COFFEE ECONOMY OF KERALA-AN ANALYTICAL STUDY

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(2018-21-045)

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DECLARATION

I, hereby declare that this thesis entitled **"COFFEE ECONOMY OF KERALA-AN ANALYTICAL STUDY"** is a bonafide record of research work done by me during the course of research and the thesis has not previously formed the basis for the award to me any degree, diploma, associateship, fellowship or other similar title, of any other University or Society.

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Certified that this thesis entitled **“COFFEE ECONOMY OF KERALA-AN ANALYTICAL STUDY”** is a bonafide record of research work done independently by **Mr. ABHINAV M C (2018-21-045)** under my guidance and supervision and that it has not previously formed the basis for the award of any degree, diploma, associateship or fellowship to him.

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Introduction

1. INTRODUCTION

Coffee (*Coffea arabica* and *Coffea canephora*/ *robusta*), the favourite drink of civilized world (Jefferson, 1824) and the second largest traded commodity after petroleum in the world market (Mussatto, 2011), originated from the highlands of Ethiopia and the Boma Plateau of Sudan. The plant coffee belongs to the family *Rubiaceae* and genus *Coffea*. The vigorous bushy coffee plants grow in the tropics and sub tropics. Coffee plants are commonly cultivated in high altitudes of the tropics.

The earliest credible evidence of coffee as a beverage dates back to the 15th century in modern day Yemen (Weinberg and Bealer, 2001). But coffee seeds were first exported from East Africa to Yemen as *Coffea arabica* plant (Tracey, 1997). By the 16th century, the drink had reached the rest of the Middle East and North Africa and from there it spread to Europe and to the rest of the world.

The two most commonly grown species of coffee are *C. arabica* and *C. robusta*. Coffee plants are cultivated in more than 70 countries, primarily in the equatorial regions of America, Southeast Asia, the Indian subcontinent, and Africa. Brazil was the leading producer of coffee beans, producing one-third of the world's total coffee in 2018-19 (ICO,2020). Green coffee, unroasted coffee and roasted coffee are the most traded agricultural commodities in the world (Mussatto, 2011).

The world coffee production increased from nine million MT in 2018-19 to over 10 million MT in 2019-20. South America, specifically Brazil contributes the major share of world coffee production. In 2019-20, Brazil produced 37,75,493 MT of coffee and Vietnam was the second leading producer of coffee, with a production of 18,70,444 MT. Over 2.25 billion cups of coffee are consumed in the world every day. More than 90 per cent of the coffee production takes place in developing countries, mostly South America, while consumption happens mainly in the industrialized economies. Millions of small producers in developing countries make their living by growing coffee (Joy, 2004).

The plantation sector in India has been regarded as a major source of foreign exchange (Joseph, 2010). India maintained a share of three to four per cent in total coffee production during the past 30 years. Among the coffee producing countries, India was in seventh position with a production of 3,18,144 MT in 2019-20 and accounted for 3.09 per cent of the total world production. India is Asia's third-largest producer and exporter of coffee and the major export markets include Italy, Germany and Russia. India exports both Robusta and Arabica varieties, besides instant coffee. Out of the total exports of 3,48,840 MT from India in 2019-20, 76,452 MT was exported to Italy, 31,818 MT to Germany and 22,292 MT to Russia. The value of coffee exports from India declined to ₹5814.60 crores in 2019-20 from ₹6159.24 crores in 2018-19, with a decline of share in world production from 3.29 per cent to 3.09 per cent (ICO, 2020).

In India, majority of the coffee plantations are in the southern states of Karnataka, Kerala and Tamil Nadu, especially in the plantation districts within the Nilgiris. Among the states, Karnataka holds 53.3 percent of the total planted area of coffee in India, while Kerala and Tamil Nadu account for 18.7 per cent and 7.7 per cent respectively. The non-traditional areas and north eastern region together contribute 20.3 per cent of the total planted area of Indian coffee. In 2018-19, India produced 95,000 MT of Arabica coffee and 2,24,500 MT of Robusta coffee, which accounted for 30 per cent and 70 per cent of the coffee production respectively. Karnataka, Kerala, and Tamil Nadu accounted for 67.7 per cent, 22.3 per cent and 6.2 per cent respectively of the total coffee production in India. The productivity of Indian coffee increased from 765 kg per hectare in 2018-19 to 767 kg per hectare in 2019-20 (Coffee Board, 2020).

