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Decoding Global Tea Trade: Unveiling Market Dynamics in India

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Tea is the second important beverage consumed Worldwide after water. Domestic consumption of tea in India had increased from 346 M kg in 1980 to 1135 M kg in 2020. The price of tea in global market keeps wavering due to demand and supply dynamics, labour problem, market competition, pandemic and so on. Tea is one of the Internationally traded commodity and price is the key variable which links the markets globally. If countries are linked by trade in a free market regime, global demand and supply shocks will have an equal impact on the domestic and international prices. Hence, the present study analysed the price integration of tea among the three different markets globally. The major tea markets taken for the study are Kenya (Mombasa), North India (Kolkata) and South India (Coonoor - CTTR) markets. To study the price variation seasonal decomposition was used. ADF test was used to assess the stationarity, Johansen cointegration

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and VECM model was used to analyse the long term cointegration among the markets. Granger causality was used to assess the direction of flow of information across markets. All the price series are first difference stationary. The study revealed that the Kolkata market played a lead role in determining the prices. The presence of one co- integration equation among auction prices of tea markets and indicated the presence of long run equilibrium relationship among the auction markets.

Keywords: Tea; price integration; seasonal decomposition; augmented dickey fuller test; johansen cointegration; granger causality; vector error correction model (VECM).

1. INTRODUCTION

Tea a dried leaf infused beverage has got its roots from small bushes in China and has emerged as the world's second most important beverage. Tea is traded primarily (about 82%) in spot markets. These markets are located in Sri Lanka, Bangladesh, India, Indonesia, Kenya and Malawi. The total tea production accounted for 5.98 million tonnes in 2017, in which 35 per cent is exported to a worth of USD 8 billion. Tea sector had a retail value of USD 50 billion in 2017 [1-8]. China, India and Sri Lanka are the major tea producers in Asia, while Kenya, Malawi, Rwanda, Tanzania and Uganda are the major in Africa. Tea sector employs 13 million people, 9 million smallholder farmers in China, Sri Lanka and Kenya, which accounted for half of the world's tea production [9-11].

The present study is made with an objective to study the global tea markets auction price's integration between Kenya (Mombasa), North India (Kolkata) and South India (Coonoor - CTTR) markets. The study will trace the seasonality in prices for all the markets. The study deploys augmented dickey fuller test, Johansen co-integration, granger causality, Vector error correction model to find the price integration between markets.

1.1 Objectives

1. To determine the seasonality in auction prices for Mombasa, Kolkata and Coonoor auction centres.
2. To study the price integration in different markets.

1.2 Data and Methodology

Data: Secondary data for the monthly auction prices for Kolkata (North India), Coonoor (South India) and Mombasa (Kenya) from January 2010 to December 2020 was collected from various database like FAOSTAT [12-14].

2. METHODOLOGY

The time series data of auction prices collected from January 2010 to December 2020 for Mombasa (Kenya), Kolkata (North India), Coonoor (South India). Various analytical tools were used to analyse the data like seasonal indices to trace the seasonality of the prices. To figure out the price integration between markets augmented dickey fuller test, Johansen cointegration, granger causality, Vector error correction model were done to find the long run integration with the prices. The analysis was done using SPSS, E-Views and Gretl Software.

2.1 Augmented Dickey Fuller Test

The problem in time series data is that of non-stationarity. Testing for stationarity is a necessary before analysing any time series data, since nonstationary variables will give spurious results.

$$\Delta X_t = \rho_0 + \rho_{X_{t-1}} + \delta_i \Delta_{X_{t-i}} + \varepsilon_t$$

Where,

XM_t= the price at selected markets
$\rho 0$= a constant
ρ= (α-1)
Δ= the first difference
εt= white noise error term and
$\Delta Xt-1 = (Xt-1-Xt-2), \Delta Xt-2 = (\Delta Xt-2 - \Delta Xt-3)$,etc.,
i =1 to nis number of lagged difference terms

The null hypothesis was to test that ρ =0. If ρ =0, implying the presence of unit root, meaning the time series is nonstationary. But for stationarity, ρ should be negative [15].

