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Export performance and trade direction of turmeric from India: Markove chain approach

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Abstract

The paper explores the export performance and direction of trade of turmeric from India. The nature of data for study was based on secondary sources. Time series data of turmeric export quantity and export value were collected for 30 years (1990-91 to 2021-22) from World Integrated Trade Solutions (WITS). Growth rate and Instability Index of turmeric exports from India were estimated using compound annual growth rates and Cuddy-Della Valley Index, respectively. Direction of trade of turmeric was estimated using the Markov chain model. The annual compound growth rate of export quantity and export value of turmeric from India were exhibited 8.11 Percent and 11.31 Percent per annum. Export quantity and export value of turmeric from India exhibited a high stability with 0.63 Percent, and 0.28 Percent instability per annum, respectively. Markov chain analysis revealed that, United Arab Emirates exhibited the highest retention probability of 84 Percent of followed by United States and Malaysia, with a retention probability of 81 Percent and 79 Percent, respectively. Iran and Bangladesh showed a retention probability of 62 Percent and 42 Percent, respectively. The remaining all other countries showed a retention probability of 55 Percent.

Keywords: Turmeric, export performance. direction of trade, Markov chain model, compound annual growth rates, instability, Cuddy-Della Valley Index

Introduction

Turmeric was the world's 3254th most traded product in 2022, with a total trade value of 354 million dollars. Trade in turmeric represents 0.0015 Percent of total world's trade. The top five exporting countries of turmeric in the world during the year 2022 were, India (226 million dollars), Myanmar (19.60 million dollars), Fiji (11.50 million dollars), Netherlands (10.3 million dollars) and Indonesia (9.75 million dollars). These five countries alone contributed 78.29 Percent (277 million dollars) of total turmeric world's exports in the year 2022.The top five importing countries of turmeric in the world in the year 2022 were United states (44.10 million dollars), Bangladesh (28.70 million dollars), India (26 million dollars), United Arab Emirates (17.4 million dollars) and China (15.8 million dollars). These five countries contributed 37.28 Percent (132 million dollar) of turmeric world's imports in the year 2022. (oec.world.com)

India is so far the leading exporter of turmeric worldwide, accounting for a significant share of the international market. The export of turmeric contributes substantially to India's foreign exchange earnings. India alone accounts for 63.80 Percent of world's turmeric exports. India exports turmeric to approximately 130 countries around the world. In 2022, India exported approximately 226 billion U.S. dollar value of turmeric which was 12 times the amount exported by the second-largest exporter of turmeric, the Myanmar of 19.60 million U.S. dollars. (oec.world.com)

Methodology

Growth rate analysis

To analyze the CAGR (Compound Annual Growth Rate), the exponential form of regression analysis was employed. To compute average compound growth rates of turmeric export from India, the following form of regression equation was used.

$$Y_t = ab^t e^u$$

Where,

Y_t = dependent variable

a = intercept term

b = (1+r) and 'r' is the compound growth rate

t = time trend
u = error term
The above model in the Logarithmic form is expressed as,

Log Y= log a + t log b+ log u

Log a and Log b values were obtained using the ordinary least squares procedures and the R^2 was computed for testing the goodness of fit. Antilog of (Log (b -1))*100 give the Percent growth rate. Significance of the growth rate was tested using 't' test.

Co-efficient of variation
The coefficient of variation (CV) also known as relative standard deviation (RSD), is a standardized measure of dispersion of a probability distribution or frequency distribution. It is often expressed as a percentage, and is defined as the ratio of the standard deviation to the mean (average). It is a measure of relative variability.

CV = Co-efficient of variation = (Standard deviation/Mean) *100

Compound annual growth rates: CAGR will be worked out using the formula

CAGR = [Antilog (log b) -1] * 100

Instability index
Cuddy-Della Valle Instability Index will be used to estimate the instability in export of turmeric data. This index is modification of coefficient of variation (CV) to accommodate for trend which is commonly present in time series economic data. It is superior over other scale dependent measure such as Standard Deviation or Root mean Square of the residuals (RMSE) obtained from the fitted trend lines of raw data and hence suitable for cross comparison. The Cuddy-Della Instability Index calculated as follows:

