Growth and Instability Analysis of Sugar Exports from India

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Authors' contributions

This work was carried out in collaboration among all authors. Author UDB performed the statistical analysis, wrote the protocol, wrote the first draft of the manuscript. Author MGD designed the study, guided the Author UDB in research and writing the manuscript. Author SMF helped in reviewing the literature, helped in data collection. All authors read and approved the final manuscript.

Original Research Article

ABSTRACT

Aims: To work out growth trends and instability in export of sugar and jaggery from India
Place and Duration of Study: Department of Agricultural Economics, Junagadh Agricultural University (between June 2018 and July 2020).
Methodology: The present study focused on analyzing the growth and instability in sugar and jaggery export quantity, value and unit value as well for the period from 1996-97 to 2005-06. Exponential growth model and Cuddy-Della index used for growth and instability analysis, respectively.
Results: study results indicate a notable annual growth rate in sugar export from India, specifically at 17.42, 23.44 and 5.13 per cent for quantity, value and unit value, respectively during the time span from1996-97 to 2018-19. Similarly, jaggery export also followed a comparable trend However,

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the export of both sugar and jaggery exhibited high volatility, attributed to low production levels during years of scarcity.

Conclusion: The potential for expanding sugar and jaggery exports is considerable, contingent upon enhancing quality to meet the specific requirements of importing nations. Jaggery, renowned for its nutritional value, warrants increased domestic consumption, thereby contributing to the augmentation of sugarcane farm income.

1. INTRODUCTION

Sugarcane (*Saccharum officinarum L.*) occupies very prominent position on the agricultural map of India. It provides employment to over a million people directly or indirectly besides contributing significantly to the national exchequer. Examining the global scenario of sugarcane production over the past two decades, Brazil witnessed a twofold increase in both the area under cultivation and the production of sugarcane. In contrast, China, India, and Thailand experienced only marginal growth in both cultivation area and production during the same period. Globally, there was a substantial rise in sugarcane production, escalating from 12,527 lakh tonnes in 2000 to 19,070 lakh tonnes in 2018. (FAO, 2020).

Sugar industry is such an industry located in rural areas which provides opportunities for the uplifting of rural masses. Sugarcane and sugar beet are the two main crops which contribute approximately 80 and 20 per cent, respectively to the total sugar production in world [1]. On an average 275 lakh farmers engaged in sugarcane cultivation and around 5 lakh workers directly employed in sugar mills [2], having annual turnover of about one lakh crores. The sugar industry also plays a leading role in global market as India being the second largest producer and the largest consumer of sugar. The growth and instability analysis of sugar export from India as traded in international market, is of strategic importance to maintain stability in the domestic sugar prices despite the cyclicality in production. A closer look into the growth and instability analysis of sugar exports from India will help the policy makers to remove bottlenecks in the present policy framework and to develop an overall improved policy for reviving the state's agriculture.

2. MATERIALS AND METHODS

Data on export of sugar and jaggery export from India were collected from Directorate of Agriculture (DAG), Government of Gujarat, Gandhinagar and Directorate General of Commercial Intelligence and Statistics (DGCIS), Government of India, and other public sources for the period from 1996-97 to 2018-19. The study period further split into three periods *viz.,* trans-WTO Period-I (1996-97 to 2005-06), Post-WTO Period-II (2006-07 to 2018-19) and overall Period-III (1996-97 to 2018-19) for better understanding. Exponential growth model and Cuddy-Della index were used for growth rate and instability analysis, respectively as given below:

2.1 Exponential Growth Model

The compound growth rate is obtained by fitting a straight line to the logarithms of the data and estimating the slope of the line [3]. In the present study, the compound growth rate was calculated using the following formula.

2.1.1 Compound growth rate

The compound growth rates (CGRs) of sugar exports was calculated by using the exponential function of the following specification:

$$Y_t = ab^t u_t \qquad (1)$$

Where,

Y_t = Dependent variable (export quantity/ export value, of sugar and Jaggery in the year 't', etc.)
t = Time variable in years taking the value of 1, 2, 3,....,n
a = Intercept;
b = Regression coefficient (1+r)
r = Compound growth rate
u_t = Error term

For the purpose of estimation, the equation was expressed in logarithmic form.

$$\text{Log } Y_t = \text{Log } a + t \log b + \log e \qquad (2)$$

The value of log b in equation (2) was computed using the formula,

$$\text{Log b} = \frac{(\sum t \log Y - (\sum t . \sum \log Y / N))}{\sum t^2 - \left(\frac{\sum t^2}{N}\right)} \quad (3)$$

Where,

N = Number of years.

