



Research Article

AN ASSESSMENT OF LONG RUN RELATIONSHIP BETWEEN SPOT AND FUTURES PRICES OF SUGAR IN INDIA

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Abstract: This paper examined the assessment of long run relationship between spot and futures prices of sugar in India. For the purpose of the paper to understand the long run relationship between spot and futures prices of sugar over the monthly comparison, for these studies used the Eview software. Entire study period has been divided into two halves i.e., 1995 to 2005 and 2005 to 2015. The present study initiates and analyzes the trends in area, production and yield, wholesale price indices of sugarcane crop by using simple descriptive statistics; linear growth rates (compound growth rates). The results of this study showed CGR, it was positive and higher in all variables during post-futures period. But wholesale price index showed that growth rate during post-futures period (2005-15) was higher as compared to pre futures period (1995-2005). Descriptive statistics showed that sugar futures and spot price not follow normal distribution. The result of ADF and Johnsan test implies that the stationarity test the presence of any long run relationship reveals co-integration of the spot market with futures market. The sugar indicates two co-integrating equations in its spot and futures market, implying that they have tight co-movements and if they move on their own because of non-stationarity they don't go far from each other.

Keywords: CGR, Descriptive statistics, ADF test, Johnsan test, spot price and futures price, long run relationship

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Introduction

Agriculture Sugarcane is a most important cash crop of India. It involves less risk and farmers are assured up to some extent about return even in adverse condition. In agriculture sector, sugarcane shared 7 percent of the total value of agriculture output and occupied 2.3 percent of India's gross cropped area during 2014-15 [1]. The area of sugarcane is not double but production of sugarcane and sugar increasing i.e., 50.32 lakh ha and 3565.61 lakh tonnes with 250.46 lakh tonnes during the year 2014-15 as compared to previous year. India is the second largest producer of sugar in the world having a share of over 17 percent of world's sugar production after Brazil's 22 percent [2]. In India, two grades of sugar namely S-30 and M-30 are produced where grade S-30 dominating the share in total production. India is the largest consumer of the sugar and about 62-65 percent of sugar is consumed directly by bulk users. Total area under sugarcane in Gujarat for the year 2014-15 was 208.0 lakh hectares. Total production of sugarcane was 14330 lakh tonnes and yield 68894 kg/ha in Gujarat for the year 2014-15 [3].

Materials and Methods

Time series data on the monthly wholesale price index (WPI) from year 1995-2005 and 2005 -2015 were obtained from the data published by the office of Economic Advisor, Ministry of Commerce and Industry, GOI. The monthly spot and futures price data of sugar were obtained from the website of National Commodity and Derivative Exchange (NCDEX), Mumbai for a period of January 2005 to December 2015 (for a period of 10 years -132 observations [4]. In order to analyze the growth in area, production and productivity of sugarcane and the wholesale price indices (WPI) of sugar were computed by Compound Growth Rates (CGRs). Stationarity, co-integration and subsequently, the causal relationship and its direction(s) between the spot and futures prices was analyzed using the ADF test, Johansen's co-integration test [5-10].

Results and Discussion

Growth rate in area, production and yield of sugarcane and wholesale prices index of sugar in India. Growth rate of area, production and yield and wholesale price index (WPI) was studied by examining the compound growth rates. The compound growth rates for area production and productivity of sugarcane and monthly wholesale price indices of sugar during the pre-futures i.e., 1994-2005 and post-futures period i.e., 2005-15 are in work out [Table-1] and [Table-2]. [Table-1] shows compound growth rates for the area, production and productivity of sugarcane in India. Growth rate of area in sugarcane was positive during the pre-futures period (0.05 %) where as significant, positive and higher during the post-futures period (2.13 %). The growth rate of production and yield of sugarcane was negative during pre-futures period for production (-1.12 %) and for yield (-1.16 %) but in post- futures period, It was positive (2.91 %) for production and for yield (0.76 %). Thus, on comparing the CGR results of pre-futures and post-futures period of area, production and yield found that, it was positive and higher in all variables during post-futures period. [Table-2] shows that the compound growth rate for the WPI of sugar was positive during the pre-futures period (1.46 %) as well as during the post-futures period (8.67 %). The growth rate during post-futures period was higher as compared to pre futures period. This result shows that after evolution of futures trading prices of sugar increased, but it may be not sure that increase in the price of sugar was only due to the futures trading. There were other several factors which affect increment in prices like consumption and export pattern, estimated output based on the acreage, government policies and intervention and shifting cropping patterns in producing countries. [Table-3] shows that the descriptive statistics of the futures and spot price were reported that the average prices of spot were higher than futures price. An analysis of price volatility as shown by standard deviation reveals that for sugar the spot markets were more volatile than the futures market.