$$CDVI = C.V \sqrt{(1 - \bar{R})^2}$$

Where,
CV = Coefficient of variation
R^2 = coefficient of determination

Direction of trade
The trade directions of exports have been analyzed by using the first order Markov chain approach. Central to Markov chain analysis by the estimation of the transitional probability matrix P. The elements P_{ij} of the matrix P indicates the probability that export will switch from country 'i' to country 'j' with the passage of time. The diagonal elements of the matrix measure the probability that the export share of a country is retained. Hence, an examination of the diagonal elements indicates the loyalty of an importing country to a particular country's exports. In the context of the current application, structural changes will be treated as a random process with selected ten importing regional countries. The average exports to a particular regional country is considered to be a random variable which depends only on the past exports to that regional country, which can be denoted algebraically as follows

$$E_{jt} = \sum_{t-1}^{r} * E_{it-1} * P_{ij} + E_{jt}$$

Where,
E_{jt} = Exports from India to j^{th} country during the year 't'
E_{it-1} = Exports to i^{th} country during the period t-1
P_{ij} = Probability that the exports will shift from i^{th} country to j^{th} country
e_{jt} = The error term which is statistically independent of E_{it-1}
t = Number of years considered for the analysis
r = Number of importing countries
The transitional probabilities P_{ij} which can be arranged in a (c * r) matrix have the following properties.
$O \leq P_{ij} \leq 1$
$\sum n_{t=1} P_{ij} = 1$ for all i.

Results and Discussion
Share of turmeric importing counties from India
The share of turmeric export quantity and export value of India from top twenty turmeric importing countries were estimated by taking the average of 30 years (1990 to 2021) to know the major contributing countries in turmeric trade. The results were presented in Table 1.

Table 1: Share of top 20 turmeric importing counties from India (1990 to 2021)

S. No.	Country	Percent share of trade quantity	Percent share of trade value
1	United States	7.09	15.25
2	United Arab Emirates	12.35	9.64
3	Bangladesh	8.95	6.55
4	Iran, Islamic rep.	8.80	7.51
5	Malaysia	5.57	5.74
6	Morocco	3.50	3.00
7	Germany	2.69	3.56
8	United Kingdom	4.49	4.74
9	Japan	4.37	5.13
10	Netherlands	2.61	2.95
11	Sri Lanka	4.03	3.03
12	France	1.19	1.37
13	Saudi Arabia	3.22	2.98
14	South Africa	2.92	2.91
15	Spain	1.43	1.53
16	Tunisia	2.42	2.04
17	Korea	0.72	1.05
18	Australia	0.74	1.12
19	Egypt, Arab rep.	2.17	1.66
20	Canada	0.86	1.02
	Total share (%)	80.13	82.79

It is revealed from the Table 1 that, among the top twenty importing countries, United Arab Emirates holds the highest share of export quantity from India, which was 12.35 Percent during the study period, followed by Bangladesh with 8.95 Percent. In case of the export value of turmeric, United States holds the highest export share value from India with 15.25 Percent of trade value in the last 30 years, followed by United Arab Emirates with 9.64 Percent.

