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Non-Alignment between Prices of Sugar and Sugarcane Creating Cyclicality in the Sugar Sector of India: An Application of Cointegration Technique

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ABSTRACT

The paper aims to study whether the non-alignment between sugar and sugarcane prices creates cyclicality in the Indian sugar sector. This paper found no non-alignment between sugar and sugarcane prices in India. Thus, the non-alignment between sugar and sugarcane prices cannot create the cycle. One need a better explanation for the cyclicality and, therefore, a better solution. Otherwise, it will affect the livelihood of a large number of people in India.

Keywords: Sugar, Sugar Policy, Sugarcane Price, Cyclicality, India

JEL Code: Q18, C22

I

INTRODUCTION

This paper studies whether the sugar price and sugarcane prices are non-aligned. The reason for studying the existence of non-alignment between prices comes from the Rangarajan Committee Report (2012), which has argued that it creates cyclicality in the Indian sugar sector. The study period is 1970-71 to 2018-19. The current policy framework, which started in the late 1960s, has four major components: minimum sugarcane price, cane area reserved for each sugar mill, regulated supply of sugar in the market, and trade restriction. The policy report written by the Rangarajan Committee (2012) has claimed that cyclicality in the sugar sector of India is due to the fixing of minimum sugarcane price as a policy decision by the Government of India. The minimum sugarcane price decided by this policy creates non-alignment between sugar price and sugarcane price, which creates year-to-year cyclicality in the sugar sector, particularly for the production of sugar and sugarcane and the area under sugarcane cultivation or cane area. Hence, this committee in 2012 and recently the Task Force on Sugarcane and Sugar Industry (2020) has suggested directly linking sugarcane price with sugar price and abolishing the current minimum support price and cane area reservation policy. This study aims to find empirical evidence for the non-alignment between sugar prices and sugarcane prices. Thus, it empirically examines the validity of a major justification for the suggested price deregulation policy in the Indian sugar sector. This study is conducted based on econometrics techniques suited for time series, including cointegration and error correction model, using the annual data aggregated at the national level from 1970-71 to 2018-19.

The sugar industry is India's second largest agro-based industry. For the sugar season 2021-22, the sugarcane area, production, and productivity were 5.15 million

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ha, 431.8 million tonnes, and 83.89 tonnes/ha (Government of India, 2021). Sugarcane provides a means of livelihood to 6.0 million farmers' families engaged in its cultivation and allied activities and employment opportunities to 0.50 million skilled and semiskilled rural workers engaged in the sugar, bio-ethanol, and power co-generation industries. Thus, the sugar sector has a significant contribution to the Indian economy both in terms of output and employment generation. The contribution of the sugar sector in the form of bio-ethanol blending as a partial replacement of non-renewable petroleum fuel and the use of bagasse and sugarcane trash for electricity co-generation will go up further as India is committed to the targets of the Paris Agreement (COP21), 2015. The Ministry of Agriculture has already asserted that by 2030, India shall require approximately 34 million tonnes of sugar and 9 million tonnes of Jaggery, 10.94 million tonnes of bio-ethanol, 14000 MW surplus power supply through co-generation to the national grid, and 48 million carbon credits (Gangwar *et al*., 2014).

According to Balasaheb (2013), Indian sugar production is characterised by a cyclic production pattern with typical sugar cycles lasting 2–3 years, as production adjusts to the fall in price, leading to lower supplies, leading to price increases, and higher production. The author recognised fluctuations (not cyclicality) in sugarcane production and cane area. He has listed several factors like variations in climatic conditions, the vulnerability of areas cultivated under rain-fed conditions, fluctuations in prices of *gur* and *khandsari*, changes in the returns from competing crops, and fluctuations in sugarcane prices. However, sugar production or sugar price are not included in his list of factors that create fluctuations in sugarcane production and cane area. Policy reports (KPMG,2007) and Rangarajan committee report (2012) posited that non alignment between sugarcane price, fixed by the Government, and domestic sugar price is creating cyclicality in the production of sugarcane and sugar. Rangarajan Committee (2012) and task force on sugarcane and the sugar industry (2020) endorsed directly linking sugarcane prices with domestic sugar prices. However, none of these studies has used any econometric modeling or statistical test for their assertions of cyclicality in the Indian sugar sector. Research has been scarce to empirically investigate the degree of non-alignment between sugarcane price and sugar price. This study is an attempt to fill this gap.

