ANALYSIS OF EXPORT COMPETITIVENESS OF INDIAN TEA: MARKOV CHAIN APPROACH

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ABSTRACT

Tea is very popular drink consumed worldwide, next to water, it is the most consumed beverage in the world, with per capita consumption of more than 120 mL/d. Major tea production countries across the globe are India, China, Kenya, Sri Lanka, and Indonesia. India is the largest tea producing country in the world and tea contributes 1% of the GDP of the country and contributes 31% of global production(Ref?). Formation of WTO in 1995, various multilateral and bilateral trade agreements, imposition of environment and labour standards, exchange rate fluctuation all have impact on export competitiveness of Indian tea and resulted into structural changes in tea export. Markov chain analysis based on transition probabilities is used to study structural changes in tea export of India. Russia Federation, United States of America and other countries are observed as more stable countries while United Arab Emirates is one of the most unstable country for Indian tea export. Future projections of India tea export has observed declining share in United Kingdom and Kazakhstan while increasing share in Russian Federation, United Arab Emirates and other countries. In case of value of export, Russian Federation and United Kingdom would decline in percentage share in future while United Arab Emirates would increase percentage share of total export value of India

Keywords: Markov chain analysis, transition probability,Tea export.

1. Introduction

Tea is very popular drink consumed worldwide, although in greatly different amounts; it is generally accepted that, next to water, it is the most consumed beverage in the world, with per capita consumption of more than 120 mL/d (Katiyaar *et al.*, 1996). Tea plant (*Camelia sinensis*) is native of southwest Asia but cultivated in more than 30 countries in world. Major tea production countries across the globe are China, Kenya, Sri Lanka, India and Indonesia which accounts for 77% of world production and 80% global exports. Tea is being produced in some quantities Malawi, Rwanda, Tanzania, Uganda, South America (Argentina, Brazil and others), The Near East (Iran and Turkey) and The CIS (Russia and Georgia).

Globally, tea is cultivated over 3.7 million hectares of land with an annual production of 4.07 million tones and productivity of 1100 kilogram per hectare (Anonymous, 2010). Average tea price (2003-09) in various auction markets *i.e.* Sri Lanka, India, Kenya and Indonesia was 221, 149, 184 and 130 respectively while FAO composite price was 149 US cents/kg (Tanui *et al.*, 2012). Arguably the increase in export earnings in 2009 at the global level, positively affected rural incomes in all tea producing countries (FAO,2010).

Tea has occupied an important place in India's economy for the last several decades. India is the largest tea producing country in the world and tea contributes

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1% of the GDP of the country (Gupta and Dey, 2010) and contributes 31% of global production. It is also a substantial foreign exchange earner and provides sizeable amount of revenue to the State and Central Exchequer. India is the fourth largest exporter of tea in the world with major export destinations as Russia, UAE, United Kingdom and Poland. Tea export from India during 2012-13 was estimated at around 216.23 million kg valued at 4005.93 crore (Anonymous, 2014).

Formation of WTO in 1995, various multilateral and bilateral trade agreements, imposition of environment and labour standards, exchange rate fluctuation all have impact on export competitiveness of Indian tea. In recent years export share of the countries like Kenya, Vietnam, Argentina, China and also of the neighboring Nepal have increased considerably as compared to the export share of India. In 1980, Kenyan export share was only 8.71 per cent which increased to 23.26 per cent in 2008. China has also increased its share from 12.57 per cent in 1980 to 18.01 per cent in 2008 despite the fact that consumption of tea in China is very high like India (Sarkar, 2014). After fragmentation, USSR was looking for tea at cheaper rate which was supplied by new emerging country *i.e.* Kenya and to maintain market of USSR India has to sell tea at cheaper rate. Even demand of famous Darjeeling tea in international market has decreased due to similar flavor tea by Nepal and China. Demand for tea in buying markets like U.K., Germany, U.S. and Ireland were also slowed down (Sarkar, 2014). Because of emergence of these competitors effects on tea export have seen which caused structural changes in export trade.

