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Stability analysis of rice export markets of India to South Asian countries- markov chain approach

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Abstract

Rice is an important food crop of India which plays a dominant role in the country's economy by meeting the domestic and export demands. It contributes significantly to both agriculture and industry in terms of farm income, employment and export earning. India, despite being the second largest producer of rice in the world, has not exploited its potential to emerge as a major player in the world Rice exports. The present level of exports is not consistent and exhibits high variations in volume and revenue earning. In this paper, the direction of changes have been measured in the export of Rice from India to among SAARC countries to different export markets employed the Markov-Chain model. The South Asian Association for Regional Cooperation Constituted by Afghanistan, Bangladesh, Bhutan, Maldives, Nepal, Pakistan, and Sri Lanka. The study endeavors to measure direction of trade policies.

Keywords- Probability, Matrix, Markov chain model, Market, Costs, Demand

Introduction

Rice is an important agricultural commodity in India grown for meeting the domestic demand as well as exports. India is the second largest producer of rice in the world after China but small proportion of it is exported. The export earnings from rice have been fluctuating over the years ranging from Rs. 75,500 lakhs in 1991-92 to Rs. 1116440.39 lakhs in 2008-09. Several factors have been contributed to the variability in exports; these included large domestic consumption, fluctuations in the production due to vagaries of weather, competition from other rice growing countries and insufficient exportable surplus of rice production during certain years and the absence of a steady export policy. Primarily, the export of rice depends on domestic production and government intervention in its export trade. Under such a scenario, it is appropriate to examine the direction and stability of exports to various

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markets with a suitable econometric model, which may help us to quantity the shifts in the shares to different markets as well as between the markets over a period of time. Accordingly, the main objective of this study was to analyze the dynamics of changes in the export of rice from India by estimating the probability of retention and switching pattern by employing a first order Markov chain model.

Materials and methods

The changes in the export of rice to South Asian countries were analyzed by employing a first order finite Markov chain model which captured the net effect in changes in the exports of rice over a period of time. There is a growing awareness of the usefulness of this technique for analysis and forecasting in many areas including exports, particularly when the process is constant but has a gradual change (Eswarprasad *et al*., 1997). The trade directions of commodities exports were analyzed using the first order Markov chain approach. Central to Markov chain analysis is 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 with the passage of time. The diagonal elements of the matrix measure the probability that the export share of a country will be retained. Hence, an examination of the diagonal elements indicates the loyally of an importing country to a particular country's exports. In the context of the current application, structural changes were treated as a random process with selected eight importing countries. The average exports to a particular country was considered to be a random variable which depends only on the past exports to that country, which can be denoted algebraically as

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

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.

$$O \leq P_{ij} \leq 1$$

$$\sum_{i=1}^{n} P_{ij} = 1 \text{ for all i}$$

Thus, the expected export shares of each country during period't' were obtained by multiplying the export to these countries in the previous period (t-1) with the transitional probability

matrix. There are several approaches to estimate the transitional probabilities of the Markov chain model such as un weighted restricted least squares, weighted restricted least squares, Bayesian maximum likelihood, unrestricted least squares, *etc.* In the present study, Minimum Absolute Deviations (MAD) estimation procedure was employed to estimate the transitional probability, which minimizes the sum of absolute deviations. The conventional linear programming technique was used, as this satisfies the properties of transitional probabilities of non-negativity restrictions and row sum constraints in estimation

The linear programming formulation is stated as

$$\text{Min } OP^* + Ie$$

Subject to,

$$XP^* + V = Y$$

$$z \quad GP^* = 1$$

$$P^* \geq 0$$

Where

0-- is the vector of zeroes.

P*-- is the vector in which probability Pij are arranged.

I-- is an apparently dimensioned vector of area.

E-- is a vector of absolute error (1 U 1).

Y-- is the vector of export to each country.

X- is the block diagonal matrix of lagged values of Y

V-- is the vector of errors

G- is the grouping matrix to add the row elements of P arranged in P* to unity.

Results and discussion

The changing pattern of rice exports were estimated by obtaining the transitional probability matrices for the annual export data of rice (in terms of value) for the period of 1991-92 to 2009-10. These analyses were carried out separately for pre-reforms period (1991-92 to 1999-2000) and post-reforms period (2000-01 to 2009-10). The SAARC countries were considered for analysis. The rice trade with the remaining countries was pooled under 'other countries'. The result of transitional probability matrix for the pre-reforms period (1991-92 to 1999-2000) and post-reforms period (2000-01 to 2009-10) are presented in tables 1 and 2, respectively. It is indicated that Bangladesh has been the only stable importer of Indian rice, as shown by probability that decreased from 0.2501 during per-reforms period to 0.1757 during post-reforms period. This implied that the share of import by Bangladesh decreased from 25.01 per cent during the pre-reforms period to 17.57 per cent during post-reforms period. Other countries were a stable market for Indian rice as market compared to the SAARC member countries in the current period. Among the SAARC countries, Afghanistan and Bangladesh were more stable market while Bhutan, Nepal, Maldives, Pakistan and Sri Lanka were highly unstable as reflected by their low transition probability value. Other Countries together 96.05 and 88.70 per cent market share during pre-reforms period and post-reforms period respectively. It shown decreases rice trade from pre-reforms period to post-reforms period. While it losing its 0.8 and 0.7 per cent market share to Bhutan and Maldives and other countries gained 92.85 per cent market share from