Table-1 Growth rate in area, production and yield of sugarcane in India

Particulars	Period	CGR %	SE	t-value
Area	Pre-futures(1994-2005)	0.05	0.0027	0.08
	Post- Futures(2005-2015)	2.13**	0.0038	2.40
Production	Pre-futures(1994-2005)	-1.12	0.0033	-1.47
	Post- Futures(2005-2015)	2.91**	0.0044	2.80
Yield	Pre-futures(1994-2005)	-1.16**	0.0019	-2.74
	Post- Futures(2005-2015)	0.76**	0.0011	2.92

** Significant at 5 % level

Table-2 Growth performance of monthly wholesale price indices (WPI) for sugar during the pre-futures (1995-2005) and post-futures period (2005-15)

Period	CGR %	SE	t-value
Spot price			
Pre-futures(1995-2005)	1.46	0.0039	1.64
Post-futures(2005-2015)	8.67**	0.0096	3.77
Futures price(2005-2015)	5.89	3.6889	0.0067

** Significant at 5 % level

Table-3 Descriptive statistics of spot and futures prices of sugan = 132

ITEM	FUTURES PRICE	SPOT PRICE
Mean	2420.5	2502.4
Median	2544.1	2724.7
Maximum	3562.1	3920.8
Minimum	1227.2	1305.0
Std. Dev.	626.6	731.5
Skewness	-28472.0	-0.109
Kurtosis	1.832	1.605

Whereas higher price volatility had been observed for sugar in the spot market. It exhibited asymmetric distribution with sugar futures and spot price being the price series were negatively skewed with longer left tail and mostly concentrated on the right. The statistical Kurtosis which measures thickness of the tails reveals that all the distributions have a K less than three indicating thicker tails and platykurtic distribution. Sugar futures and spot price not follow normal distribution. The price exhibits the pattern of small changes that would happen less frequently as there was clustering around the mean and a more likely large variation with fat tail.

Table-4 ADF unit root test for spot and futures prices of sugar without log (2005-2015) Lag Length: 0 (Automatic - based on AIC and BIC, maxlag=12)

Commodity	TEST statistics	Levels	Level difference		1 st difference		NONE	
Sugar futures price			ADF	PP	ADF	PP	ADF	PP
	-1.26 (0.644)	1 %	3.4808	-3.48	-4.03	0	-2.582	-1.615
	-11.07 (0.000)	5 %	2.8836	-2.88	-3.444	0.957	-1.943	---
	0.434 (0.806)	10 %	2.5786	-2.578	-3.147	0.727	-1.615	---
Sugar spot price								
	-1.525 (0.517)	1 %	3.4808	0.129	-4.03	0	-2.58	0.88
	-9.117 (0.000)	5 %	2.8836	0.012	-3.444	0.414	-1.943	0.015
	0.139 (0.724)	10 %	2.5786	0.105	-3.147	0.542	-1.615	---

Table-5 ADF unit root test for spot and futures prices of sugar with log (2005-2015) Lag Length: 4 (Automatic - based on AIC and BIC, maxlag=12)

Commodity	TEST statistics	Levels	Level difference	1 st difference	NONE			
Sugar futures price			ADF	PP	ADF	PP	ADF	PP
	-153.850(0.0001)	1 %	3.48	0	3.48	0	-2.582	0
	-8.539 (0.000)	5 %	2.883	0.467	2.883	0.0003	-1.943	----
	-154.710(0.000)	10 %	2.578	----	2.578	0.0351	-1.615	----
Sugar spot price								
	-194.255(0.0001)	1 %	3.48	0	3.48	0	-2.582	0
	-12.460 (0.000)	5 %	2.883	0.3796	2.883	0.0065	-1.943	----
	-195.16(0.000)	10 %	2.578	----	2.578	0.358	-1.615	----

Table-6 Johansen's co-integration test results for sugar

Commodity	Hypothesis	λtrace	Critical value (5%)	Prob. Value	Decision
Sugar	None	131.035	15.494	0.0001	Indicates two co-integrating equations
	At most one	60.888	3.841	0.000	Indicates two co-integrating equations
Trace test indicates 2 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					
Commodity	Hypothesis	λmax	Critical value (5%)	Prob. Value	Decision
Sugar	None	70.146	14.264	0.000	Indicates two co-integrating equations
	At most one	60.888	3.841	0.000	Indicates two co-integrating equations
Max-eigen value test indicates 2 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					