This study contributes to the existing literature by showing the existence of an alignment between sugarcane and sugar prices. It thus takes away the justification for the policy, as mentioned earlier, for price deregulation in the Indian sugar sector. The time series econometric techniques have been adopted in this paper. For testing the alignment between sugar price and sugarcane price, the techniques of cointegration and the Error Correction Model suggested by Engle-Granger for the bi-variate framework have been used. We took 1970-71 to 2018-19 as a study period as it is long enough to use time series econometric techniques. The methods for fixation of minimum support price by the Government of India have also been broadly similar during this period, though there were minor changes periodically. This article uses annual data on wholesale price index numbers for sugar and sugarcane.

The remaining paper is structured as follows: Section II describes the policy environment around the sugar sector of India. Section III is used for model building and description of data and methodology adopted for testing the proposition. In Section IV, we discuss and analyze the findings. Lastly, Section V consists of the concluding remarks.

II

POLICY ENVIRONMENT FOR THE SUGAR SECTOR IN INDIA

The main components of the current policy framework of the sugar sector in India are (1) fair and remunerative prices (FRP) for farmers, (2) cane area reservation for sugar mills, (3) regulated supply of sugar by the mills in the market and (4) trade restrictions both on import and export of sugar. This present policy framework of regulations in India originates in the Sugarcane (Control) Order, 1955 and the Sugar (Control) Order, 1955. However, the basic structure of the current regulation system started with the Sugar (Control) Order, 1966, and the Sugarcane (Control) Order, 1966. Sugar (Control) Order, 1966, authorized the Central Government to direct that no sugar is to be manufactured from sugarcane without a license, whether on payment of the fee or otherwise; it also could restrict the sale or delivery of sugar by producers and issue other necessary directions to them about production, storage, sale, movement, quality, and other matters. Sugarcane (Control) Order,1966 authorized the Central Government to fix a minimum price of sugarcane from time to time. Subsequent changes to the Orders allowed calculations of fixing the minimum price of sugarcane differently. They allowed state governments to fix the minimum sugarcane price above the minimum sugarcane price decided by the Central Government.

In the present system of fixing the minimum price of sugarcane, also known as FRP, the Government of India decides it after taking into account the following factors:(1) the cost of sugarcane production, (2) the general trend of the prices of agricultural commodities in India, (3) availability of sugar to the consumer at a fair price, (4) price of sugar, (5) recovery rate of sugar from sugarcane, (6) realization made from selling by-products like molasses, bagasse, and press mud, or their imputed value, and (7) reasonable margins for the growers of sugarcane on account of risk and profits (*Gazette of India*, 2010, Extraordinary Part II, Section 3, Subsection (i)).

In order to ensure that higher sugar recoveries are adequately rewarded and considering variations amongst sugar mills, the FRP is linked to a basic recovery rate of sugar, with a premium payable to farmers. Accordingly, FRP for the 2022-23 sugar season has been fixed at Rs. 305 per quintal linked to a basic recovery of 10.25 per cent subject to a premium of Rs. 3.05 per quintal for each 0.1 per cent increase of recovery over and above 10.25 per cent and a reduction in FRP at the same rate for each 0.1 per cent decrease in the recovery rate till 9.5 per cent (DFPD, Ministry of Consumer Affairs Food and Public Distribution). However, it is pertinent that the FRP applies only to the sugar mills; it does not apply to other users like the *gur* and *khandsari* industries. According to the data found in various issues of the *Indian Sugar*

Yearbook and *Indian Sugar Journal* published by the Indian Sugar Mill Association (ISMA), sugarcane is also sold to *gur* and *khandsari* producers and sugarcane juice extractors. In the 1970s, roughly 20 per cent of the cane used to come to the mills; however, the share of the mill has gradually increased over the years. In the 1980s, the mills procured roughly 40 per cent of sugarcane. In the next two decades, the share of the procurement of mills increased to 60 per cent. This means that sugar mills must purchase the sugarcane at the FRP price because of the cane area reserved for them, although a sizable amount of sugarcane is sold to other industries. Since sugar mills thus have competition, the market price for sugarcane is always there, while the FRP Price largely works as the anchor. The State Governments of UP, Uttarakhand, Haryana, Punjab, Bihar, and Tamil Nadu have announced a State Advised Price (SAP) as mark up over the FRP of sugarcane. Under the cane area reservation policy, a sugar mill can purchase sugarcane from its reserved area only, typically the mill's surrounding area. Whatever sugarcane is produced in this reserved area comes to the mill, and the mill procures it. Hence, the policy of cane area reservation for sugar mills ensures no competition among sugar mills to procure sugarcane.

