3.5270	-3.5270	-3.5270
	DW statistics	1.93	1.99	1.96	1.93	1.99	1.96
Intercept and linear trend	P_t	-2.3370	-2.5475	-2.6791	-2.6025	-3.5012	-2.6720
	ΔP_t	-8.6403**	- 8.8054**	-9.1448**	-8.7033*	- 13.1157**	-9.8994**
	Critical value at 1% level	-4.0925	-4.0925	-4.0925	-4.0925	-4.0925	-4.0925
	DW statistics	1.95	2.00	1.98	1.95	2.00	1.98
None	P_t	-0.5525	-0.2995	-0.5691	-0.6788	-0.9590	-0.9502

	ΔP_t	-8.5899**	-8.8904**	-9.1538**	-8.5910**	-11.0573**	-9.5101**
	Critical value at 1% level	-2.5979	-2.5979	-2.5979	-2.5979	-5979	-5979
	DW statistics	1.93	1.99	1.97	1.93	1.99	1.96

Note:
1. P_t and ΔP_t are at level and differenced series,
2. ** p<0.000 (MacKannon one-sided p value)
3. ADF: Augmented Dickey- Fuller 4. PP: Phillips-Perron

The three price series models (1) (2) and (3) were used for testing unit roots. The findings showed that all the series were non-stationary at level both ADF and PP unit root tests. It means that the null-hypothesis set for ADF and PP tests was that there is unit root in the all three series. The τ statistic (tau) of the original cocoon price series of three markets was lower than critical values at 5 per cent level. It proved that the original price series were non-stationary form. They had unit roots irrespective of market prices. However, when the data were differenced once, the τ statistic (tau) for all three markets became greater than the critical values of ADF and PP tests. Therefore, the first differenced data are considered to be stationary and technically, we reject the null-hypothesis that the data series have unit roots. This is one of the first conditions for performing co-integration test.

Cointegration Analysis: Confirming the price series of three markets were stationary I(0), after first differences, co-integration between the markets has been tested using Johansen's test using maximum likelihood procedure. It helps to find out both long-term and short term relationships among the price variables. The results of Johansen's co-integration for three markets are reported in Table 2.

Table 2: Johansen Co-integration (Rank Test) of Silk Cocoon Markets

Name of State	**Null Hypothesis**	**Eigen value**	**Trace Rank Test statistic**			**Maximum Eigen Rank Test statistic**		
			λ-Trace	Critical value at 5 % level	Prob.	λ- Max Eigen	Critical value at 5 % level	Prob.
Karnataka	None	0.489728	69.42015	29.79707	0.000	47.09676	21.13162	0.000
	At most one	0.258785	22.32339	15.49471	0.0040	20.96248	14.26460	0.0038
	At most two	0.019254	1.360907	3.841466	0.2434	1.360907	3.841466	0.2434

Note: Trace and Max-eigen tests indicate 2 cointegrating eqn(s) at the 0.05 level
denotes rejection of the hypothesis at the 0.001 level
MacKinnon-Haug-Michelis (1999) p-values

From the perusal of Table 2, the null-hypothesis is being accepted as some of the price variables were co-integrated. The results of Trace and Max-Eigen tests indicate that there were at most one co-integrating equation that exists among the price variables of three markets. It means that two markets were integrated in terms of cocoon price. In other words, price series converged towards equilibrium in the long run even though they might deviate in the short run. This is happening due to prices were moved together in the long-run, but perhaps it might drift apart in the short-run period as prevailing poor co-ordination and dissemination of information among the markets.

Vector Error Correction Model (VECM): A pre-condition for construction of VECM model is that the time series variables are to be co-integrated based on Johansen's Co-integration (Rank Test). It is confirmed (Table 2) that price series of three markets were co-integrated in the long-run. Another requirement is selection of lag length of dependent variable based on AIC, SIC and HQ criteria. To determine the short-run equilibrium, the VECM model is used. The results of lag selection are presented in Table 3. As per the selection criteria, the lowest values of AIC, SC and HQ at lag one considered in the study for constructing VECM.

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

Lag	**LogL**	**LR**	**FPE**	**AIC**	**SC**	**HQ**
0	-712.3909	NA	521720.4	21.67851	21.77804	21.71784
1	-643.0030	130.3651	83733.22*	19.84858*	20.24670*	20.00589*

2	-637.8790	9.161107	94353.29	19.96603	20.66274	20.24133
3	-625.2642	21.40687*	84958.22	19.85649	20.85179	20.24978
4	-618.2377	11.28507	90972.44	19.91629	21.21018	20.42757
5	-609.2279	13.65117	92217.89	19.91600	21.50847	20.54526
6	-599.5320	13.80927	92181.74	19.89491	21.78598	20.64216
Note: * indicates the lag order selected by criteria LR: sequential modified LR test statistic (each test at 5% level)						
FPE: Final prediction error						
AIC: Akaike nformation criterion						
SC: Schwarz information criterion						
HQ: Hannan-Quinn information criterion						