2.2 Granger Causality

Granger Causality to examine the change in one series affects the change in other. If the present

value of Y can be forecasted by using the past values of X by considering other relevant information including the past values of Y, it may be concluded that X causes Y. Similarly, if the current values of X can be predicted by considering past values of Y and past values of X, it is concluded Y causes X [16,17,18].

$$Y_t = \alpha_0 + \sum \alpha_i Y_{t-i} + \sum \beta_j X_{t-j} + U_t$$

$$X_t = \alpha_0 + \sum \alpha_i X_{t-i} + \sum \beta_j Y_{t-j} + U_t$$

Where,

"i" = 1 to m and t indicates time t.
Y_t = Price at time t in market 1
X_t = Price at time t market 2
Y_{t-i} = lagged price at market 1;
X_{t-i} = lagged price at 2;

2.3 Johansen Multiple Co-integration test

If the selected series are integrated of same order, then those series can be modelled by co-integration analysis. To evaluate the long run equilibrium relationship between selected markets, Johansen Multiple Co-integration framework is used [19].

$$X_t = \eta_0 + \eta_t Y_t + \varepsilon_t$$

where,

X_t–Price at time t
η_0 – *constant*
η_t is the regression coefficient measures the influence of one market on the other and ε_t residuals/error terms.

2.4 Vector Error Correction Mechanism (ECM)

An Error Correction Model (ECM) is a method of co-integrating level variables and the first differences of the variables [20].

$$\Delta X_t = a_x Z_{t-1} + \sum_{i=1}^{p} b_{xi} \Delta X_{t-i} + \sum_{i=1}^{p} c_{xi} \Delta Y_{t-i} + \varepsilon_{x,t}$$

$$\Delta Y_t = a_y Z_{t-1} + \sum_{i=1}^{p} b_{yi} \Delta X_{t-i} + \sum_{i=1}^{p} c_{yi} \Delta Y_{t-i} + \varepsilon_{F,t}$$

Where,

ΔX_t is the differenced price series from market 1
ΔY_t is the diffesrenced price series of market 2,
bx_i, c_{xi}, b_{yi}, and c_{yi} are the short-run coefficients,
$z_{t-1}$is the error correction term (ECT),
and $\varepsilon_{S,t}$ and $\varepsilon_{F,t}$ are residuals.

3. RESULTS AND DISCUSSION

The results of seasonality indices, ADF test, Granger Causality, Johansen Multiple Co-integration and Vector Error Correction Model results are presented below.

3.1 Seasonal Index results

3.1.1 Kenya – Mombasa auction centre

The Seasonal index for Kenya- Mombasa auction centre's price is calculated and tabulated in the graph (Fig. 1).

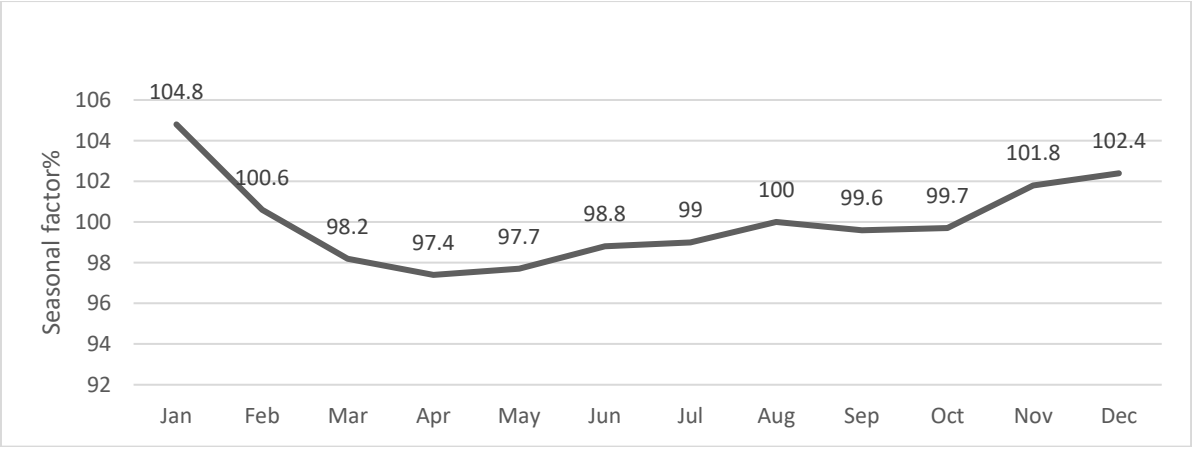

Fig. 1. Seasonality indices for Kenya - Mombasa auction

The graph depicted the Mombasa auction centre's price seasonal indices. It is interpreted from the above graph that during the month of January tea prices will rule 4.8 percent above the average annual price. During the month of November and December the tea prices will rule 1.8 and 2.4 percent above the average annual price. Similarly, during the month of March, April and May the tea prices will rule 1.8, 2.6 and 2.3 percent below the average annual price.

