Stability Analysis of Raw Cotton Export Markets of India – Markov Chain Approach

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Abstract

Cotton is an important fibre 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 earnings. India, despite being the third largest producer of cotton in the world, has not exploited its potential to emerge as a major player in the world raw cotton exports. The present level of exports is not consistent and exhibits high variations in volume and revenue earnings. In this paper, the dynamics of changes have been measured in the export of raw cotton from India to different export markets employing the Markov-Chain model. The results have shown China as the sole stable destination for our cotton exports. The other traditional importing countries such as Bangladesh, Germany, Indonesia, the UK, Japan and Korea have recorded low retention probabilities during pre- and post-economic reform periods, indicating unstable export share to these markets.

Introduction

Cotton is an important agricultural commodity in India grown for meeting the domestic demand as well as exports. India is the third largest producer of cotton in the world but only a small proportion of it is exported. The export earnings from cotton have been fluctuating over the years ranging

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from Rs 32.37 crores in 1988-89 to Rs 1,484 crores in 1996-97, and declined to Rs 811.47 crores during 2003-04. Several factors have contributed to the variability in exports; these included large domestic consumption, fluctuations in production due to vagaries of weather, competition from other cotton-growing countries, insufficient exportable surplus of cotton production during certain years and the absence of a steady export policy. Primarily, the export of cotton depends on domestic production and government's intervention in its export trade. Under such a scenario, it is appropriate to examine the direction and stability of exports to various markets with a suitable econometric model, which may help us to quantify 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 cotton from India by estimating the probability of retention and switching pattern by employing a first order Markov chain model.

Methodology

The changes in the export of cotton to different countries were analyzed by employing a first order finite Markov chain model which captured the net effect in changes in the exports of cotton 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).

In this paper, the structural change in raw cotton exports from India in terms of market retention and market switching was examined by using the Markov chain approach. The estimation of the transitional probability matrix (P) was central to this analysis. The element P_{ij} of the matrix indicated the probability that the exports would switch from the ith country to j^{th} country over a period of time. The diagonal elements P_{ij} indicated the probability that the export share of a country would be retained in the successive time periods, which in other words, measured the loyalty of an importing country to a particular exporting country. In the context of the current application, there were eight major importing countries for Indian cotton, viz. Bangladesh, China, Germany, Japan, Korea, Indonesia, the UK and all other countries grouped under 'others'. The average exports to a particular country was considered to be a random variable which depended only on its past exports to that country and which was denoted algebraically by Eq. (1):

$$E_{jt} = \sum_{i=1}^{r} E_{it-1}\ P_{ij}\ +\ e_{jt} \qquad\qquad\qquad …(1)$$

where,

E_{jt} = Exports from India to the i th country during the year t

E_{it-1} = Exports to the ith country during the year t – 1

P_{ij} = Probability that exports will shift from the ith country to jth country

e_{jt} = Error-term which is statistically independent of e_{jt-1}, and

r   = Number of importing countries.

The transitional probabilities P_{ij}, which can be arranged in a (c × r) matrix, had the following properties:

$0 \leq P_{ij} \leq 1$

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

The expected export-share of India during a particular period, t, was obtained by multiplying the quantity of exports to the selected countries (eight in the present study) during the previous period (t–1) with the estimated transition probability matrix (P). The transition probability matrix was estimated in the linear programming (LP) framework by a method referred to as minimization of Mean Absolute Deviation (MAD); the LP formulation on analysis was stated as per expression (2):

Min O P* + I$_e$ …(2)

subject to,

XP* + V = Y   …(3)

GP* = 1   …(4)

P* ≥ ϕ   …(5)

where, P* is a vector of the probabilities P_{ij}; O is a null vector; I is an appropriately dimensional vector of areas; e is the vector of absolute errors (| U |); Y is the vector of exports to each country; X is a block diagonal matrix of lagged values of Y; V is the vector of errors; and G is a grouping matrix to add the row elements of P arranged in P* to unity.

P* vectors were arranged to obtain the transitional probability matrix which indicated the overall structure of the transitions that had taken place in the system. Essentially, the transitional probability matrix captures the dynamics of the changes in raw cotton exports from India. The individual probabilities P_{ij} indicate the probability of the shift from the country i to country j.

Results and Discussion

The changing pattern of raw cotton exports were estimated by obtaining the transitional probability matrices for the annual export data of raw cotton (in terms of volume and value) for the period 1981-82 to 1998-99. These analyses were carried out separately for pre-reforms period (1981-82 to 1990-91) and post-reforms period (1991-92 to 1998-99). The major cotton importers from India, i.e. Bangladesh, China, Germany, Japan, Korea, Indonesia and the UK were considered for analysis. The cotton trade with the remaining countries was pooled under 'other countries'. The results of transitional probability matrix for the pre-reforms period (1981-82 to 1990-91) and post-reforms period (1991-92 to 1998-99) are presented in Tables 1 and 2, respectively. It is evident that China has been the only stable importer of Indian cotton, as reflected by the high probability of retention that increased from 0.0832 during the pre-reforms period to 0.3155 during the post-reforms period. This implied that the share of import by China increased from 8.32 per cent during the pre-reforms period to 31.55 per cent during the post-reforms period. It was interesting to find that even though China is the largest producer of cotton in the world (accounts for 25 per cent of world cotton production, *Cotton Annual*, 1998), it imports medium and long staple cotton from India and exports its low quality cotton to other countries.