In India, out of the 1,38,000 registered cultivators, 98 per cent are small growers, with a holding size of less than 10 hectares and contributing more than 70 per cent of the production. Hence, as a labour-intensive production system, coffee is the major source of income for the small and marginal farmers as well as plantation workers (Upendranath, 2010). The average number of persons employed in coffee plantations in India was 6,64,505 in 2019-20 (Coffee Board, 2020).

During 1940s, the marketing of coffee in India was extremely unstable as it was inextricably linked to the changes in the world market and hence the farmers struggled with extreme fluctuations in prices of coffee. The Coffee Board of India, as a premier research and development organization under the Ministry of Commerce and Industry of the Government of India (GoI) was established by an act of parliament in 1942. The pooling system established in the late 1940s by Coffee Board supported the farmers for a period of time and the Board happened to be the sole authority to sell Indian coffee until 1992-93 (Joy, 2004). Extreme restrictions, stagnant price, mounting marketing cost, low minimum release price, restricted transportation and excessive bureaucratization in the marketing of coffee made the farmers to turn against the pooling system. In a state of resentment and economic liberalization, the partial pooling was introduced during 1992-93. Under partial pooling, the GOI introduced the Internal Sale Quota (ISQ) in 1993, which allowed all growers to sell 30 per cent of their produce in the open market. Subsequently in 1994-95, the introduction of Free Sale Quota (FSQ) allowed the small and large farmers to sell 100 per cent and 70 percent respectively of their produce in the open market. Later in 1995, the pooling system was completely abolished (Coffee Board, 1995).

As a founder member of the World Trade Organization (WTO) in 1995, India substantially-liberalised its agricultural commodity trade under the multilateral trading process. The Agreement on Agriculture (AoA), Most Favored Nation (MFN) clause, national treatment clause and removal of quantitative restrictions opened up Indian markets to international competition, which had significant implications on coffee growers and coffee economy of the country (Girippa, 1995). The superior quality coffee from Brazil and Columbia and cheap coffee from Vietnam and Indonesia began to reach India after the liberalization, which in turn led to fall in prices, extreme price fluctuations, loss of employment and income in the coffee sector.

Kerala is the second largest producer of coffee in India and is characterized by the cultivation of trade dependent plantation crops, including coffee, which are either export oriented or import substituting. The trade liberalization policies have brought challenges as well as opportunities for the state because of the increased integration of the country with the world, with serious implications for price stability and trade competitiveness (Chand, 2001).

Kerala accounted for 19.2 per cent of the area and 20.3 per cent of the production of coffee during the Triennium Ending (TE) 2019-20. The increase in production from 18,893 MT in 1950-51 to 3,16,000 MT in 2019-20, could be attributed to the fivefold increase in area from 92,523 ha to 4,54,722 ha, along with a fourfold increase in productivity during the period (Coffee Board, 2020). The coffee economy of Kerala is nearly the coffee economy of Wayanad as the district produces more than 80 percent of the total coffee output from the state. Cultivation of coffee is considered to be the major source of income and employment generation in coffee growing regions of Kerala (Karunakaran, 2017). The total number of coffee growers/ coffee holdings in India was estimated as 3,79,697, out of which 77,861 holdings were in Kerala. The average number of persons daily employed in coffee plantations in India was estimated as 6,65,769, in which Kerala accounted for 44,194 persons (Coffee Board, 2020).

Kerala was a model for high human development at low income. In recent years, the income levels have risen and Kerala is gradually shifting from an Agrarian to a market economy (Planning Board, Kerala, 2020). This shift has increased the importance of a commercial crop like coffee in Kerala economy. Kerala's share in national production of coffee was 21.87 per cent and the production of coffee increased from 64,676 MT in 2018-19 to 65,459 MT in 2019-20, with increase in area from 84,976 ha to 85,880 ha (UPASI, 2020). Among the coffee producing states in India, Kerala is positioned second to Karnataka. The productivity of the crop in Kerala in terms of the bearing area was 762 kg/ha in 2019-20. Export of coffee from Kerala through Cochin Port was 31,750 MT in 2019-20, as against 40,670 MT in 2018-19, registering a decline of 22 per cent. Export of coffee through Cochin port has been declining continuously. Even though the Kerala's economy has flourished with an increase in production, area and exports, the declines and deep dips in export through Kerala ports exerts backward pressure on Kerala's market economy (Planning Board, Kerala, 2020).