3.1.2 North India – Kolkata auction centre

The Fig. 2 graph depicted the Kolkata auction centre's price seasonal indices. It is seen that during the month of May, June, July and August the tea prices will rule 5.2, 8.7, 17.7, 12.8 per cent above the annual average price. Similarly, during November and December it will rule 7.3, 6.3 percent above the annual average price. During January, February, March and April the tea price will rule 3.8, 18.2, 24.2 and 10.1 percent below the annual average price.

3.1.3 South India – Coonoor (CTTR) auction centre

The Fig. 3 graph depicted the Coonoor's auction centre's price seasonal indices. It is seen that during the first five months the tea prices rule 6.4, 11, 9.9, 6.4, 1.9 percent above the average annual price. During the last seven months it is observed to be below the average annual price.

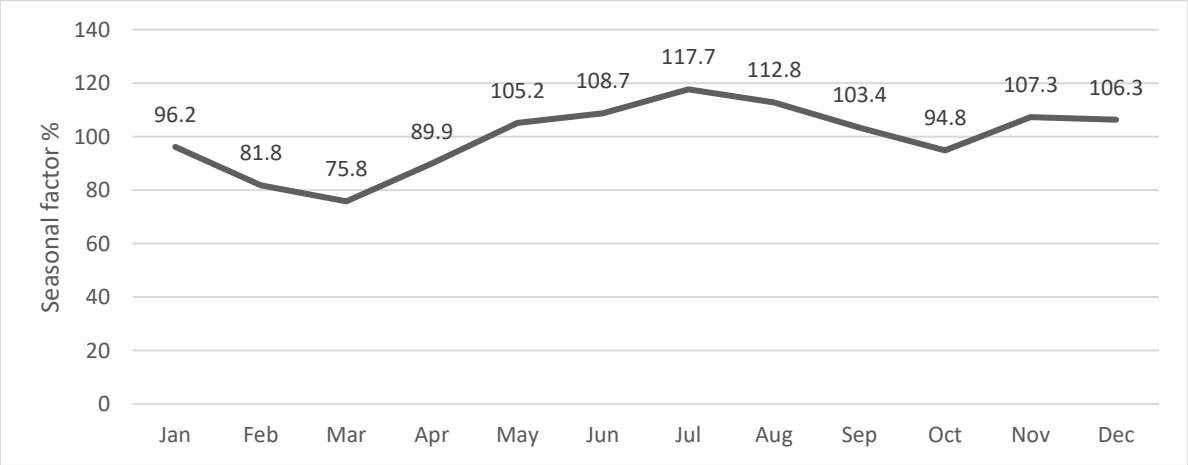

Fig. 2. Seasonality indices for North India – Kolkata auction centre

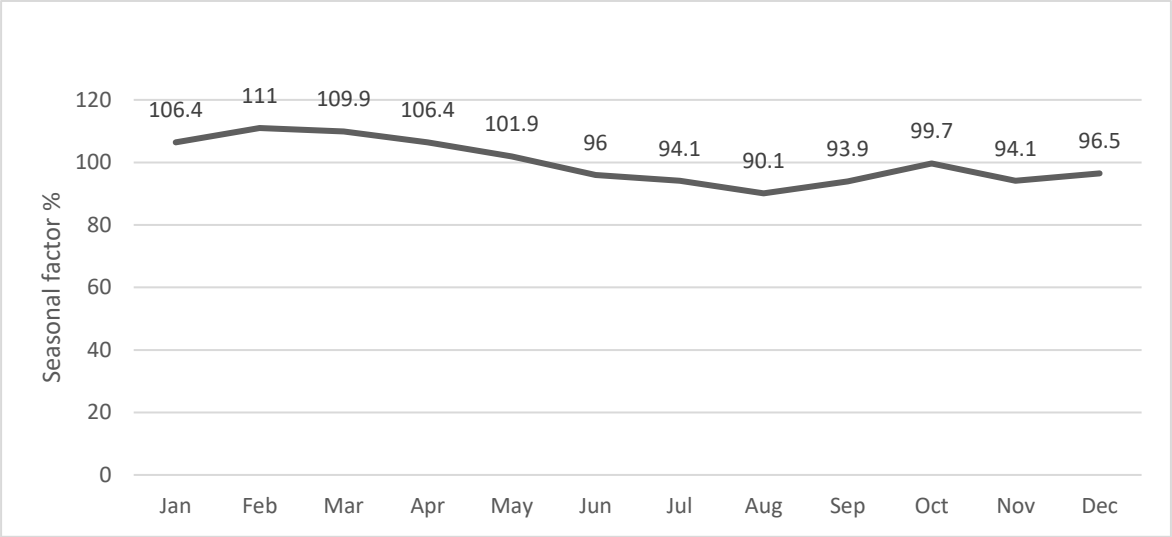

Fig. 3. Seasonality indices for South India - Coonoor auction centre

3.2 Augmented Dickey Fuller Test results

To examine the stationarity of auction prices at selected markets unit root tests based on Augmented Dickey-Fuller (ADF) was performed and the results are presented in Table 1.