Nagoor (2009) studied the export performance of Indian tea in comparison with the major producing countries in world. NPC (nominal protection co-efficient) was used to assess the competitiveness in export performance of agricultural commodity. Result from NPC (nominal protection co- efficient) concluded that India's share in tea import of Egypt was 16.26 per cent in1986 which was reduced to 0.56 per cent during 2001 and in 2004 share was virtually nil. Rajesh *et al.*(2002), Suseela and Prasad (2003), Mahadevaiah *et al.* (2005) used Markov chain analysis to study the structural changes in export of major spices, turmeric and raw cotton from India respectively. As tea export plays important role in Indian economy, it is necessary to see the shifts in tea export may not be that huge but of

such shift but realignment of destination from low-value to high-value market is discernible. Hence this paper aims with studying the structural changes in tea export in terms of quantity and value in India for planning and policy making purpose.

2. Material and methods

To study the structural changes in tea export, data of tea export to major destination countries (quantity and value) during 1996-2011 is obtained from tea board of India. Following table denotes the average export of tea from India to major destination countries during 1996-2011 and its percentage contribution to average export from India.

Table 1: Contribution of different countries towards average tea export (million kg.) of India (1996-2011)

Name of country	Average export of tea from 1996-2011 (million kg.)	Percentage share to India average export from 1996-2011
Russian Federation	47.91	24.23
United Kingdom	23.49	11.88
United Arab Emirates	22.25	11.25
United States of America	9.08	4.59
Kazakhstan	9.01	4.56
Iran	7.95	4.02
Pakistan	6.51	3.29
Poland	6.02	3.04
Germany	5.67	2.87
Saudi Arabia	4.88	2.47
Others	54.96	27.80
Total	**197.72**	**100.00**

Source: Tea board of India, annual reports 1996 to 2011

From the table it is observed that Russia Federation, United Kingdom and United Arab Estimates are major export destinations contributing more than 10% of total share while USA and Kazakhstan share more than 4%. These countries were selected for Markov chain analysis.

Time series data are very much susceptible to presence of outlier; as such present investigation started with test for outlier as per Grubb's statistic (www.graphpad.com). On rejection of outlier or replacement of extreme values (if any) by median, the data are subjected to test of randomness using turning point test. Descriptive statistics are used to describe the basic features of the data in any study. The most widely used descriptive measure of central tendency and dispersions like arithmetic mean, range, standard deviation along with simple and compound growth rates per are used to explain each series. Simple and compound

growth rates are calculated by using formula described by Mishra *et al.* (2012).

Markov chain analysis

Structural change in exports is examined using the Markov chain approach. Central to Markov chain analysis is the estimation of the transitional probability matrix P. The elements P_{ij} of the matrix indicates the probability that export will switch from country i to country j with the passage of time. The diagonal P_{ij} measure the probability that the export share of a country will be 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 according to study period, major importing countries of tea will be considered. The average exports to a particular country will considered as 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 to 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.

$$O < P_{ij} < 1$$

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

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 deviation (MAD) estimation procedure is employed to estimate the transitional probability which minimizes the sum of absolute deviations. The conventional linear programming technique is 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

Min OP* + Ie

subject to,

XP* + V = Y

GP* = 1

P* > 0

Where,

0 = is the vector of zeros

P* = is the vector in which probability P_{ij} are arranged

I = is an appropriately dimensioned identity matrix

e = is a vector of absolute errors ($|_V|$)

Y = is the vector of exports 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

Using the estimated transitional probabilities, the export of tea to various destinations will be predicted by multiplying the same with the respective shares of base year. The accuracy of developed model is checked through residuals analysis and hence Root Mean Square Error (RMSE), Mean Absolute Error (MAE), Mean Absolute Percentage Error (MAPE), Maximum Absolute Percentage Error (MAXPE) and Maximum Absolute Error (MAE) are also calculated.