The English East India Company introduced coffee into Kerala during 1820s. The very first coffee plantation in Kerala was established at Ambukuthy hills and valleys of Mananthavady, Wayanad. The first large sized coffee estate, the Wayanad Coffee plantations, was established by M/s Parry and Company of Madras in 1841. By 1869, British established 1,20,000 acres of Arabica coffee plantations in South India, out of which 60,000 acres were in Wayanad (Indira, 1988). The period from 1825 to 1869 in Wayanad is chronicled as the golden era of coffee or Arabica coffee in Kerala. After 1869, the Arabica coffee plantations perished extensively due to pest and disease outbreaks. The Robusta coffee was introduced in Wayanad along with the new cultivation practice of shade trees in the second half of 19th century and Arabica was gradually replaced by Robusta (Joy, 2004). In 2019-20, Arabica accounted for less than five per cent of the area cultivated under coffee in Wayanad and presently, coffee is grown in three major zones of Kerala *viz*., Wayanad, Travancore and Nelliampathy. Among the zones, the production from Wayanad was 58,450 MT, which accounted for 83 per cent of total production from the state during 2019-20 and two other zones together contributed only 17 per cent of the production in Kerala.

Coffee is cultivated as a mixed crop along with black pepper and arecanut in Kerala. The total area under coffee cultivation in Kerala during 2019-20 was 84,976 ha, out of which 67,426 ha was in Wayanad and the remaining 12,717 ha and 4,833 ha in Travancore and Nelliampathy zones respectively. While 100 per cent of the coffee area in Wayanad zone is accounted by Robusta coffee, Nelliampathy zone has more than 40 percent of its coffee area under Arabica coffee and it was only 15 per cent in Travancore zone. Out of the 70,435 MT of coffee produced in Kerala during 2019-20, about 97 percent was Robusta coffee.

The coffee cultivation is labour as well as cost intensive. Compared to other crops and states, the cost of production of coffee (establishment and maintenance costs) is very high in Kerala (Joseph, 2010). While considering the labour wages prevailing in coffee plantations across different states in India, it could be observed that Kerala had the highest labour wage rate of ₹391 per day. Karnataka and Tamil Nadu planters have been paying a wage of ₹324.6 and ₹318.4 per day respectively in 209-20 (Coffee Board, 2020). Among the coffee growing states, Kerala was found to be having better labour friendly environment than other states in India (ITC, 2020). Coffee sector is the largest provider of employment in Wayanad district and nearly one-half of the coffee work force are women. Majority of the tribal communities in Wayanad also rely on coffee cultivation for employment.

The coffee economy of Kerala is facing serious challenges including price fall, extreme price fluctuations, loss of income and employment, distress sale, subsistence picking, loss of employment to migrant labours and shift in cultivation, all of which have aggravated after the implementation of the trade liberalization policies. In addition, coffee economy of Kerala as well as India is adversely affected by extreme climatic conditions such as reduced rainfall, long periods of drought and rising temperature in coffee growing belts (ITC, 2017).

In the above context, this study on the coffee economy of Kerala was conducted with the overall objective of analyzing the economics of production, marketing, prices and trade of Indian coffee. The study has analysed the current cultivation as well as livelihood status of coffee growers of Kerala by surveying 160 coffee farmers of Wayanad district. Coffee is a highly price volatile commodity and the study has estimated the magnitude, significance and inter relationships of domestic as well as international prices and price volatility, and suggested suitable strategies to manage the price volatility. The estimation of micro level implications of price volatility also helps to understand the responses of coffee farmers to changes in prices in the domestic market. The study throws light on implications of climate change as well as price volatility on coffee cultivation. The trade performance and competitiveness of Indian coffee in the international market were analysed in the study and strategies have been formulated to improve the performance of Indian coffee in the international market. The findings from the analysis of production constraints could be beneficial for the government and other developmental institutions to develop policies for the enhancement of production and exports of coffee.