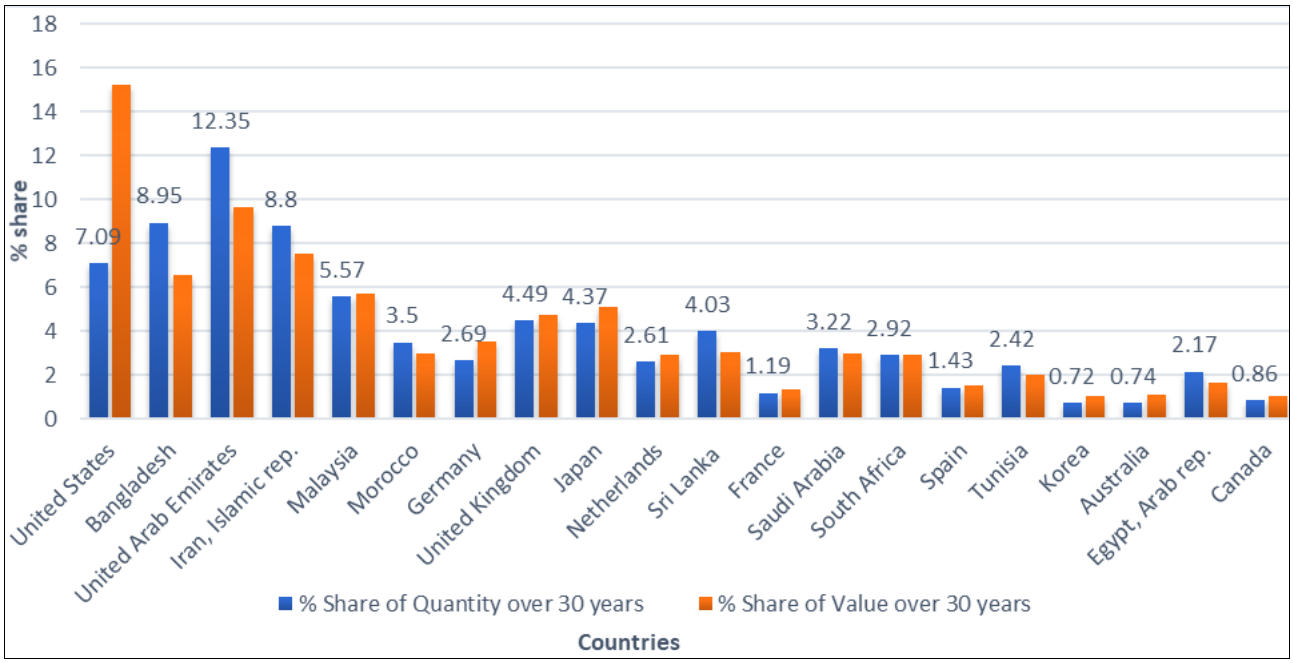

Fig. 1: Share (%) of turmeric export quantity and value of top 20 countries from India (1990 to 2021)

Trend in export of turmeric from India

The trends in export quantity and export value of turmeric from 1990 to 2021 were plotted in the fig. 2 and 3. It is seen from the figure that, the trend line of India's turmeric export quantity and export value from 1990 to 2021 was showing a steady increase trend in the export quantity and export value of turmeric from India from the last 30 years. The similar results were seen the findings of Angles S. *et al.* (2001) [1] in their study, "Production and export of turmeric in South India" revealed that, the growth in export of turmeric were significant in both trade quantity and trade value because of the high demand of Indian turmeric in the international market.

In case of export quantity, from 1990 to 2002 the export trend was increasing but during 2003 export trend declined suddenly that may be due to export barriers, then from 2004 onwards the quantity of export trend was found to be steadily increased up to 2021. However, the trend in export value of turmeric from India at constant price shares increasing trend from 1990 to 2009, then the export trend was found to be suddenly hike during 2011 and afterwards it became normal and increased steadily up to 2021.