3. Results and discussion

Per se performance of tea export to major countries from India is presented in table 8.1. From the table, it is observed that on an average 47.91 million kg of tea exported from India to Russia Federation during study period followed by United Kingdom and United Arab Emirates. Coefficient of variation is found maximum in Kazakhstan (51.34 %) followed by Russia federation (38.70%) and Unites States of America (37.27%). United Kingdom (16.11 %), United Arab Emirates (18.12%). The CV figures clearly indicate the most unstable market for India tea during study period. Simple growth rate per annum is found highest for Kazakhstan (63.51 %) while least for Russia Federation (1.64 %). Thus in highest importing country the growth of Indian tea remains almost stagnant. Negative compound growth rate is observed in Russia Federation which revealed that quantity of tea export to this is declined during study period. Nagoor (2009) has also observed decline in percentage share of Russia Federation to India's total tea export. The main reason for this down was due to poor quality of Indian tea in response to low prices offered by the Russian Federation under special Rupee-Rubles rate trade (Economic Times, Feb 11, 2007). Value of export follow same pattern as quantity of export to major countries from India. As more quantity was

exported to Russian Federation, it has impact on its value. Value of tea export from India is found maximum 50.31 million dollar for Russia Federation and lower for Kazakhstan 2.68 million dollar. Simple growth rate per annum is found highest for Kazakhstan (132.27 %) while least for Russia Federation (4.26 %). Negative compound growth rate is observed in Russia Federation which revealed that tea export value to this is declined during study period.

From test of outlier and randomness (Table 2), revealed that none of the series exhibited presence of outlier. In case of quantity of export, Russia Federation and United States of America has followed definite trend while United Kingdom, United Arab Emirates and Kazakhstan followed random pattern. In case of export value of tea from India, all selected countries except United States of America has followed random pattern. Randomness nature of the export value from major importing countries clearly indicates the fluctuating behavior of Indian tea in world export market.

Changes in direction of export from one country to other are analyzed using Markov chain model. Result of transitional probability matrix for export quantity and value from India is given in table 3. The row elements in the transitional probability matrix provide the information on the extent of loss in trade, on account of competing countries. The columns element indicates the probability of gains in volume of trade from other competing countries and the diagonal element indicates probability of retention of the previous year's trade volume by the respective country. Form table, transitional probability values in diagonal elements of matrix were higher for Russia Federation and United States of America which revealed that these countries are observed as stable market for Indian tea export. United Arab Emirates has observed as unstable market for Indian tea export.

Russia Federation has probability to retained 76 per cent of its previous market share. It would lose 8 per cent market share to United Arab Emirates and 3 per cent market share to Kazakhstan and 12 per cent market share to other countries under study. Although Russia Federation has probability to gain 27 per cent market share of United Kingdom and 6 per cent market share of other countries. United Kingdom has probability to lost 2 per cent of previous share to United Arab Estimates and 35 per cent of share to other countries. Although it has probability to gained 4 per cent of share from United Arab Estimates and 15 per cent share from other countries. Anonymous (2012) also observed results in decline share of export of India tea by United Kingdom. The reason for declined India's tea export to the UK

was due to stiff price competition by new emerging competitor Kenya tea. United States of America has observed as one of the most stable market for Indian tea and retained probability of 66 per cent of previous market share while it would lost 34 per cent of share to Kazakhstan and probably would gain 2 per cent share from other countries. Kazakhstan would probably retained 31 per cent of its previous market share and it would lost 69 per cent of its share to other countries although it would gain 2 per cent share from other countries. From the transitional probability matrix of quantity of tea export, it can be said that share of export to traditional countries will reduced while the export may be billowed by including to other countries.

For value of export, Russia Federation and other countries are observed as stable market for value of Indian tea export followed by United Arab Emirates. United States of America has observed as unstable market for value of Indian tea export. Results of coefficient of variation (Table 1) for export of tea from India to United States of America are observed in line with this result. Russia Federation has probability to retain 76 per cent of its previous market share. It would lose 4 per cent market share to United Kingdom, 13 percent market share to United Arab Emirates and 5 per cent market share to other countries than under study. Russia Federation would probably gain 25 per cent market share from United Kingdom. United Kingdom has probability to retain 22 per cent of its previous market share and would lose 53 per cent of previous share to other countries. It has probability to gain 5 per cent of share from Kazakhstan and 17 per cent share from other countries. United States of America as one of the most unstable market for Indian tea and has retained nothing from its previous market share. Jain (2011) has also observed that United Arab Emirates is stable market for value of tea from India. One thing it is clear from the analysis that India needs to explore non-traditional market for export of Indian tea and with all likelihood the traditional market for Indian tea may not remain granted.