Subsequently, the compound growth rate (%) was computed using the formulation,

Compound growth rate (r) = [(Antilog of log b) -1] *100 (4)

Student 't' test was used to determine the significance of the growth rates obtained for which the following formulation was employed,

t = Log b/ SE (Log b) (5)

$$SE = \sqrt{\frac{\sum(Y-\bar{Y})^2 - \log b * (\sum(Y*t) - \sum(Y)*\bar{t})}{(N-2)\sum(t-\bar{t})^2}} \quad (6)$$

The calculated 't' values, from equation (5), was compared with the table 't' values and the significance was tested at 1, 5 and 10 per cent levels.

2.2 Instability Analysis

Instability is the one of the important decision parameter in development dynamics, more so in the context of agriculture production.

Cuddy-Della index is most commonly used measures of instability of time series data and is universally acceptable. The original formulation of the index is given as follows:

Instability index (Ix) = $CV\sqrt{(1 - \bar{R}^2)}$

CV(%) = S/ $\bar{X}$ *100

Where,

Ix = Instability index;
CV = Coefficient of variation;
$\bar{R}^2$ = Coefficient of multiple determination;
$\bar{X}$ = Mean value;
S = Standard deviation.

3. RESULTS AND DISCUSSION

3.1 Export-Import Scenario

Sugarcane as such is neither exported nor imported, however the sugar which is a main produce of sugarcane crop is exported and imported as per the Government policies. The total export of sugar during 2010-11 was17.34 lakh tonnes worth Rs. 5473 crores and import about 10.35 lakh tonnes valued to Rs. 2790 crores during the same year (Table 1). The domestic demand of sugar in India was rotating around 210 lakh tonnes annually in 2010-11, increased to around 260 lakh tonnes in 2018-19, whereas, the production of sugar estimated around 327.50 lakh tonnes.

India is 4th largest exporter of sugar and has the potential and advantage in export of sugar to sugar deficit countries in the Middle East and East Africa. India is by and large self-sufficient in sugar production to meet the domestic consumption demand. However, in the years of scarcity sugarcane production declined drastically due to lack of irrigations, which compel to import of sugar in India in next year. Except, the scarcity years, India earns sizable foreign revenue from sugar export.

3.2 Growth Rates of Sugar and Jaggery Export from India

Results of Growth rates of sugar export (Quantity, value and unit value) presented in Table 2. In all periods the growth rates of sugar export quantity and export value were highly significant, *i.e.* significant at 1 per cent level. Besides, growth rates of sugar unit value were highly significant in Post-WTO period and overall period, but it noticed stagnant in Trans-WTO period. The period spanning from 1996-97 to 2018-19 witnessed a notable annual growth rate of 17.42 per cent in the quantity of sugar exports, accompanied by a substantial 23.44per cent increase in export value. However, the unit price demonstrated a more modest annual growth of 5.13 per cent. This suggests a significant acceleration in India's sugar exports over the past two and a half decades, particularly after the establishment of the WTO. Similar findings were reported by Adhikari and Sekhon [4] for basmati rice exports and by Devi [5] for fresh mango and mango pulp exports from India during comparable periods. During the Trans-WTO period, there was a notable annual growth rate of 19.14 per cent and 19.37 per cent in sugar export quantity and export value, respectively. However, the unit value increased only insignificantly at 0.19 per cent per annum. This stagnation in export unit value may be attributed to heightened competition, with more countries participating in exports during this period.

Swaminathan et al. [6] found comparable trends in marine product exports, where unit prices remained stable amid global competition. Geetha and Srivastava [7] observed similar results for maize export unit value in the Post-WTO period.

In the Post-WTO period, sugar export demonstrated a moderate annual growth rate of 7.31 per cent, with export value experiencing a higher rate of 13.09 per cent per annum. Notably, the export unit value increased significantly at a moderate rate of 5.39 per cent per annum when compared to quantity and value. This analysis over the past two and a half decades' underscores India's substantial potential for sugar exports. Despite heightened competition, there has been a considerable increase in both the quantity and unit value of India's sugar exports in recent years.

In the overall period from 1996-97 to 2018-19, the growth rates for jaggery export quantity and export value were notably high at 9.22 per cent and 17.12 per cent per annum, respectively. Meanwhile, the export unit value demonstrated a moderate increase at 7.29 per cent per annum.