Long Run Equilibrium Between Spot and Futures Market

The [Table-4] and [Table-5] explain the results of ADF test with trend and without trend suggests the existence of unit root in the price series. Akaike's information criterion (AIC) was used to determine the lag length. The ADF test at the series levels [integrated of order 0, I (0)] supported the null hypothesis of unit root (non-stationary) at 99 % level of significance for the spot and futures prices of sugar. The ADF test statistics of spot and futures prices had fallen within the confidence interval, indicating all price series exhibited random walk or levels of series were non-stationary. The first difference of all these non-stationary time series of spot and futures price of sugar was then tested using unit root test. The first difference or integrated of order 1 denoted as I (1) of all price series was found to be significant or stationary. Thus, the price series of spot and futures markets have a unit root. To run the Johansen co-integration test, it was necessary that the first

form difference is integrated of order 1 or higher. The order of integration of the spot price ($\ln P_{st}$) and futures price ($\ln P_{ft}$) series was examined using Augmented Dickey Fuller (ADF) test. It was observed that both spot and futures price series were non-stationary at the level form, Whereas these were stationary at first form difference, i.e., future series ($\ln P_{ft} / P_{ft-1}$) and spot series ($\ln P_{st} / P_{st-1}$). Hence, it can be concluded that the series were all integrated of order 1, viz. I (1) processes and Johansen test for long run equilibrium relationship can be applied. The result of the stationarity test was given in [Table-4]. Earlier researches had estimated market integration based on the Engle-Granger (1987) technique of bivariate co-integration. It involved two or more series, which were non stationary, but a linear combination of them was stationary. The more recent techniques were suggested by Johansen (1988) and Johansen & Juselius (1990, 1992) to determine the co-integrating relationships. Johansen (1988) derived two likelihood ratio test Gamit

statistics to test for the number of co-integrating vectors. The null hypothesis for co-integrating vectors against alternative of more than r co-integrating vectors was tested by using the lambda-trace statistics which is given by:

$$\lambda_{\text{trace}} = T \sum_{i=r+1}^n \ln(1 - \hat{\lambda}_i)$$

On the other hand, the null hypothesis of r co-integrating vectors against the alternative of $(r+1)$ co-integrating vectors was tested by using the λ_{max} statistics.

$$\lambda_{\text{max}} = T \sum_{i=r+1}^n \ln(1 - \hat{\lambda}_{r+1})$$

Where " $\hat{\lambda}_i$ "s were the estimated Eigen values (characteristic roots) and T was the number of usable information. The lambda-trace test and maximum Eigen value test had been applied on two non-stationary variables spot price ($\ln P_{st}$) and future price ($\ln P_{ft}$) of sugar using the bivariate framework.

The results of Johansen trace test and maximum Eigen value were reported in Sugar commodity null hypothesis that spot and futures market are co-integrated since both the statistics λ_{trace} and λ_{max} exceed the critical value with a 5 % level of significance [Table-6]. The presence of any long run relationship reveals co-integration of the spot market with futures market. The sugar indicate two co-integrating equations in its spot and futures market, implying that they have tight co-movements and if they move on their own because of non-stationarity they don't go far from each other.

Conclusion

There is very limited research work on the role of futures markets in price discovery of sugar. Empirical literature deals with price discovery adjustment process between futures and spot market. Based on analysis of results comparing the CGR of pre-futures and post-futures period of area, production and yield found that, it was positive and higher in all variables during post-futures period. The result of monthly wholesale price indices showed that growth rate during post-futures period (2005-15) was higher as compared to pre futures period (1995-2005). Descriptive statistics showed that sugar futures and spot price not follow normal distribution. The result of ADF test with trend and without trend suggests the existence of unit root in the price series. The ADF test statistics of spot and futures prices had fallen within the confidence interval, indicating all price series exhibited random walk or levels of series were non-stationary. After the analysis of ADF test non stationary series converted into stationary. Hence, it can be concluded that the series were all integrated of order 1 and Johansen test for long run equilibrium relationship can be applied. The result of the stationarity test the presence of any long run relationship reveals co-integration of the spot market with futures market. The sugar indicates two co-integrating equations in its spot and futures market, implying that they have tight co-movements and if they move on their own because of non-stationarity they don't go far from each other.

Application of research: This research will be helpful for policy maker and government institute can use the result of this study to analyse the role of futures market. Futures market can perform the function of price discovery for agricultural commodities.

Research Category: Agricultural commodities

Abbreviations:

AIC - Akaike Information Criterion

ADF- Augmented Dickey Fuller

CGR - Compound Growth Rate

WPI - wholesale price index

NCDEX - National Commodity and Derivative Exchange

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