The projection of the Indian tea export to different countries is computed using the transitional probability matrix and the results of actual and projected exports of Indian tea have been presented in figure 1 and 2. The accuracy of developed model is checked through residuals from model and presented in table 4. Results of error measures revealed that mean absolute percent error for quantity of export ranged from 7.4% to 27.65 % while for value 5.2 % to 13.2 %. The results of future projections of importing countries from India for the period 2012 to 20 are presented in table 4. From figures, it is observed that United Arab Emirates, Russia

Federation, United States of America exhibited increasing trend. It is also revealed that declining trend of total export to Russia Federation during 1996 to 2005 but after 2006 is has shown increasing trend. Percentage share of Russia Federation to India export was declined from 38 % to 15 % during 1997-2005 however it increased to 18 % during 2006-2011. May be because of this, Russia Federation has found as stable market for tea export from India. In case of value of export from India, increasing trend is observed in United Arab Emirates.

The projected shares of importing countries for tea from India showed that Russia Federation have shown relatively small increase in percentage share of Indian export. United Kingdom, Kazakhstan and Unites States of America have shown decreasing trend in quantity of tea import from India while share of tea export to United

Arab Emirates and other countries will increase. In case of value of export, same trend has followed as in quantity of export from India. United Kingdom have shown decreasing trend while United Arab Emirates have shown increasing trend in value of export of tea from India. In future projection, share of Indian tea export to United Arab Emirates will increase in both terms quantity and value. Even Kazakhstan has observed declining share in quantity of export but value of export has observed more or less stable.

4. Conclusion

Thus, from Markov Chain analysis of tea export from India to major countries following salient features emerge out. Russia Federation, United States of America and other countries are observed as more stable countries for tea export while Unites Arab Emirates is one of the

Table 1: *Per se* performance of tea export to major countries from India

	R.F.	U.K.	U.A.E	U.S.A	Kazakhstan	Others
Quantity (million kg.)						
Maximum	83.18	31.40	30.28	16.22	16.65	127.94
Minimum	27.77	16.55	15.26	4.02	1.49	62.63
Mean	47.91	23.49	22.25	9.08	9.01	85.98
SD	18.54	3.78	4.03	3.38	4.63	17.83
CV (%)	38.70	16.11	18.12	37.27	51.34	20.74
Skewness	-0.66	0.06	0.06	-0.06	-0.70	0.31
Kurtosis	0.91	0.14	-0.20	0.68	0.34	0.69
SGAR (%)	1.64	2.75	2.82	18.96	63.51	0.01
CGAR(%)	-0.04	0.02	0.02	0.08	0.08	0.02
Value (million dollar)						
Maximum	99.36	55.20	57.80	26.34	23.04	208.63
Minimum	195.87	104.39	82.26	58.21	59.38	439.31
Mean	50.31	35.92	33.54	9.51	2.68	121.86
SD	47.08	18.54	14.54	13.24	14.24	88.04
CV (%)	93.59	51.62	43.36	139.28	531.62	72.25
Skewness	-0.09	2.08	-0.74	0.99	1.58	1.78
Kurtosis	0.99	1.43	0.15	1.26	1.05	1.42
SGAR (%)	4.26	9.82	8.80	32.03	132.27	16.28
CGAR(%)	-0.03	0.04	0.04	0.09	0.11	0.07

Note: R.F.= Russian Federation, U.K.= United Kingdom, U.A.E =United Arab Emirates, U.S.A=Unites States of America

Table 2: Test of outliers and randomness for tea export to major countries from India

	R.F.	U.K.	U.A.E	U.S.A	Kazakhstan	Others
Quantity (million kg)						
P	7	11	11	5	7	7
E (P)	9.33	9.33	9.33	9.33	9.33	9.33
V(P)	2.52	2.52	2.52	2.52	2.52	2.52
ô Cal	1.47	1.05	1.05	2.73	1.47	1.47
Inference	Random	Random	Random	Trend	Random	Random
Outlier	No	No	No	No	No	No
Value (million dollar)						
P	7	11	11	5	7	7
E (P)	9.33	9.33	9.33	9.33	9.33	9.33
V(P)	2.52	2.52	2.52	2.52	2.52	2.52
ô Cal	1.47	1.05	1.05	2.73	1.47	1.47
Inference	Random	Random	Random	Trend	Random	Random
Outlier	No	No	No	No	No	No