During the Trans-WTO period, results for jaggery export remained quite similar to the overall period, with notable increases in export quantity (9.22% per annum) and export value (17.12% per annum). However, in the Post-WTO period, there was a decline in jaggery export at a rate of -11.15 per cent per annum, accompanied by a non-significant decrease in export value (-0.68% per annum). In contrast, the unit value experienced a significant increase at a rate of 11.78 per cent per annum during this period. This

decline in export quantity and value is attributed to poor monsoons in 2012-13, 2014-15, and 2015-16, leading to reduced sugarcane production in the country. Despite this, the remarkable increase in export unit price indicates high demand, highlighting India's substantial potential for jaggery exports.

3.3 Instability of Sugar and Jaggery Export from India

The instability analysis of sugar and jaggery exports (quantity, value, and unit value) in Table 4 for the overall period from 1996-97 to 2018-19 reveals high instability in export quantity, with rates of 62.03% for sugar and 134.74 per cent for jaggery. Similarly, export values showed high instability, recording rates of 49.08 per cent for sugar and 82.49 per cent for jaggery. In contrast, export unit values for sugar and jaggery indicated medium instability, with rates of about 24.46 per cent and 25.61 per cent, respectively. Gajavali [8] reported similar findings in her study on the growth and instability of castor oil exports by India from 1986-87 to 2017-18.

In the Trans-WTO period, there was very high instability recorded in the export quantity of sugar and jaggery, at rates of 105.99 per cent and 83.57 per cent, respectively. Sugar export value also exhibited high instability at 95.58 per cent, whereas the unit value of sugar showed medium instability (17.12%). For jaggery, both export value (66.87%) and unit price (32.35%) demonstrated high instability, but compared to export quantity and value, the unit value of

Table 1. Export import earning balance of sugar in India

Year	Sugar export from India			Sugar import in India			Balance
	Quantity (000' tonnes)	Value (Rs. Crore)	Unit value (Rs/kg)	Quantity (000' tonnes)	Value (Rs. Crore)	Unit value (Rs/kg)	Value (Rs. Crore)
1995-96	434	597	13.75	151	216	14.33	381
2000-01	339	431	12.72	30.4	31	10.23	400
2005-06	321	569	17.72	558.8	652	11.66	- 83
2010-11	1734	5473	31.56	1035	2790	26.96	2683
2011-12	2749	8767	31.89	100	314	31.47	8453
2012-13	2794	8577	30.70	1122	3094	27.57	5482
2013-14	2478	7179	28.97	881	2287	25.96	4892
2014-15	1955	5329	27.25	1539	3668	23.84	1661
2015-16	3844	9825	25.56	1943	4038	20.78	5787
2016-17	2544	8660	34.04	2146	6869	32.80	1791
2017-18	1758	5226	29.73	2403	6036	25.12	- 810
2018-19	3988	9518	23.87	1491	3175	21.30	6343

Source: DES, 2020

Table 2. Growth rates of sugar export from India

Periods	Sugar export	Quantity (000' tonnes)	Value (Rs. Crores)	Unit value (Rs. /Kg)
Trans-WTO period (1996-97 to 2005-06)	Mean	595.4	700.5	13.1
	CGR (%)	19.14***	19.37***	0.19
	SE	1.81	1.72	0.17
Post-WTO period (2006-07 to 2018-19)	Mean	2580.8	6281.1	25.2
	CGR (%)	7.31***	13.09***	5.39***
	SE	1.20	1.12	0.28
Over all period (1996-97 to 2018-19)	Mean	1717.6	3854.8	20.2
	CGR (%)	17.42***	23.44***	5.13***
	SE	1.44	1.37	0.25

*Note: 1. *, ** and *** indicate significance at 10%, 5% and 1% levels, respectively.*
2. CGR – Compound Growth Rate and SE – Standard Error

Table 3. Growth rates of jaggery export from India

Periods	Jaggery export	Quantity (000' tonnes)	Value (Rs. Crores)	Unit value (Rs/kg)
Trans-WTO period (1996-97 to 2005-06)	Mean	151.8	205.8	16.2
	CGR (%)	10.10***	13.83***	3.38***
	SE	1.35	1.14	0.31
Post-WTO period (2006-07 to 2018-19)	Mean	652.2	1641.3	35.8
	CGR (%)	-11.15***	-0.68	11.78***
	SE	0.76	0.58	0.25
Over all period (1996-97 to 2018-19)	Mean	434.6	1017.1	27.3
	CGR (%)	9.22***	17.18***	7.29***
	SE	1.20	0.99	0.30