The Indian sugar market has a dual structure. The Government procures a particular portion of sugar produced by the mills at a levy price. The Government distributes this levy of sugar through its public food distribution system, primarily targeting people experiencing poverty. This share of levy sugar has changed many times in the past. On the recommendation of the Rangarajan committee (2012), the sugar levy has been completely abolished. The mills sell the non-levy part of the produce in the open market. However, there are some restrictions on the quantity supplied to the market on a quarterly basis (presently). It primarily brings some stability to the market price against seasonal fluctuations in sugar demand. As these restrictions should only influence seasonality, the annual price of sugar, which is free from seasonality, is largely market-driven and depends on the demand and supply of sugar.

III

METHODOLOGY, MODELS, AND DESCRIPTION OF DATA

In the past decade, the Government of India had a major policy re-thinking, which resulted in the formation of the Rangarajan Committee. The Rangarajan Committee argued that production responses to the existing pricing mechanism of sugar and sugarcane create cyclicality in the sugar sector (Rangarajan, 2012).

If we paraphrase the Rangarajan Committee's report, the detailed mechanism of creating a cycle is this: During the years of high sugar production, prices of sugar in the market are low. As the sugarcane price remains high due to the minimum sugarcane price enforced by the Government, payments by the sugar mill to the farmers are delayed. This leads to an accumulation of cane arrears, which prompts sugarcane farmers to shift to alternate crops, reducing the cane area. In addition, farmers may supply sugarcane to the alternate industry of *gur* and *khandsari*, where payments are in cash and made immediately. This sets in motion the next phase of the cycle in which sugarcane production falls in the subsequent year, leading to less

availability of the raw material for the sugar industry and sugar prices going up, which enables the mills to pay up most of the cane arrears due to higher revenues they received. This makes the farmer shift back to cane cultivation, which will cause overproduction of sugarcane in the next year. Since whatever sugarcane comes to the mills' gate has to be purchased by the mill, the sugar production will go up, and the sugar price will fall again.

This mechanism tells us that non-alignment between the price of sugar and the price of sugarcane due to the minimum support price policy for sugarcane by the Government of India creates an accumulation of cane arrear, which then discourages the sugarcane production and ultimately end up creating a cycle in cane area, production of sugarcane and sugar.

In this study, we tried to find the empirical validity of the non-alignment between the price of sugar and sugarcane. If the two prices are interdependent, we can infer some alignment between them.

So, Ho: Sugar price and Sugar cane price are non-aligned with each other,

and H1: Sugar price and Sugar cane price are not non-aligned with each other

We can reject the null hypothesis if we found both long-run and short-run relationships between the two. To track long-run and short-run relationships between two variables, the cointegration and error correction modeling is a popular time series econometric technique, and we have adopted that technique here. The details are the following-

Suppose the price of sugar at time *t* is P_{st}, and the sugarcane price at time *t* is P_{ct}.Suppose the two variables, the price of sugar and cane, have the unit root of the same order. In that case, we can find out the short- and long-term relationship between P_{st} and P_{ct} using Engle-Granger methodology as it is a bi-variate model, which can be written as:

$$P_{st} = a + bP_{ct}$$

The sugar and sugarcane prices are annual wholesale price index (WPI) numbers taken from the database of EPWRF.

IV

RESULTS AND DISCUSSIONS

Using the Augmented Dicky–Fuller test for stationarity (Table 1), by taking the general and moving towards a specific data-generating process, we found that the wholesale price of both sugar and sugarcane are non-stationary series. However, the first differences of both series are stationary. This tells us these variables are I(1) process and maybe cointegrated. So, both variables may have a long-term relationship as well as a short-term one with each other.