Besides, China is a major competitor to India in the export of fabrics and readymade garments. Japan and Korea have depicted low probability retention of 0.0979 and 0.2026, respectively during the pre-reforms period which reduced to almost zero during the post-liberalization period, indicating that they were the unstable importers of Indian cotton. This is attributed to the stiff competition offered and higher market penetration efforts made by the major cotton exporting countries like the USA, Egypt, China, Mexico and Sudan. The transition probabilities for the remaining importing countries, viz. Bangladesh, Germany, Indonesia and the UK were found as zero in both the periods, indicating instability in India's exports to these countries. The sharp decline in the export of raw cotton 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 competitiveness by decreasing costs and improving yield and quality. Also, we need to move away from the present policy regime of controlled exports through export quota so as to enable our exporters to enter into long-term contract with the buyers in the international markets and achieve growth.

Interestingly, the minor importers of raw cotton, the 'other countries' category, had remained the most stable and loyal markets for Indian cotton, though the retention probability had marginally reduced from 0.7682 during

Table 1. Transitional probability matrix of Indian cotton exports during pre-reforms period (1981-82 to 1990-91)

Country	Bangladesh	China	Germany	Japan	Korea	Indonesia	UK	Other countries
Bangladesh	0.0000	0.7773	0.2227	0.0000	0.0000	0.0000	0.0000	0.0000
China	0.0031	0.0832	0.0016	0.3301	0.0000	0.0058	0.0075	0.5687
Germany	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000
Japan	0.0374	0.8390	0.0000	0.0979	0.0000	0.257	0.0000	0.0000
Korea	0.0000	0.0000	0.0180	0.4749	0.2067	0.0000	0.0933	0.2070
Indonesia	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000
UK	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.0000
Others	0.0101	0.0000	0.0197	0.1212	0.0522	0.0059	0.0227	0.7682

Table 2. Transitional probability matrix of Indian cotton exports during post-reforms period (1991-92 to 1998-99)

Country	Bangladesh	China	Germany	Japan	Korea	Indonesia	UK	Other countries
Bangladesh	0.0000	0.8864	0.1136	0.0000	0.0000	0.0000	0.0000	0.0000
China	0.1171	0.3155	0.1335	0.0872	0.0078	0.3390	0.0000	0.0000
Germany	0.0543	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.9457
Japan	0.0387	0.0692	0.0120	0.0000	0.0177	0.6986	0.0000	0.1639
Korea	0.0000	0.0000	0.0000	0.6516	0.0000	0.3485	0.0000	0.0000
Indonesia	0.0342	0.0000	0.0000	0.0000	0.0000	0.0000	0.0502	0.9156
UK	0.0000	0.9279	0.0000	0.0000	0.0000	0.0721	0.0000	0.0000
Others	0.0055	0.0000	0.0176	0.2505	0.0000	0.0000	0.1055	0.6209

the pre-reforms period to 0.6209 during the post-reforms period. The major gainers among the importers of Indian cotton during the second period over the first period were China, Japan, Indonesia and other minor importers as a group. China, in addition to its higher probability of retention is likely to gain from the switch over from the UK and Bangladesh with a high probability of 0.9279 and 0.8864, respectively. Japan has zero probability of retention of its own share of imports of Indian cotton but is likely to gain 65 per cent from Korea, 25 per cent from other countries and 9 per cent from China. Similarly, Indonesia, which also has a zero probability of retention of its own share of imports, is likely to gain from Japan (70 %), China (34%), the UK (7 %) and Korea (3.5 %). The 'other countries' group importing Indian cotton in addition to having a reasonably high retention probability (62 %) is likely to gain from Germany (15 %), Indonesia (92 %) and Japan (16 %).

Conclusions

The Markov chain analysis of raw cotton exports from India has indicated China as the most stable market which has depicted an increase in its import share from the pre-reform period to the post-reform period. China imports high quality cotton from India for its readymade garment sector even though it is one of the largest producers of cotton in the world. The transitional probability matrix has indicated that India is likely to loose most of its export share in the traditional markets such as Bangladesh, Germany, Indonesia and the UK. The estimation has indicated comparatively lower reduction of market share in Japan and Korea. Though China has remained a loyal market to Indian cotton, India should not have high dependency on one market so as to avoid trade risks in the long-run. Therefore, appropriate export promotion strategies have to be envisaged to diversify the geographical concentration of cotton exports and minimize market risks.

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