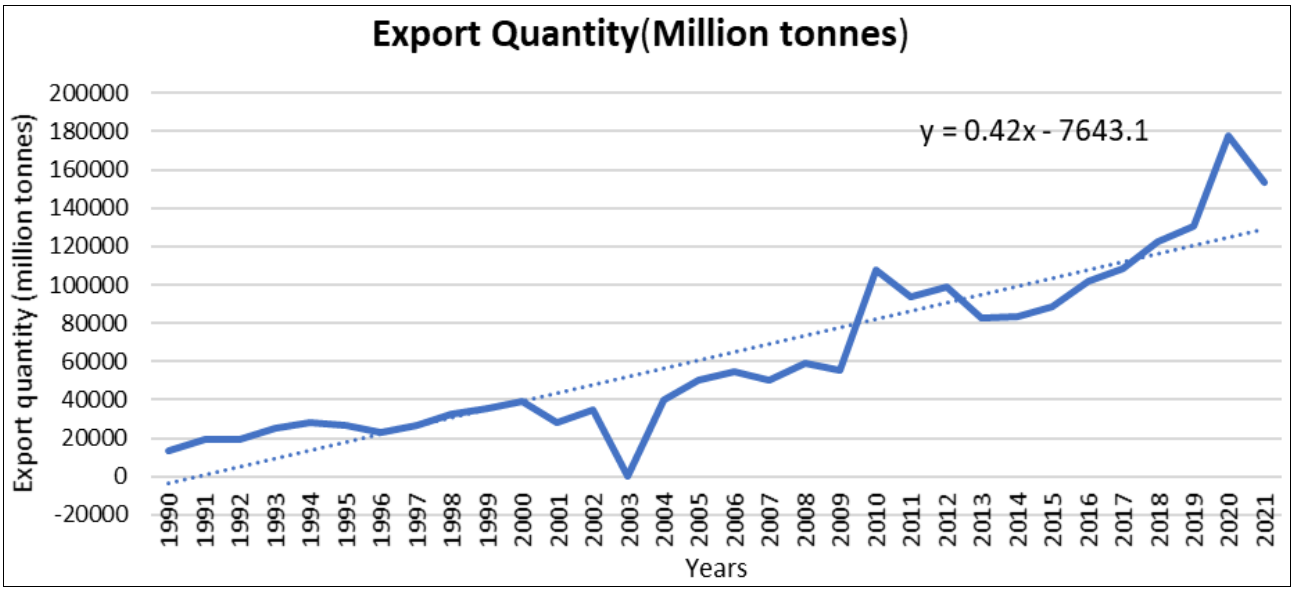

Fig. 2: Trend in export quantity of turmeric from India (1990 to 2021)

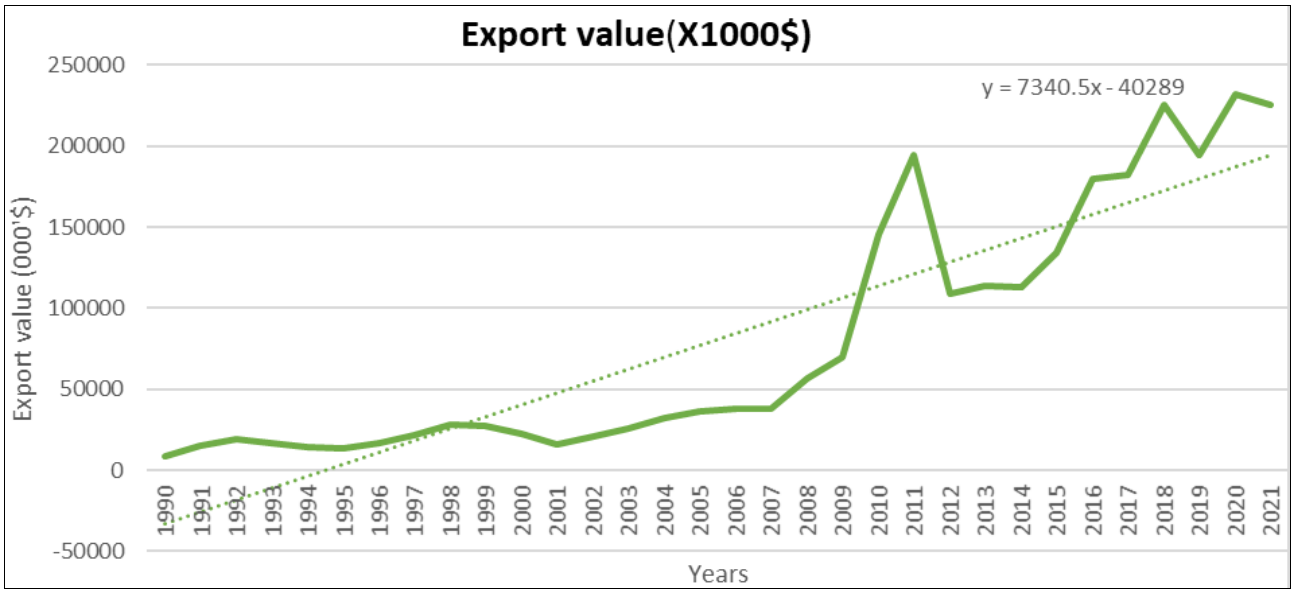

Fig. 3: Trend in export value of turmeric from India at constant prices (1990 to 2021)

Annual compound growth rates and instability indices of turmeric export from India

The Annual compound growth rates and instability indices of turmeric export quantity and export value of India were worked out for the period 1990 to 2021 and presented in the Table 2.

Table 2: Annual compound growth rates and instability indices of turmeric export quantity and export value from India

Particulars	Mean	SD	R^2	CV	CAGR (%)	CDVI (%)
Export quantity	62,933,373	44364328.70	0.19	0.70	8.11**	0.63
Export value	80829.37	76909.92	0.91	0.95	11.31***	0.28

(*** Significant at 1 percentage, ** Significant at 5 percentage)

It was revealed from the table that, the annual compound growth rate of export quantity of turmeric from India was exhibited 8.11 Percent growth rate per annum during the study period, which was found to be positive and significant at 5 Percent. Similarly, the annual compound growth rate of export value of turmeric from India was also exhibited 11.31 Percent growth rate per annum during the study period which was found to be positive and significant at 1 Percent. The coefficient of variation of turmeric export quantity and export value of India were observed to be 0.70 and 0.95, respectively, indicated very low variability in export of turmeric.