TABLE 1 AUGMENTED DICKY-FULLER TEST FOR UNIT ROOT

Variable (1)	Level (2)	First Difference (3)
Log of Sugarcane Price	0.073 (0.9641)	-5.342(0.0000)
Log of Sugar Price	-1.041(0.7381)	-5.944(0.0000)

Source: Author(s)

Note: Values in the parenthesis are the p-value, and the values outside the parenthesis are Z(t) statistics

The Engle-Granger method has been used to test the existence of cointegration. In step 1, one price is regressed over the other price by using OLS (Reported in Table 2). In step 2, the estimated error term from OLS is tested for having unit root or not by using Augmented Dicky–Fuller test (Table 3). Since the findings suggest that the error term is stationary the step 3 is taken to estimate error-correction model. In step 3, we used the VAR model where the two dependent variables are the first difference of two prices. The independent variables are the first difference of the two prices (the dependent variables) with lag 1 and 2 and the estimated error term from OLS with lag 1. The optimum lag length for the dependable variables is determined through the minimum values of various information criteria (Reported in Table 4). The estimated VAR results are reported in Table 5. In step 4, various diagnostic tests for the VAR model were conducted (reported in Table 6 and Figure 1).

TABLE 2. COINTEGRATING EQUATION

Variables (1)	Value of Coefficient (2)
Sugar Price	1
Sugarcane Price	0.7048244 (0.0160206)*
Constant	1.744077 (0.1024218)

Source: Author(s).
Note: values in parentheses are S.E. *is significant at 1 per cent level.

TABLE 3. AUGMENTED DICKY-FULLER TEST FOR UNIT ROOT

Variable (1)	Level (2)
Residual	-3.473 (0.0424)

Source: Author(s)
Note: Values in the parenthesis are the p-value, and the values outside the parenthesis are Z(t) statistics.

Table A.3 shows that the estimated error term from OLS has no unit root at a 5 percent significance level. Thus, the OLS estimation of two prices estimates the cointegrating equation. The cointegrating equation is

Sugar price = -1.744077−0.7048244 × Sugarcane Price

This equation was normalized on sugar price. When predictions from the cointegrating equation are positive, the sugar price is above its equilibrium value because the coefficient of sugar price in the cointegrating equation is positive. It shows that a 1 per cent increase in the sugarcane price will increase the sugar price by 0.704 per cent.

TABLE 4. DETERMINATION OF LAG LENGTH

	LL	LR	FPE	AIC	HQIC	SBIC
(1)	(2)	(3)	(4)	(5)	(6)	(7)
0	89.7282		0.000064	-3.98765	-3.95757	-3.90655
1	93.8471	8.2377	0.000063	-3.99305	-3.90282	-3.74975
2	106.171	24.649*	0.000043*	-4.37142*	-4.22105*	-3.96593*
3	106.465	0.58761	0.000052	-4.20296	-3.99243	-3.63526
4	107.188	1.4463	0.00006	-4.05401	-3.78333	-3.32412

Note: All the information criteria showing Lag 2 is the optimum lag length

Table 5 shows the existence of the error correction term. We found that the statistically significant estimated value of the adjustment coefficient for sugar price is -0.0154856. Thus, when the average sugar price is too high, it falls back to approach the sugarcane price. The adjustment coefficient for sugarcane price is 0.0043997. It implies that when the average sugar price is too high, the average sugarcane price adjusts towards the sugar price. However, the adjustment speed for sugarcane price is lower than that of sugar price.

TABLE 5. ESTIMATION OF THE VAR MODEL

	Log of Sugar Price	Log of Sugarcane Price
Residual lag(1)	-0.0154856 (0.0180325)	0.0043997 (0.0124388)
Log of Sugar Price lag(1)	0.1743773 (0.1232362)	0.2279099* (0.0850081)
Log of Sugar Price lag(2)	-0.5453115* (0.1210296)	-0.1278549 (0.0834859)
Log of Sugarcane Price lag(1)	0.6540302* (0.1991015)	0.2555681*** (0.1373398)
Log of Sugarcane Price lag(2)	-0.0148142 (0.2042141)	-0.3234757** (0.1408664)

Source: Author(s).

Note: Values in parenthesis are S.E. Values outside parenthesis are coefficients.