The specific objectives of the study were

1) To estimate the economics of production and marketing of coffee.
2) To identify the constraints in production of coffee.
3) To find out the implications of prices on production, employment and income at the farm level.
4) To estimate the magnitude and determinants of volatility in prices of coffee in India.
5) To study the behavior, integration and transmission of coffee prices in domestic and international markets.
6) To analyse the export performance and competitiveness of Indian coffee

1.1 LIMITATIONS OF THE STUDY

The primary data for the study was collected only from farmers growing Robusta coffee in Wayanad district because more than 80 per cent of total coffee bearing area in Kerala was accounted by Wayanad district and more than 95 per cent of the cultivated coffee species in Wayanad district was *Coffea robusta*. The micro level study was based on limited number of respondents from Wayanad district and hence the generalizations based on the microlevel study need to be made with utmost care. The normal errors inherent in social science surveys like bias in reporting the data, inadequacy of information, recall bias, common limitations of statistical analysis and restrictions due to COVID-19 also need to be kept in mind while using the results for policy prescriptions. In spite of the above constraints, maximum care has been taken to ensure that such limitations do not affect the authenticity of the findings or results of the study.

All the decisions made during the study period were with utmost caution to avoid personal bias and errors.

1.2 PLAN OF THESIS

The thesis has been divided and presented in five chapters. The first chapter gives a general introduction to the thesis explaining the background and rationale of the study, its relevance and significance, objectives and major limitations. The second chapter is intended for providing the theoretical and empirical background of the study by reviewing previous studies related to the present research. The third chapter describes the study area and methodology followed. The fourth chapter includes the results and discussion and a summary of the study is presented in the fifth chapter followed by references, abstract and appendices.

Review of literature

2. REVIEW OF LITERATURE

The review of literature is a comprehensive and systematic summary of past studies and experiences on a particular topic. The reviewing of literature gives a wide understanding of the objectives, methodology and findings of the related studies. In this chapter, an effort has been made to review the past studies related to production, marketing and trade of coffee and its economic determinants, which are systematically collected and presented under the following sub-headings.

2.1 Coffee economy

2.2 Coffee production

2.3 Coffee marketing

2.4 Constraints in coffee production

2.5 Price volatility

2.6 Price integration and transmission

2.7 Export performance and competitiveness

2.1. COFFEE ECONOMY

Loftus (1944) analyzed the world coffee economy with special reference to the control schemes. He found that coffee, the western hemisphere product which rules the world market, comes from the bordered Caribbean countries. After World War II, coffee had great influence over the economy of Latin American countries producing it and in the diet of consumers in the United States. Coffee also stood as the logical first choice of commodity to picture in inter-American understandings as well as one of the five so called enjoyment goods of world importance. He found that coffee trade struggled with highly stable consumption requirement and highly unstable supply, rigid control measures and, inappropriate higher and lower yield movements.

Sick (1999) studied how Costa-Rican coffee producing households coped with the complexities of globalization through a commodity approach. The Costa-Rican coffee households efficiently managed the effects of globalisation and emerged as a dominant coffee exporter in the world market. The globalization and associated issues between rural communities, among households, between cooperative and private sectors and between nations were studied. It was found that the integrated regional-global trade process, household level management and non-traditional trade policies paved the path for the economic change and sustainability of coffee households in the Costa-Rican economy.

Topik (2003) studied the integration of world coffee markets to coffee economy of Africa, Asia and Latin America during the period from 1500 to 1989. He observed the transformation of coffee from Arab monopoly to European colonialism and finally into a globally produced multinational commodity. He reported coffee as an oligopolised and oliopsonised commodity.

Joy (2004) while studying the small coffee growers of Sultan Bathery in Wayanad found that majority of the coffee holdings in Wayanad were small and marginal in size. It was also found that more than 90 per cent of the holdings were sized less than two hectares. The Wayanad farmers predominantly practiced mixed farming and the volatility in prices of coffee had greater influence in the economy of Wayanad. It was reported that the fall in prices have caused employment as well as income losses to coffee farmers.

Sunil and Devadas (2011) stated that the coffee economy of Kerala was virtually the coffee economy of Wayanad since more than 90 per cent of the total coffee output in the state was from Wayanad district.

NCA (2016) measured the economic impact of coffee industries in USA. They observed that coffee consumption in US was even more than that of tap water consumption. Coffee was found to be having influence on all the communities in the country and the economic impact included tax generation and creation of jobs from super markets to farms through complex supply chain activities. The total economic impact of coffee industries in the US in monetary terms was estimated as 225.2 billion US dollars. The economic activities in relation to coffee industries accounted for about 1.6 per cent of the total GDP of the US. Coffee industries were responsible for the 1,694,710 jobs in the US economy and contributed 28 billion US dollars as taxes. It was found that about 74.2 billion US dollars were spent by US consumers on coffee consumption.

