International Journal of Applied Social Science
Volume 6 (7), July (2019) : 1788-1792
Received : 04.05.2019; Revised : 19.05.2019; Accepted : 04.06.2019

RESEARCH PAPER
ISSN : 2394-1405

The Causal Relationship between Sugar Production and Sugar Consumption in India

K. PUSHPARANI*[1] AND P. JAYA PRAPAKARAN[2]
[1]Guest Faculty and [2]Assistant Professor
[1]Department of Economics, The Government Law College, Madurai (T.N.) India
[2]PG and Research Department of Economics, M.D.T. Hindu College, Tirunelveli (T.N.) India

ABSTRACT

This paper is an attempt to find the casual relationship between sugar production and per capita consumption of sugar for India over the period 1970-71 to 2017-18. The DF unit root test, Johansen cointegration test, VECM and Granger causality tests were used in this study. The Johansen cointegration test showed one equation is the co-integrated in Trace and Maximum Eigen value tests. The results showed the presence of co-integration between per capita consumption of sugar and sugar production implying the presence of the even short-run and long-run relationship between them. Therefore, there is unidirectional causality running from per capita consumption of sugar to sugar production.

Key Words : Sugarcane, Production, Consumption, Per capita, Granger Causality

INTRODUCTION

India had been the home for sugarcane cultivation from very ancient times and references could be found even in the early vedic literature. The sugarcane was one of the luxuries provided by Vishwamitra to Trishanku in the special heaven created for him by the sage. In an article on "Sugarcane improvement in India", Mr. N.L. Dutt, the Government of India sugarcane expert, had written that sugarcane had been grown in India from time immemorial and a mention had been made in the vedic literature also (5000 B.C). The Chinese visitors of the 18th century B.C. had recorded that the knowledge about sugarcane and its products were derived from India. In 600 A.D. the Chinese expert Tsai Hong had sent agents to Bihar in India to learn about the art of sugar manufacturing and it was perhaps the first instance on record of a technical term "honey need", and there are many reasons for believing that India was the original home of sugarcane cultivation. The Indian sugar industry was the second largest agro – processing industry in the country, next only to that of the Cotton Textiles. The sugar industry had provided employment for about half a million people directly and had brought within its ambit about 7.5 per cent of the total rural population of India. The sugar industry is supported by about 4 million hectares of land of sugarcane cultivation and by about 45 million farmers engaged in sugarcane cultivation in India.

METHODOLOGY

The study is based on secondary data only. The secondary data have been collected from Hand Book of Sugar Statistics, Indian Sugar Mills Association and Ministry of Consumer Affairs.

Tools for analysis:

The secondary data is expressively analyzed by using econometrical tools such as Granger Causality Test. Three methods are Unit Root Test, Johansen's Co-integration Test, Vector Error Correction Estimates and Pairwise Granger Causality Test. Analysis has been done

How to cite this Article: Pushparani, K. and Jaya Prapakaran, P. (2019). The Causal Relationship between Sugar Production and Sugar Consumption in India. *Internat. J. Appl. Soc. Sci.,* **6** (7) : 1788-1792.

with help of computer by using E-views software.

Period of the study:

The period of the study taken up for the analysis was a period of 48 years, from the year 1970-71 to that of the year 2017-18.

Mathematical background:

Unit Root Test:

Time series analysis is about the identification, estimation and diagnostic checking of stationary time series.

Definition:

The sequence y_t is said to be covariance stationary if for all t and t - s

$E(y_t) = E(y_s) = \mu$

$E(y_t - \mu)^2 = E(y_{t-s} - \mu)^2 = \sigma$

$E(y_t - \mu)(y_{t-s} - \mu) = E(y_{t-j} - \mu)(y_{t-j-s} - \mu) = \Upsilon^2$

The Dickey-Fuller Test for Unit Roots:

Dickey and Fuller (1979, 1981) devised a procedure to formally test for the presence of a unit root. The Dickey-Fuller test simply includes AR (p) terms of the Xt term in the three alternative models.

Therefore we have:

$$\Delta X_t = \gamma Y_{t-1} + \sum_{I=1}^{P} \beta_I \Delta X_{t-1} + \varepsilon_t$$

Johansen test:

This test permits more than one co-integrating relationship so is more generally applicable than the Engle Granger test which is based on the Dickey Fuller (or the augmented) test for unit roots in the residuals from a single co-integrating relationship. In fact, Johansens procedure is nothing more than a multivariate generalisation of the Dickey-Fuller test. Consequently, he proposes two different likelihood ratio tests namely

– The trace test

– Maximum eigenvalue test

Johansen's method takes as a starting point the vector auto regression (VAR) of order p given by

$$X_t = \Pi_1 X_{t-1} + \Pi_2 X_{t-1} + u_t$$

where Xt is an n * 1 vector of variables that are integrated of order one. u_t is an n * 1 vector of innovations while Π_1 through Πp are m*n coefficient matrices.