Short-Run Equilibriu: The purpose of estimating the VECM is to find out the short-run equilibrium position of dependent variable towards its movement to long-run equilibrium. The concept of a restricted VAR models is to have built into the specification of co-integration restrictions. Thereby, we can use with non-stationary variables of the same order which will be co-integrated. In case the variables are not co-integrated, the model can be an unrestricted VAR model but not VECM. Another use of VECM is to find out the long-run causality in all possible combinations among three series. It is observed from the Table 4 that F-statistic for all the three series were significant at one per cent level, indicating the fitting of the model well. Added to that, the R^2 value is sufficient to show the goodness of fit of the model. The coefficient C(1) shows the Error Correction Term (ECT), which is the indicator for the speed of adjustment towards equilibrium from short-run to the long-run. The ECT for Ramnagaram (-0.697), Siddalaghatta (-0.894) and Kolar (-1.278) had negative sign and statistically significant at 5% per cent level. A negative sign of each markets with statistically significant confirms that there was a long-run causality running from Ramnagaram towards Siddalaghatta and Kolar markets. The speed of price adjustment has been very fast by Kolar market (127.89 per cent) as compared to other two markets, Ramnagaram (69.73 per cent) and Siddalaghatta (89.48 per cent) towards long-run equilibrium. The coefficients of Kolar market were statistically significant indicating the prices of cross-breed cocoons were decided by the one lag price period of their own market and prices of Ramnagaram and Siddalaghatta markets. Out of 55 cocoon markets in Karnataka, Ramnagaram and Siddalaghatta are the largest markets in terms of transactions as well bidding the highest prices among the markets. As a result of that, the prices of both markets are integrated in long-run to decide the future prices on other markets in the state.

Table 4 : OLS of VECM of Silk Cocoon Markets

Error Correction Model	**Ramnagaram**	**Siddalaghatta**	**Kolar**
C(1)-ECT	-0.697336* (0.19606) [- 3.55676]	-0.894891* (0.15715) [- 5.69462]	-1.278952* (0.17017) [-7.51581]
D(LOGRAMNAGRAM(-1))	-0.275478 (0.25366) [-1.08602]	-0.269012 (0.20331) [-1.32313]	-0.472317* (0.22016) [-2.14532]
D(LOGSIDDALAGHATTA(-1))	-0.224481 (0.35658) [-0.62954]	-0.877179* (0.28581) [-3.06913]	-0.658957* (0.30949) [-2.12918]
D(LOGKOLAR(-1))	0.249906 (0.35455) [0.70486]	0.857718* (0.28418) [3.01825]	0.788626* (0.30773) [2.56276]
Constant	0.007558 (0.01047) [0.72202]	0.008237 (0.00839) [0.98175]	0.008032 (0.00909) [0.88407]
R-squared Durbin-Watson stat F-statistic Probability	0.250205 1.975900 5.422591** 0.001	0.407619 2.154545 11.18169** 0.000	0.552886 2.060714 20.09416** 0.000

Note: *- Significant at 5% level; and ** Significant at 1 % level
Figures in parentheses indicate t-statistics

Table 5 : Granger Causality Test for Silk Cocoon Markets

Market pair	F-statistics	Probability	Decision of H_0	Result
Ramnagaram-Siddalaghatta	8.45714	0.000	Reject H_0	Causality
Siddalaghatta-Ramnagaram	1.89817	0.1581	Accept H_0	No causality

Ramnagaram-Kolar	23.4124	0.000	Reject H_0	Causality
Kolar-Ramnagaram	7.99654	0.008	Reject H_0	Causality
Siddalaghatta-Kolar	10.0247	0.000	Reject H_0	Causality
Kolar-Siddalaghatta	4.31557	0.017	Reject H_0	Causality

The Granger causality test was used to examine the casual relationship between economic variables. This test is applied after performing test of co-integration among the variables. This helps to know whether the relations are unidirectional or bidirectional. The findings of Granger causality is presented in Table.5. The F-statistics was found to be significant at 1% level for Granger causality between markets from Ramnagram and Siddaghatta markets with Kolar market. Except Siddalaghatta-Ramnagaram, all other market pairs had bidirectional relation between Ramnagaram towards other two markets. This shows that there was inter-transmission of prices happened between Siddalaghatta and Kolar markets in short-run period. However, there was no short-run causality between Siddalghatta and Ramnagaram markets as evident from Table 5.

CONCLUSION:

The main idea behind the study is to investigate the long-run and short-run relationship between three silk cocoon markets, namely, Ramnagaram, Siddalaghatta and Kolar in Karnataka. To achieve the same, Johansen's co-integration test was employed after confirming all the price series had the same order I(1). The tests of Trace and Maximum Eigen Ranks suggested, there were two co-integration equations exist among the three markets. Therefore, Vector Error Correction Model (VECM) was applied to find out short-run equilibrium position of the markets. All the three markets showed that their error correction terms were with negative sign and statistically significant coefficients. These suggested that among the three markets, Kolar market had dynamically adjusting its price changes and moving fast towards long-run equilibrium price. Further, Granger causality test showed that there were bidirectional movements between Ramnagaram, Siddalaghatta and Kolar markets, except Siddalaghatta-Ramnagaram. The study established the fact that Ramnagarm cocoon price was the main determinant to other markets. This is due to fast price transmission taking place between Ramnagarm and other markets. The present digital era further explores for possible price connectivity between the markets at a faster rate. It is suggested to include the transmission cost and other factors that influence the degree of market integration in the framework of analysis.

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