Ferguson (2017) estimated the impact of coffee production in the economy of Colombia. The country had more than 5,00,000 small and marginal coffee farms managed by families or households. The Colombian coffee sector struggled with coffee rust infestation and declined coffee yield during 2008 and 2011. It was found that the GDP and coffee production of Colombia had a significant positive correlation and a 10 per cent increase in the production was found to result in 3.4 per cent increase in the GDP.

Abdul Kader (2018) studied the importance of optimized coffee cultivation and its impact on economic growth and export earnings of Saudi Arabia. He found that coffee had inter linkages with the economic growth and GDP of Saudi Arabia. The country had the relative comparative advantage in coffee cultivation with respect to other competing countries and this potential to expand coffee cultivation could help to meet its escalating domestic demand as well as to increase its world market share up to 2 per cent. The optimized yield forecast of 80,070 MT from 2861.78 ha could generate a net return equivalent to 395.72 million US dollars per year, which would in turn support the country's strategy to diversify the economic base and lower the dependency on oil extraction.

Kumar *et al.* (2018) discussed as a case study the nexus of coffee, climate and biodiversity and its implications in Wayanad, Kerala. The Monsooned Malabar Arabica coffee was a speciality coffee of India. The coffee-agroforestry system was globally recognized for its high-level carbon management potential and the production system claimed properties like carbon sequestration, climate resilient agriculture and carbon mitigation. This system had high potential to conserve biodiversity and stabilize the ecosystem. Mainstreaming the Indian Monsooned coffee system would help the coffee households to improve their income and livelihood.

Muhammed *et al.* (2018) developed an optimum crop mix model for crop cultivation in homesteads of Kerala, with special reference to Wayanad and coffee was the core component of homestead farming in Wayanad district.

Cramer *et al*., (2019) studied the policy, political economy, and performance of Ethiopia's coffee sector. It was fund that the development of coffee sector and export markets caused the Ethiopian economy to flourish significantly. The export earnings were found to be the most reliable path to address the balance of payment constraints than relying on foreign aids or global capital flows. The growing global demand for coffee acted as a stimulant for the Ethiopian economic activities.

ICO (2019) stated that Indian coffee had a high export potential with a dynamic Compound Annual Growth Rate (CAGR) of 6.09 per cent over the last 25 years. The coffee production in India stood at 3,16,000 MT in 2017-18, from an area of 4,54,722 ha under cultivation.

Volsi *et al.* (2019) studied the dynamics of coffee production in Brazil during the period from 1984 to 2015. They found that coffee was the back bone of Brazilian agribusiness and significant changes had occurred in the distribution of regimes specializing in coffee production. The quality and value of Brazilian coffee had improved over the years. The low-cost production and economies of scale made Brazilian coffee more competent in the world coffee market. The Brazilian coffee was affected by the international coffee market regulation in 1990, which increased the price volatility and decreased the price levels and producer’s income.

2.2 COFFEE PRODUCTION

Graaff (1986) estimated the economics of coffee production in developing countries and it was found that the land and labour were the most prominent or driving factors in Arabica coffee cultivation. These factors were combined based on their relative scarcity and proportionate requirements. The man-land ratio and type of planting materials largely determined the coffee farming and production systems in developing countries.

Joy (2004) studied the small coffee growers of Wayanad district and reported that the cost of production of coffee was very high when compared to any other perennial crop in Kerala. Cow dung and compost were predominantly used during the planting and chemical application was practiced only after first year of planting. It was reported that coffee farms provided all season employment to all categories of people, especially women were employed in more than half of the activities in coffee plantations.

Tejaswi *et* al. (2006) estimated the establishment cost of coffee and black pepper in a mixed farming situation and the total establishment cost was estimated as ₹1,28,067 per hectare. The coffee gardens incurred huge capital investment during the first three years of establishment or the gestation period. The maintenance cost was worked out as ₹49,915.56 per hectare and input cost was found to be the major component of the maintenance cost. The study inferred that the coffee-based cropping system was relatively labour intensive as more than 50 per cent of the maintenance cost was paid as labour charges. The gross return from mixed farming was estimated as ₹1,01,057 per hectare, out of which coffee accounted for 62 per cent and 38 per cent was accounted by black pepper.