Trace Test:

The trace test tests the null hypothesis of r co-integrating vectors against the alternative hypothesis of n co-integrating vectors. The test statistic is given by

$$\tau_{trace} = -T \sum_{i=r+1}^{k} \ln(1 - \lambda_i)$$

Maximum Eigenvalue Test:

The maximum eigen value test, on the other hand, tests the null hypothesis of r co-integrating vectors against the alternative hypothesis of (r + 1) co-integrating vectors. Its test statistic is given by

$$\tau_{trace} = -T(1 - \lambda r) + 1$$

Where T is the sample size, and λ_i is the i^{th} largest canonical correlation.

Vector Error Correction Model:

Once the co-integration is confirmed to exist between variables, then the third step entails the construction of error correction mechanism to model dynamic relationship. The purpose of the error correction model is to indicate the speed of adjustment from the short-run equilibrium to the long-run equilibrium state.

A Vector Error Correction Model (VECM) is a restricted VAR designed for use with non-stationary series that are known to be co-integrated. Once the equilibrium conditions are imposed, the VECM describes how the examined model is adjusting in each time period towards its long-run equilibrium state. Since the variables are supposed to be co-integrated, then in the short-run, deviations from this long-run equilibrium will feedback on the changes in the dependent variables in order to force their movements towards the long-run equilibrium state. Hence, the co-integrated vectors from which the error correction terms are derived are each indicating an independent direction where a stable meaningful long-run equilibrium state exists.

The VECM has co-integration relations built into the specification so that it restricts the long-run behavior of the endogenous variables to converge on their co-integrating relationship while allowing for short-run adjustment dynamics. The co-integration terms is known as the error correction term since the deviation from long-run equilibrium is corrected gradually through a series of partial short-run adjustments. The dynamic specification of the VECM allows the deletion of the insignificant variables, while error correction term is retained. The size of the error correction term indicates the speed of adjustment of any disequilibrium towards a long-run equilibrium state.

In this study the error correction model as suggested by Hendry (1995) has been used. The general form of the VECM is as follows:

$$\Delta X_t = \alpha_0 + \lambda_1 EC^1_{t-1} + \sum_{i-1}^{m} \alpha_i \Delta X_{t-i} + \sum_{j=1}^{n} \alpha_j \Delta Y_{t-j} + \varepsilon_{1t}$$

$$\Delta Y_t = \beta_0 + \lambda_2 EC^2_{t-1} + \sum_{i-1}^{m} \beta_i \Delta Y_{t-i} + \sum_{j=1}^{n} \beta_j \Delta X_{t-j} + \varepsilon_{2t}$$

where Δ is the first difference operator; EC_{t-1} is the error correction term lagged one period; λ is the short-run coefficient of the error correction term ($-1 < \lambda < 0$); and ε is the white noise. The error correction coefficient (λ) is very vital in this error correction estimation as the greater coefficient indicates higher speed of adjustment of the model from the short-run to the long-run.

The error correction term represents the long-run relationship. A negative and significant coefficient of the error term indicates the presence of long-run causal relationship. If both the coefficients of error correction term in both the equations are significant, this will suggest the bi-directional causality. If only λ_1 is negative and significant, this will suggest a unidirectional causality from Y and X, implying that Y drives X towards long-run equilibrium, but no other way around. Similarly, if λ_2 are negative and significant, this will suggest a unidirectional causality from X and Y, implying that X drives Y towards long-run equilibrium but not the other way around.

On the other hand, the lagged terms of ΔX_t and ΔY_t appeared as explanatory variable, indicating a short-run cause and effect relationship between the two variables. Thus, if the lagged coefficients of ΔX_t appear to be significant in the regression of ΔY_t , this will mean that X causes Y. Similarly, if the lagged coefficients of ΔY_t appear to be significant in the regression of DX_t, this will mean that Y causes X.

RESULTS AND DISCUSSION

The results are presented in Table 1, to empirically analyse the Sugar Production and Per capita Consumption of Sugar in India, the present study primarily tested the stationarity of the selected time series data for which univariate Dickey-Fuller test have been conducted. The DF statistics were calculated for the variables in levels and first differences. The series of the sugar production at levels is non-stationary at one per cent level of significance but per capita consumption of sugar at first difference is non-stationary at one per cent level of significance.

This paper considers trace and maximum eigen value statistics as to interpret the co-integration results for further granger causality tests. Based on the Johansen co-integration results, we cannot reject the null hypothesis of a single co-integrating vector using Trace and Maximum Eigen value tests at the one per cent level of

Table 1 : Unit Root Test

Sugar		Consumption		
Level		Level		First difference
Intercept	Trend and Intercept	Intercept	Trend and Intercept	Intercept
0.0817	-6.7057	-0.3274	-2.8100	-6.7418
-2.6150 (1%)	-3.7700 (1%)	-2.6150 (1%)	-3.7700 (1%)	-2.6173 (1%)

Source: Author's own calculation.