Note: R.F.= Russian Federation, U.K.= United Kingdom, U.A.E =United Arab Emirates, U.S.A=Unites States of America, No of turning points= P

Table 3: Transitional probability matrix of tea export to major countries from India

	R.F.	U.K.	U.A.E	U.S.A	Kazakhstan	Others
Quantity (million kg.)						
R.F.	**0.76**	0.00	0.09	0.00	0.03	0.12
U.K.	0.27	**0.36**	0.02	0.00	0.00	0.35
U.A.E	0.00	0.04	**0.00**	0.00	0.00	0.96
U.S.A	0.00	0.00	0.00	**0.66**	0.34	0.00
Kazakhstan	0.00	0.00	0.00	0.00	**0.31**	0.69
Others	0.06	0.15	0.22	0.04	0.02	**0.51**
Value (million dollar)						
R.F.	**0.77**	0.04	0.13	0.00	0.00	0.05
U.K.	0.25	**0.22**	0.00	0.00	0.00	0.53
U.A.E	0.00	0.06	**0.45**	0.00	0.03	0.46
U.S.A	0.00	0.00	0.00	**0.00**	0.62	0.38
Kazakhstan	0.00	0.05	0.33	0.01	**0.30**	0.32
Others	0.00	0.17	0.06	0.13	0.00	**0.65**

Note: R.F.= Russian Federation, U.K.= United Kingdom, U.A.E =United Arab Emirates, U.S.A=Unites States of America

Table 4: Residual analysis of Markov model for tea export to major countries from India

	R.F.	U.K.	U.A.E	U.S.A	Kazakhstan	Others
Quantity (million kg.)						
RMSE	4.09	2.25	2.20	1.10	1.77	6.59
MAPE	8.15	7.40	7.99	12.07	27.65	6.92
MAE	3.63	1.75	1.60	0.88	1.43	5.62
MaxAPE	21.07	20.64	38.32	50.79	213.34	14.72
MaxAE	7.46	5.44	5.88	2.04	3.18	12.10
Value (million dollar)						
RMSE	10.19	3.11	5.09	2.67	3.77	10.84
MAPE	5.83	5.2	7.52	11.06	13.22	5.20
MAE	6.99	2.68	4.11	2.34	2.97	8.30
MaxAPE	12.95	11.32	21.76	23.37	25.05	14.74
MaxAE	25.07	5.95	10.21	4.60	7.85	22.38

Note: R.F.= Russian Federation, U.K.= United Kingdom, U.A.E =United Arab Emirates, U.S.A=Unites States of America

Table 5: Projected shares (percent) of importing countries for exports of tea from India during 2012 to 2020

	R.F.	U.K.	U.A.E	U.S.A	Kazakhstan	Others
Quantity (million kg.)						
2012	22.71	11.07	11.31	6.08	5.77	43.06
2013	22.74	11.01	11.40	5.78	5.44	43.63
2014	22.78	11.08	11.52	5.62	5.25	43.75
2015	22.84	11.12	11.55	5.52	5.13	43.84
2016	22.90	11.15	11.58	5.45	5.06	43.85
2017	22.96	11.16	11.59	5.41	5.03	43.86
2018	23.00	11.17	11.59	5.38	5.00	43.85
2019	23.04	11.17	11.60	5.36	4.99	43.85
2020	23.07	11.17	11.60	5.35	4.97	43.84
Value (million dollar)						
2012	13.97	12.32	11.94	6.48	6.50	48.79
2013	13.83	12.30	12.20	6.47	6.36	48.84
2014	13.72	11.60	12.26	6.47	6.32	49.63
2015	13.56	11.57	12.25	6.69	6.31	49.62
2016	13.33	12.27	12.26	6.57	6.44	49.12
2017	13.33	12.34	12.26	6.51	6.41	49.16
2018	13.34	12.36	12.24	6.51	6.36	49.18
2019	13.36	12.36	12.22	6.52	6.35	49.19
2020	13.37	12.36	12.21	6.52	6.34	49.19

Note: R.F.= Russian Federation, U.K.= United Kingdom, U.A.E =United Arab Emirates, U.S.A=Unites States of America