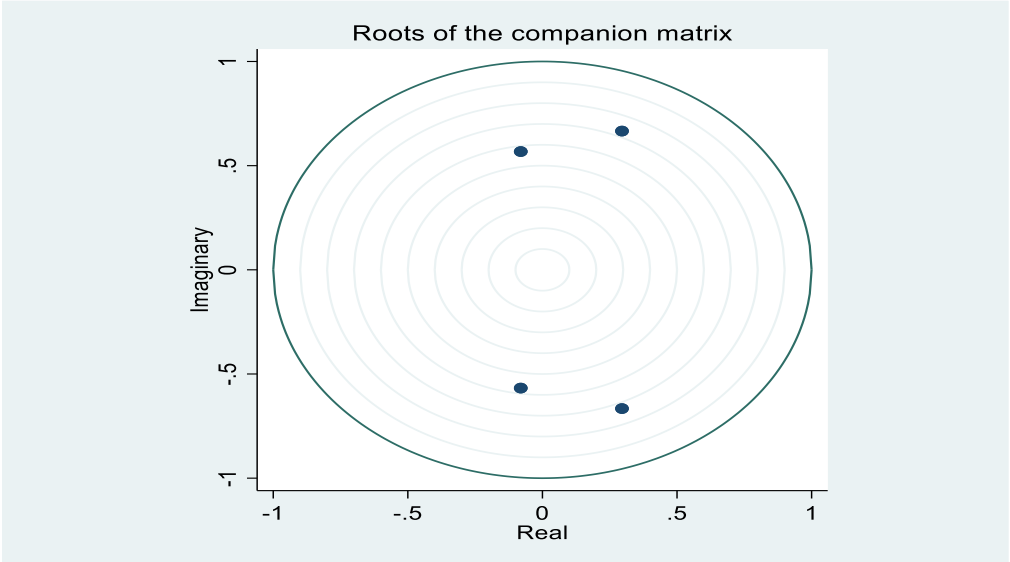
***, **and * Significant 10 , 5 and 1 per cent level respectively.

So, there is both long- and short-term alignment between sugarcane price and sugar price. Thus, we can reject the null hypothesis. This confirms that sugar and sugarcane prices are not non-aligned.

TABLE 6 LAGRANGE-MULTIPLIER TEST

lag	Value of chi2	Prob> chi2
1	0.1575	0.99706
2	1.0788	0.89762

H0: No autocorrelation at lag order



All the Eigen values lie inside the unit circle. VAR satisfies stability conditions.

Figure 1: Eigenvalue Stability Condition

The results indicate that cyclicality in sugar production does not arise from the non-alignment between sugar price and sugarcane price as they are interrelated both in long-run and short-run. This result is also commensurate with the findings of Kaler and Guha (2022). Second, as the non-alignment between sugar price and sugarcane price does not exist, it opens up wide possibilities of shocks from natural factors like weather conditions, water availability, pest attacks, etc., creating the cycle in sugarcane production.

V

CONCLUSION

This paper offers a significant result for the Indian sugar sector; that is, sugar price and sugarcane price are not non-aligned; they have a stable long-term relationship. In case of any movement away from that relationship, sugar and sugarcane prices adjust towards their long-run relationship. Hence, the Government's fixing of minimum cane prices creating the non-alignment between sugar and sugarcane prices may not be a statistically valid argument for removing the cyclicality in the Indian sugar sector. The possible reason behind this is that even when the minimum support price for sugarcane is decided, the sugar price has always been an important consideration for policymakers. If this is true, removing the minimum support price or directly linking it with the sugar price, as suggested by the Rangarajan Committee (Rangarajan, 2012), will not reduce the cyclicality. Thus, we need different explanations for cyclicality. The existing literature suggests two probable factors that may create cyclicality: - fluctuations in international sugar prices and shocks from natural factors.

The existing literature shows evidence of alignment between international sugar prices and the domestic sugar price of India. Jati (2013), for instance, found a dynamic relationship among the sugar prices of Brazil, India, and Indonesia in a multivariate framework by incorporating macroeconomic variables like exchange rate, interest rate, and oil price. Although (Murali *et al.,* 2019) recognize that Indian sugar prices are higher than international sugar prices, they found that prices of different sugar markets from India, London, and New York were integrated in different combinations. Alignment between Indian and International sugarcane prices has also been argued for. Mittal and Reimer (2008) argued that domestic sugarcane prices in India vary closely with the world sugarcane price, with a one percent increase in the world price associated with a 0.866% rise in the domestic price. Thus, fluctuations in international prices may create fluctuations in the sugar economy.

Balasaheb (2013) identified climatic variations and vulnerability of areas cultivated under rain-fed conditions as important factors causing fluctuation in sugarcane production and cane area. This opens up vast possibilities of cyclicality for various other reasons, including shocks from natural factors like weather conditions, water availability, and pest attacks that could create a cycle in sugarcane production.

To conclude, the existing literature discussed in the previous paragraph and the results of this paper show that we need a better explanation of cyclicality in the Indian sugar sector and a better solution to address cyclicality.

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