In case of instability indices, the instability index values of export quantity and export value of turmeric from India were estimated and observed to be 0.63 Percent, and 0.28 Percent, respectively, indicated very low instability of export quantity and export value of turmeric from India during the study period and export of turmeric from India was very much stable during the past 30 years.

Direction of trade of turmeric export from India

The direction of trade of turmeric export from India to different countries was critically analyzed with the estimation of diagonal transitional probability matrix using Markov chain analysis. Top five turmeric importing countries namely, United states, Bangladesh, UAE, Iran, and Malaysia were selected and the total of the turmeric imports of rest of the countries was labelled as "All Others". An overview of the top five import destinations for turmeric have been presented in the Table 3. The table also clearly states the Percent share of the importing destinations for turmeric during 2020-21.

Table 3: Transitional Probability Matrix of India's turmeric export quantity

Country	United States	Bangladesh	United Arab Emirates	Iran	Malaysia	All others
United States	0.81	0.14	0.0007	0	0.02	0.02
Bangladesh	0	0.42	0.32	0.22	0.001	0.03
United Arab Emirates	0	0.14	0.84	0	0.02	0
Iran	0.26	0	0	0.62	0.06	0.04
Malaysia	0	0.05	0	0.13	0.79	0.015
All other	0.44	0	0	0	0	0.55

It was revealed from the Table 3, that, United Arab Emirates found to be the most stable or reliable importer among the major importers of Indian turmeric as reflected by the higher probability of retention at 0.84, indicated that the probability of United Arab Emirates retaining its previous import share over the study period was 84 Percent. Thus, United Arab Emirates was found to be the most reliable and loyal market of Indian turmeric and at same time it has lost its 14 Percent share to Bangladesh and 2 Percent share to Malaysia. Murugananth *et. al.* (2008) [9] in their study "A Study on the Direction of Trade in the Indian Turmeric Exports: Markov Chain Approach" stated that, United Arab Emirates was the most reliable and loyal market of Indian turmeric.

After UAE, United States had higher probability retention of

0.81 which retaining its previous import share of 81 Percent, found to be the second most reliable and loyal market of Indian turmeric and at the same time Unites states has lost 14 Percent share to Bangladesh, 2 Percent share to Malaysia and 2 Percent share to other remaining countries. Malaysia also had higher probability retention of 0.79, retaining its previous import share of 79 Percent, found to be the third most reliable and loyal market of Indian turmeric and at same time and it has lost 13 Percent of its share to Iran, 5 Percent to Bangladesh and 1 Percent to remaining countries.

Iran and Bangladesh were also had a probability retention of 0.62 and 0.42, retaining their previous import share of 62 Percent, and 42 percent, found to be the fourth and fifth loyal market of Indian turmeric. Joshi *et. al.* (2015) [4] in their study "stability analysis of Indian spice exports" stated Bangladesh as the most reliable and loyal market of Indian turmeric.

The remaining all other countries that are importing turmeric from India, had a combined probability retention of 0.55, indicated that, these countries were retaining the previous import share of 55 Percent. Angles S. *et al.* (2011) [1] conducted research on "Impact of Globalization on Production and Export of Turmeric in India – An Economic Analysis" noticed that, export share retention for Indian turmeric was high in minor importing countries which were pooled under others category.

Conclusion

United Arab Emirates (UAE) had the highest share of turmeric export quantity from India, accounted for 12.35 Percent of the total export quantity during the study period. This is followed by Bangladesh (8.95%) and Iran (8.80%). In terms of export value, the United States holds the highest share of 15.25 Percent, followed by the UAE (9.64%) and Iran (7.51%).

The annual compound growth rate of export quantity and export value of turmeric from India were exhibited 8.11 Percent and 11.31 Percent per annum. Export quantity and export value of turmeric from India exhibited a high stability with 0.63 Percent, and 0.28 Percent instability per annum, respectively.

Markov chain analysis revealed that, United Arab Emirates exhibited the highest retention probability of 84 Percent of followed by United States and Malaysia, with a retention probability of 81 Percent and 79 Percent, respectively. Iran and Bangladesh showed a retention probability of 62 Percent and 42 Percent, respectively. The remaining all other countries showed a retention probability of 55 Percent.

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