Nepal during pre-reforms period. While during post-reforms period it gained 95.29 per cent market shares from Sri Lanka. Afghanistan and Bangladesh were the major importer of rice besides other countries and India's rice export to Afghanistan and Bangladesh were 100 and 25.01 per cent year's share of the pre-reforms period. Bangladesh lost its 66.21 per cent market share to other countries and 5.08 per cent to Sri Lanka. It lost market share to 0.47 per cent market share to Nepal. On the other hand it lost 7.48, 0.17 and 0.14 per cent share from Sri Lanka, Maldives and Pakistan during post-reforms period. Afghanistan, Bhutan, Maldives, Nepal, Pakistan and Sri Lanka are highly unstable importer of rice among SAARC countries as retain zero per cent of their previous market share. Maldives lost its 8.29 per cent market share to Nepal and Bhutan lost its 0.96 per cent market share to Sri Lanka. Nepal gained its 92.85 per cent share from other countries during pre-reforms period and during post-reforms period Bhutan lost its 0.043 per cent share from Afghanistan, Pakistan lost 0.14 per cent and 7.48 per cent from Bangladesh. Besides, China is a major competitor to India in the export of rice. The post-reforms period this reduced to almost zero during the post-liberalization period, indicating that they were the unstable importers of Indian rice. This is attributed to the stiff competition offered and higher market penetration efforts made by the major exporting countries. The transition probabilities for the remaining importing countries viz. Bhutan and Pakistan were found as zero in both the periods, indicating instability in India's exports to these countries. The sharp decline in the export of rice from India reflects our inability to retain the share in the traditional markets and explore new markets. These call for appropriate policy measures and marketing efforts to sustain in these growing markets. We need to improve our export competiveness by decreasing costs and improving yield and quality. Also, we need to move away from the present policy regime of controlled exporters to enter into long term contract with the buyers in the international markets and achieve growth.

Table 1.Transitional probability matrix of Indian exports during pre-reforms period (1991-92 to 1999-2000)

	Afganistan	Bangladesh	Bhutan	Maldives	Nepal	Pakistan	Sri Lanka	Other
Afganistan	1	0	0	0	0	0	0	0
Bangladesh	0	0.2501	0.0029	0	0.0479	0	0.05080	0.6621
Bhutan	0	1	0	0	0	0	0	0
Maldives	0	1	0	0	0	0	0	0
Nepal	0	0	0	0.0829	0	0	0	0.9285
Pakistan	1	0	0	0	0	0	0	0
Sri Lanka	0	0.9912	0.0096	0	0	0	0	0
Other	0	0.0425	0.0008	0.0007	0	0	0.0013	0.9605

Table 2. Transitional probability matrix of Indian exports during post-reforms period (2000-01 to 2009-10)

	Afganistan	Bangladesh	Bhutan	Maldives	Nepal	Pakistan	Sri Lanka	Other
Afganistan	0	0	0	0	1	0	0	0
Bangladesh	0	0.1757	0.0043	0.0017	0	0.0014	0.0748	0.7529
Bhutan	0	0	0	0	1	0	0	0
Maldives	0	0	0	0	0	0	0	1
Nepal	0	0	0	0	0	0	0	1
Pakistan	0	0	0	0	0	0	0	1
Sri Lanka	0	0	0.0491	0	0	0	0	0.9575
Other	0	0.09396	0.0019	0.0033	0.0254	0	0.0059	0.8870

Conclusion

The Markov-Chain analysis of Rice exports from India has indicated as the most stable market which has depicted an fluctuations in its import share from the pre-reforms period (1991-92 to 1999-2000) and post-reforms period (2000-01 to 2009-10). The Association provides a platform for the peoples of South Asia to work together in a spirit of friendship, trust and understanding. It aims to promote the welfare of the peoples of South Asia and to improve their quality of life through accelerated economic growth, social progress and cultural development in the region. SAARC countries have many common economic features like poverty, income inequality, large population, low productivity, illiteracy and mass unemployment. South Asia occupied an important place in global balance of power and concomitant strategic formulation. SAARC has generally accepted as a necessary and desirable mechanism for the countries of the region to achieve self-reliance and progress in social and economic matters.

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