Table 2 : Rank Test for Trace

Hypothesized No. of CE(s)	Eigen value	Trace Statistics	0.05 CV	Prob.**
None*	0.3340	20.1205	15.4947	0.0093
At Most 1	0.0303	1.4165	3.8414	0.2340

Source: Author's own calculation

Table 3 : Rank Test for Maximum Eigen value

Hypothesized No. of CE(s)	Eigen value	Max-Eigen Statistics	0.05 CV	Prob.**
None*	0.3340	18.7040	14.2646	0.0093
At Most 1	0.0303	1.4165	3.8414	0.2340

Source: Author's own calculation.

Table 4 : Vector Error Correction Estimates

Error Correction	D (PRO)	D (CON)
CointEq1	-0.5348 (0.1811) [-2.9526]	-0.0018 (0.0063) [-0.2957]
D (PRO(1))	0.0989 (0.1543) [0.6410]	0.0063 (0.0054) [1.1652]
D (PRO(2))	-0.2916 (0.1504) [-1.9388]	0.0025 (0.0053) [0.4717]
D (CON(1))	-12.8264 (5.0811) [-2.5243]	-0.3040 (0.1789) [-1.6990]
D (CON(2))	-9.0121 (4.9403) [-1.8240]	-0.3805 (0.1740) [-2.1870]
C	9.9022 (4.5552) [2.1738]	-0.3542 (0.1604) [2.2079]

Source: Author's own calculation.

Table 5 : Pairwise Granger Causality Test

Null Hypothesis	F Statistics	Probability
PRO does not Granger cause CON	2.1313	0.1316
CON does not Granger cause PRO	11.0681	0.0001

Source: Author's own calculation

significance.

Table 4 presents the results of VECM. The Vector Error Correction Model conveys the long-run causal effects, while the lagged explanatory variables give an indication of the short-run adjustments. The coefficient of VECM contains information about whether the past values of variables affect the current values of variable under study. A significant coefficient implies that the past equilibrium errors play a role in determining the current outcomes. The significance of VECM implies the presence of causal relations from the independent variables to dependent variable, even in case when the lagged independent variables are jointly insignificant in the grangerian framework, used for testing the bivariate causal relationship between sugar production and per capita consumption of sugar. In the present case, we examine a negative coefficient of the VECM in the regression equation of per capita consumption of sugar on sugar production. The negative coefficient signifies that the per capita consumption of sugar to its long-run equilibrium at one per cent level.

Table 5 results indicate that the per capita consumption of sugar does not granger cause of sugar production is rejected Null Hypothesis at one per cent level. This result supports the previous result obtained from VECM that there is short-run causality at one per cent level of significance. Based on this causality test, changes capita consumption of sugar cause changes in sugar production in short-run and long-run. Therefore, there is unidirectional causality running from per capita consumption of sugar to sugar production.

Conclusion:

This study estimates the critical parameters of per capita consumption of sugar to sugar production in India for the study period. The DF unit root test, Johansen co-integration test, VECM and Granger causality tests were used in this study. The Johansen co-integration test showed one equation is cointegrated in Trace and Maximum Eigen value tests. The results showed the presence of cointegration between per capita consumption of sugar and sugar production implying the presence of the short-run and long-run relationship between them, and suggest a one-way causation from per capita consumption of sugar to sugar production in India. It does not support the conception of bi-directional causation.

REFERENCES

Anwar, M. and Sampath, R (2000). Exports and economic growth. *Indian Economic J.*, **47** (3) : 79-88.

Bhat, S. (1995). Exports and economic growth in India. *Artha Vijana*, **37** (44) : 350-358.

Chandra, R. (2000). Export Growth and Economic Growth: An Investigation of Causality in India. *Indian Economic J.*, **49** : 64-73.

Ghosh, A.D. (2006). Sugar Industry – Recent Trends and Outlook, WAR Rating features, pp. 36.

Hapse, D.G. (2011). Developmental management for sustainable growth of Indian sugar industry. Souvenir. STAI. 128–133.

Idowu Raheem (2016). Analysis of the effects of oil and non-oil export on economic growth in Nigeria, Hall Archives, pp. 476-483.

Jaya Prapakaran, P. (2016). The causal relationship between agriculture exports and agriculture growth in India. *International Trade Issues & Challenges*, pp. 1-9.

Jeyalakshmi and Satheesh Kumar (2019). Causality between oil exports and GDP in India. *International Journal of Applied Social Science*, **6** (4) : 859-862.

Jyothi, K.C. (2014). Impact of policy of government on import and export of sugar from India. *J. Economic & Finance*, **3** (2) : 41-42, ISSN: 2321-5933.

Satheesh Kumar, P. (2014). Growth and Structure of Exports in India During 1981-2010, Unpublished Ph.D Thesis.

Solomon, S. (2011). The Indian Sugar Industry: An overview. *Sugar Tech.*, **13**(4) : 255-265.

Srivastava, A.K (2006). Sugar cane at a Glance" International Book Distribution.

Suresh, S. and Satheesh Kumar, P (2017). The Causal Relationship Between Agriculture Exports and Agriculture Growth in India. *Bodhi Internat. J. Res. Humanities, Arts & Sci.*, **1** (3) : 28-33.

****