Fig. 1: Observed and expected trends of quantity of tea export to major countries from India using Markov model
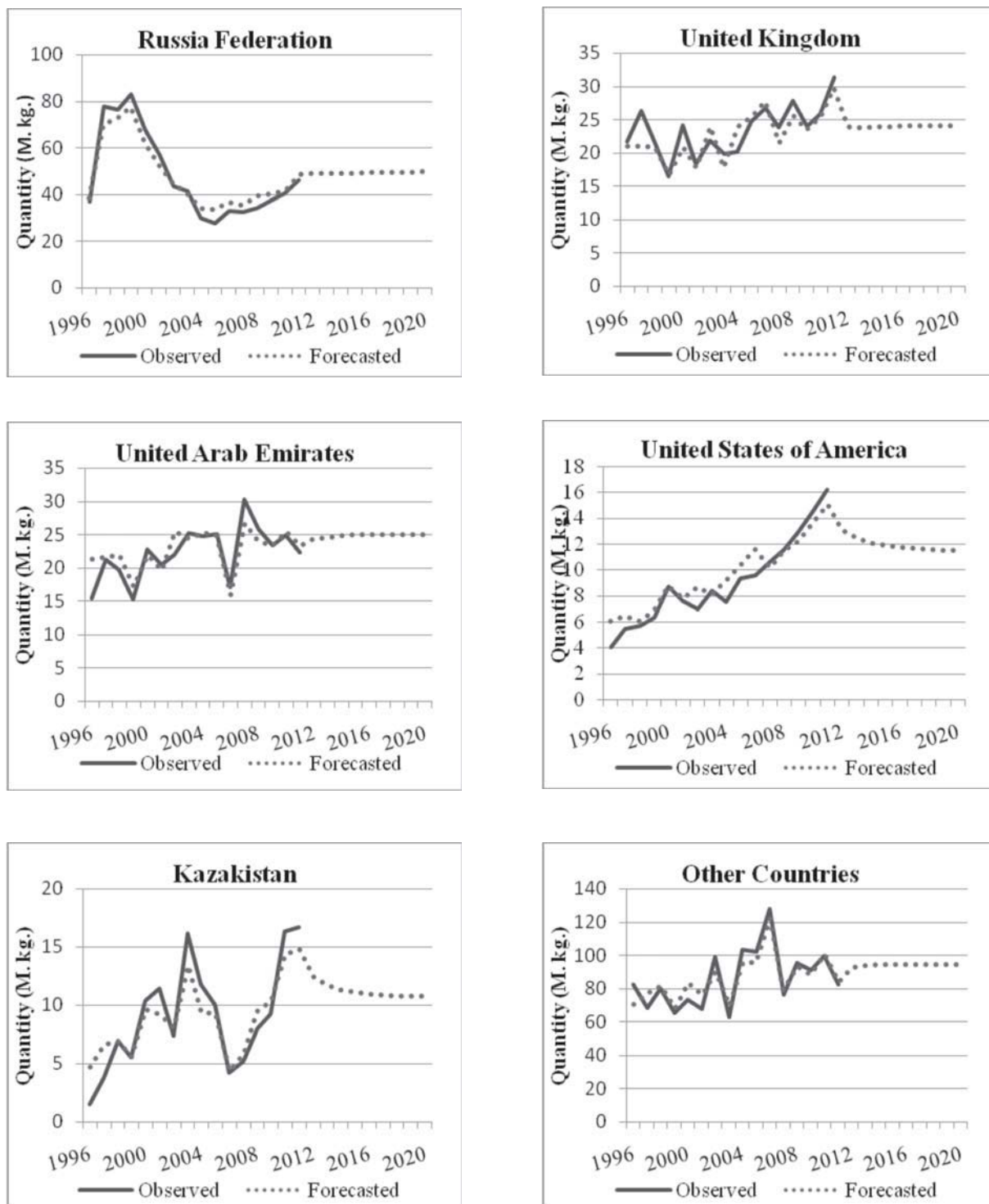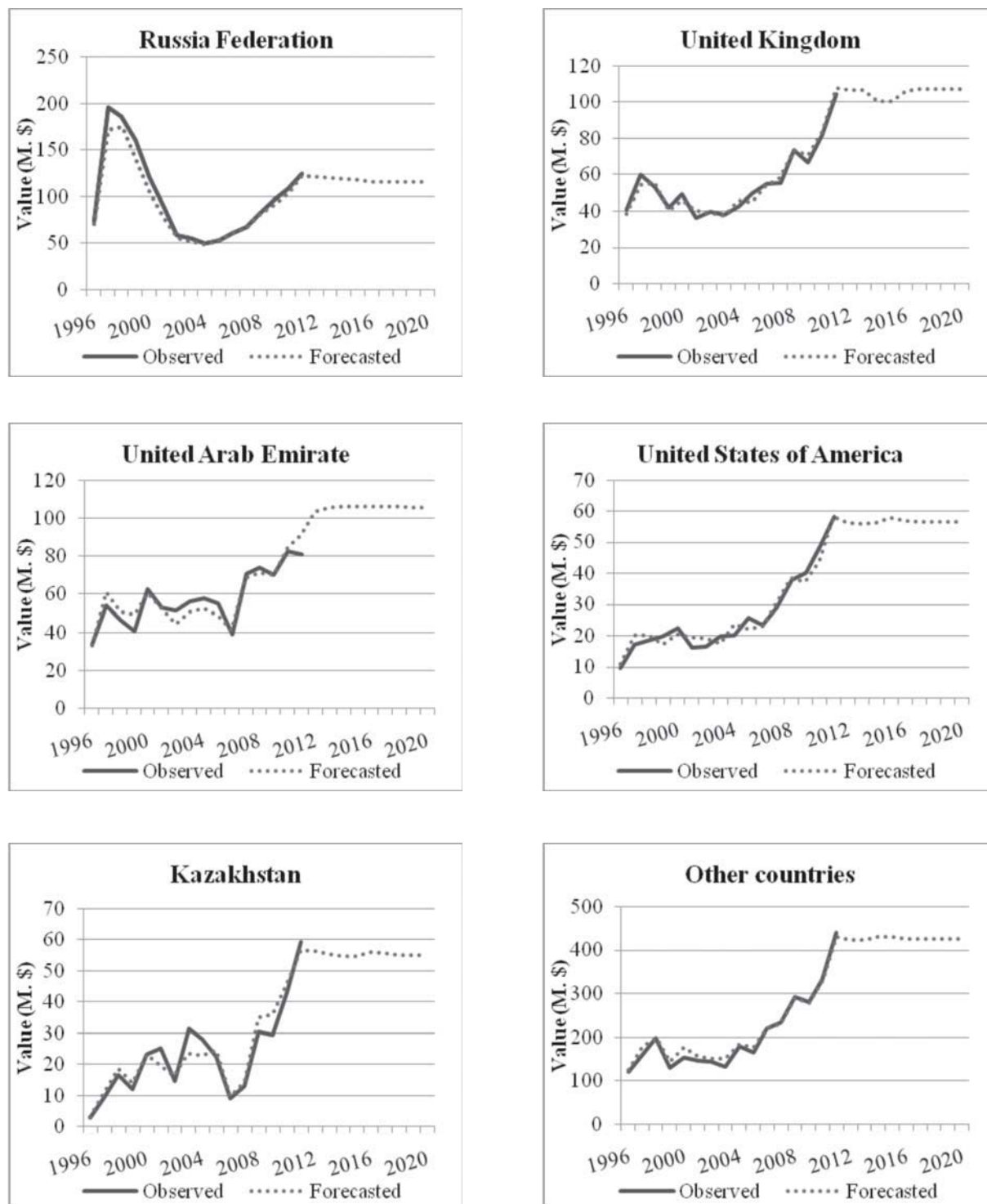
Fig. 2: Observed and expected trends of value of tea export to major countries from India using Markov model

most unstable country for India tea export. In case of value of export, United States of America is observed as most unstable country while Russia Federation is observed as stable country. In future projection, share of Indian tea export to United Arab Emirates will increase in both terms quantity and value. It can be concluded that although United Arab Emirates and Kazakhstan has observed unstable country for Indian tea export, but it will fetch better price Indian tea. Future projections of India tea export has observed decline share in United Kingdom and Kazakhstan while increasing share in Russia Federation and other countries. In case of value of export, Russia Federation and United Kingdom would decline in percentage share in future while United Arab Emirates would increase percentage share of total export value of India.

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