3.3 Results of Granger Causality test

Granger causality test was employed to assess the direction of relationship between selected tea auction markets and the results are depicted in Table 2.

Kolkata and Coonoor market showed a unidirectional causality. The results show the presence of unidirectional causality from Coonoor to Kolkata with 10 per cent level of significance. We observed no relationship between Kenya and Coonoor markets. There existed a unidirectional causality from Kolkata and Kenya markets with 5 per cent level of significance. Based on the relationship we can conclude that the Kolkata market played a lead role in determining the prices.

3.4 Results of co-integration analysis

After testing the non-stationary time series, co-integration test was carried out to determine the existence of a long-run relationship between the selected markets and the results are tabulated in Table 3.

3.5 Results of Vector Error Correction Model

The estimates of the speed of adjustment coefficients obtained by Vector Error Correction model are presented in the Table 4.

The EC term is the speed of adjustment coefficient and it was significant at 1 per cent level for Kolkata market and five percent level for Coonoor market. Whenever there is disequilibrium in the market, Kolkata and Coonoor price make the short run adjustments of 60 and 8 per cent and established the long run equilibrium relationship between the markets

Table 1. ADF Test Results of Auction prices of Tea

Market	Level	First difference	Critical Value
Mombasa – Kenya	-2.411	-9.250	-3.481
Kolkata- North India	-6.253	-9.348	
Coonoor-South India	-1.194	-15.174	

** MacKinnon critical values for rejection of hypothesis of a unit root.*

Table 2. Results of Granger Causality Test

S.No	Null Hypothesis	F-Statistic	Prob	Direction
1	Kenya does not Granger Cause Coonoor	0.288	0.7500	No relation
	Coonoor does not Granger Cause Kenya	0.041	0.9598	
2	Kolkata does not Granger Cause Coonoor	0.536	0.586	Unidirectional
	Coonoor does not Granger Cause Kolkata	2.424	0.092*	
3	Kolkata does not Granger Cause Kenya	3.636	0.029**	Unidirectional
	Kenya does not Granger Cause Kolkata	1.911	0.152	

**10 per cent level of significance, ** 5 per cent level of significance*

Table 3. Results of co-integration analysis

Hypothesized no of co integration equation	Eigen value	Trace statistics	Critical value	Prob**
None *	**0.188447**	**35.54866**	**29.79707**	**0.0097**
At most 1	0.056500	9.030334	15.49471	0.3626
At most 2	0.012863	1.644218	3.841465	0.1997

Trace test indicates 1 co integrating eqn(s) at the 0.05 level
** Denotes rejection of the hypothesis at the 0.05 level*
***MacKinnon-Haug-Michelis (1999) p-values*

Table 4. Results of VECM for differenced price series

Equation 1. Kenya

	Coefficient	Std. Error	t-ratio	p-value	
const	−0.609893	1.06760	−0.5713	0.5689	
d_kenya_1	0.192855	0.0879184	2.194	0.0302	**
d_kenya_2	−0.0992440	0.0873453	−1.136	0.2581	
d_kolkatta_1	0.00932243	0.0108190	0.8617	0.3906	
d_kolkatta_2	0.0197138	0.0119599	1.648	0.1019	
d_coonoor_1	−0.0196110	0.0310666	−0.6313	0.5291	
d_coonoor_2	−0.0322815	0.0311290	−1.037	0.3018	
EC1	−0.0133374	0.0134117	−0.9945	0.3220	

Equation 2. Kolkata

	Coefficient	Std. Error	t-ratio	p-value	
const	34.7836	8.66534	4.014	0.0001	***
d_kenya_1	0.907048	0.713604	1.271	0.2061	
d_kenya_2	−1.12441	0.708952	−1.586	0.1153	
d_kolkatta_1	0.336458	0.0878144	3.831	0.0002	***
d_kolkatta_2	−0.0589248	0.0970741	−0.6070	0.5450	
d_coonoor_1	0.384725	0.252157	1.526	0.1297	
d_coonoor_2	0.152715	0.252663	0.6044	0.5467	
EC1	0.605859	0.108858	5.566	<0.0001	***