*Note: 1. *, ** and *** indicate significance at 10%, 5% and 1% levels, respectively.*
2. CGR – Compound Growth Rate and SE – Standard Error

Table 4. Instability of sugar and jaggery export from India

Particulars		Sugar export			Jaggery export		
		Quantity	Value	Unit value	Quantity	Value	Unit value
Trans-WTO period	CV (%)	104.52	95.47	16.10	79.79	66.05	33.44
	CDV (%)	105.99	95.58	17.12^	83.57	66.87	32.35
Post-WTO period	CV (%)	47.13	44.98	27.63	107.17	56.23	38.49
	CDV(%)	49.40	39.28	24.40	92.11	57.51^	13.38
Overall period	CV (%)	81.89	91.86	41.07	133.53	98.39	53.61
	CDV (%)	62.03	49.08	24.46	134.74	82.49	25.16

Note:CV- Coefficient of Variation (%), CDV – Cuddy Della Valle Index (%), ^- Non significant

jaggery was relatively stable. Adhikari and Sekhon [4] observed similarly high instability in basmati rice export quantity and export value during the Pre and Post-WTO period from 1980-81 to 2012-13. Adhikari et al. [9] also reported similar findings for rice export from India in the Post-WTO period. In the Post-WTO period, both the quantity and value of sugar and jaggery exports exhibited high instability, while the unit value of sugar showed medium instability (24.40%) and jaggery displayed low instability (13.38%). Geetha and Srivastava [7] found

similar results in their study on the growth and instability of maize exports from India from 1981 to 2016, attributing the high instability to inconsistent domestic production, consumption, and international demand [10,11].

4. CONCLUSION

As per the availability of the data the export performance and instability of sugar and jaggery from India were carried out from the year 1996-97 to 2018-19, which in turn, split into three

periods *viz.,* trans-WTO Period-I (1996-97 to 2005-06), Post-WTO Period-II (2006-07 to 2018-19) and overall Period-III (1996-97 to 2018-19). The compound growth rates were worked out for quantity, besides, value and unit value of sugar and jaggery export. For the estimation of instability in sugar and jaggery export, Cuddy Della Valle index for each period was calculated.

The results of growth rate of sugar export revealed that there were significantly higher growth rates in quantity and value of sugar exported from India during overall period (1996-97 to 2018-19). In Post WTO period, growth rates of sugar export quantity and value were decreased as compared to Trans-WTO period and overall period. The highest growth rate in unit value was recorded in Post-WTO period *i. e.,* 5.39 per cent. Whereas, in case sugar export value, the highest growth rate was recorded in overall period (1996-97 to 2018-19). The highest growth rate in export quantity was recorded in Trans-WTO period about 19.14 per cent per annum. Moreover, as compared to quantity and unit price, export value showed higher growth rate in all periods. In case of Jaggery export, the highest growth rate in jaggery export quantity of about 10.10 percent was recorded in Trans-WTO period. Whereas, the highest growth rate in jaggery export value was recorded in overall period. Moreover, the highest growth rate in unit price of jaggery export was recorded during Post-WTO period. While, in Post-WTO Period, jaggery export quantity and value were showing decreasing growth trend.

The instability analysis of sugar export indicates the highest instability in both quantity and value, reaching approximately 106 per cent and 96 per cent, respectively, during the Trans-WTO period. Conversely, the highest instability in unit price was recorded across the overall period. Sugar export quantity and value displayed high instability consistently across all periods, while unit value demonstrated medium instability in each period. For jaggery export, the highest instability in quantity and value, around 135per cent and 82.49 per cent, respectively, occurred in the overall period. In contrast, the highest instability in unit price, about 32.35 per cent, was recorded during the Trans-WTO period. Jaggery export quantity and value exhibited high instability across all periods, whereas unit value showed medium instability in all periods except the Trans-WTO period.

India has demonstrated a remarkable growth rate in the export of sugar and jaggery, showcasing vast potential for further expansion. There is an opportunity for improvement in quality to align with the preferences of importing countries. Jaggery, being a highly nutritious food, should also be promoted for domestic consumption, a move that could contribute to the enhancement of sugarcane farm income. This dual strategy of focusing on export quality and encouraging domestic consumption holds promise for the continued success and economic benefits of the sugarcane industry in India.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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