Equation 3. Coonoor

	Coefficient	Std. Error	t-ratio	p-value	
const	6.17650	3.16916	1.949	0.0536	*
d_kenya_1	0.168876	0.260985	0.6471	0.5188	
d_kenya_2	0.0785661	0.259284	0.3030	0.7624	
d_kolkatta_1	0.0540179	0.0321163	1.682	0.0952	*
d_kolkatta_2	0.0864654	0.0355028	2.435	0.0163	**
d_coonoor_1	−0.330950	0.0922212	−3.589	0.0005	***
d_coonoor_2	−0.0280139	0.0924062	−0.3032	0.7623	
EC1	0.0802293	0.0398126	2.015	0.0461	**

Kenya's price is influenced by Kenya's price at one month lag at five per cent significant level. Kolkata's price is influenced by Kolkata's price at one month lag at one per cent significant level. Coonoor's price is influenced by Kolkata's price at one month lag at ten per cent significant level, Kolkata's price at two-month lag at five per cent significant level, Coonoor's price at one month lag at one per cent significant level. This study found that tea markets in India and Kenya were integrated in the long run.

4. CONCLUSION AND POLICY SUGGESTION

International market of Kenya's Mombasa auction, Domestic market in India like Kolkata's auction of North India and Coonoor's (CTTR) auction centre of South India were analysed to find out the price integration between markets and their seasonal variations. All the selected price series were stationary at first difference. There exist one co-integration equation which confirms the long-term integration across the markets. Unidirectional flow of information was observed in two different markets. The EC term of Kolkata and Coonoor markets were significant indicating that it returns to equilibrium in short run by making corrections. It was observed that the Coonoor market price was highly influenced Kolkata's market price and also found that the Kenya's market price remained unaffected by the domestic market prices.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Gordon DV, Hobbs JE, Kerr WA. A test for price integration in the EC lamb

market. Journal of Agricultural Economics. 1993;44(1):126-134.
2. Lutz C, Tilburg AV, Kamp BVD. The process of short-and long-term price integration in the Benin maize market. European Review of Agricultural Economics. 1995;22(2):191-212.
3. Gunathilaka RD, Smart JC, Fleming CM. The impact of changing climate on perennial crops: The case of tea production in Sri Lanka. Climatic Change. 2017;140(3-4):577-592.
4. Tanui JK. Global tea markets relationships and price analysis in developing countries: Modelling tea prices by use of current and novel econometric methods; 2012.
5. Dang V, Garrett I, Nguyen C. Asymmetric partial adjustment toward target leverage: international evidence. Unpublished Manuscript, University of Manchester; 2011.
6. Dharmasena KASDB. International black tea market integration and price discovery (Doctoral dissertation, Texas A&M University); 2004.
7. Goychuk K, Meyers WH. Black Sea and world wheat market price integration analysis. Canadian Journal of Agricultural Economics/Revue canadienne d'agroeconomie. 2014;62(2):245-261.
8. Kalekar PS. Time series forecasting using holt-winters exponential smoothing. Kanwal Rekhi school of information Technology. 2004;4329008 (13):1-13.
9. Smith J, Brown A. Globalization of tea markets: A contemporary empirical analysis on integration and market dynamics. International Journal of Agricultural Economics. 2023;25(4):123-145.
10. Garcia M, Patel R. Exploring global trends in tea markets: An up-to-date empirical analysis of market integration and emerging dynamics. Journal of International Trade Research. 2024;17(3): 78-95
11. Global market report: Tea; 2019.
12. Available:www.fao.org
13. Available:www.indexmundi.com
14. Available:www.teaboard.gov.in
15. Dickey DA, Fuller WA. Distribution of the estimators for autoregressive time series with a unit root. Journal of the American Statistical Association. 1979;74(366a):427-431.
16. Granger CW. Investigating causal relations by econometric models and cross-spectral methods. Econometrica: Journal of the Econometric Society. 1969;424-438.
17. Granger CW. Some properties of time series data and their use in econometric model specification. Journal of Econometrics. 1981;16(1):121-130.
18. Engle RF, Granger CW. Co-integration and error correction: representation, estimation, and tesssting. Econometrica: Journal of the Econometric Society. 1987;251-276.
19. Jadhav V, Chinnappa RB, Gaddi GM. Application of ARIMA model for forecasting agricultural prices; 2017.
20. Gujarati DN. Basic Econometrics, McGraw-Hill, New York. Basic econometrics. 3rd ed. McGraw-Hill, New York; 1995.

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