Avinash (2011) studied the production and marketing of coffee in Chikamangalur district of Karnataka. The district exhibited a positive growth rate in area as well as production (2.5 per cent and 0.21 per cent), while the productivity showed declining trend of -1.96 per cent. The establishment cost per hectare of coffee plantations was found to be ₹3,93,371 and ₹3,61,860, for small and large coffee plantations respectively. The per hectare maintenance cost during bearing period was worked out as ₹1,10,761.90 and ₹ 1,02,968 for small and large plantations respectively. The average yield obtained per hectare from small and large plantations were 3,143.80 kg and 3,125.96 kg respectively. The net present values (NPV) for small and large coffee enterprises were estimated as ₹3,05,992.41 and ₹3,96,471.69 respectively, with benefit cost ratios (BCR) of 1.35 and 1.49, and respective internal rate of returns (IRR) of 17 per cent and 19 per cent.

Mamta and Reddy (2013) evaluated the impact of organic coffee production on profitability of coffee cultivation in Kodagu district of Karnataka. It was reported that the organic coffee production was more labour intensive and less productive in comparison with inorganic coffee production. The productivity, cost of cultivation, gross returns, and net returns of organic coffee were estimated as 6.88 quintal per acre, ₹22,485 per acre, ₹44,214 per acre and ₹21,729 per acre respectively and the incremental benefit from organic coffee production was ₹2625 per acre.

Sunanda and Nagaraja (2014) reviewed the coffee production and productivity in Karnataka state and found that the state showed an upward momentum in coffee production and a marginal increase in area under coffee cultivation. A similar trend was seen in the shift from Arabica coffee to Robusta coffee, with a marginal shifting rate of 3 per cent per annum. The study pointed out that there was four and a half times increase in area as well as production during the last six decades, while the productivity increased by sixteen times.

Sharma *et al.* (2015) conducted a study to understand the economic significance of coffee production in Parbat district of Nepal. The coffee sector in Nepal had greater influence on the economy as it contributed 16.26 per cent of the total household income. The cultivation of coffee in Nepal was found to be a profitable enterprise, with a gross margin of NRs.90,205.43 per hectare, Benefit Cost ratio (BCR) of 3.84 and profitability index of 1.23.

Thanuja and Singh (2017) analyzed the cost and returns of coffee production in Kodagu district of Karnataka. They inferred that coffee being a perennial crop, required heavy investment and maintenance costs. In the study area, establishment cost for small plantation was ₹ 4, 64,947.47 per hectare and for large plantations, it was ₹4,42,513 per hectare. The average yield reported in the study area was 1620.2 Kg per hectare and 1619.8 Kg per hectare for small and large plantations respectively.

Reddy (2018) calculated the various costs incurred for coffee farming in Karnataka state. The costs incurred for maintenance during the bearing period, labour and fixed investment were estimated as ₹24,700, ₹85,700 and ₹1,76,393 respectively. The expense of ₹50000-80000 during the gestation period of 3 to 4 years was mainly attributed to manuring, fertilizer application, irrigation and electricity.

Pradeepa *et al.* (2019a) studied the trends in area, production and productivity of coffee across the major coffee growing states in India. The study revealed that the growth in production was led by area rather than productivity. A structural change in production from Arabica coffee to Robusta coffee occurred over the years. The planted and bearing area under coffee cultivation increased at a higher rate, but productivity levels declined persistently. Overall, productivity fluctuated erratically due to the extremities and irregular fluctuations in climate.

Pradeepa *et al.* (2019b) evaluated the value chain systems and strategies for integrating Indian small coffee growers into the global value chain system. There was a huge price spread of ₹34,147 per ton in coffee value chain due to the inability of the small coffee growers to ship their coffee directly to export destinations, which was caused by a number of impediments like low bargaining power associated with fragmented production, lack of knowledge on trade, lack of capital and information barriers. The study also inferred that there was a huge potential for enhancing the gross income of coffee growers from the existing ₹94,900 per acre to ₹1,29, 047 per acre by moving up in the value chain.

2.3 COFFEE MARKETING

Indira (1988) analyzed the coffee marketing in India and reported that the coffee board acted as the sole marketing authority of coffee in India prior to 1994. Coffee had wide range of quality variations and the price fluctuations were also very high and erratic in nature. The world price and demand for coffee in South India were the principal factors determining the price of Indian coffee. The increased expenses incurred for coffee marketing were attributed to the rising costs for storage, processing and transportation.

Narayana (1994) examined the marketing, pricing and export of coffee in India. The Internal Sale Quota (ISQ) introduced during 1993-94 and the Free Sale Quota (FSQ) announced during 1994-95 were considered to be the major decisions liberalising the internal marketing and exporting of coffee in the country. Under the ISQ (or FSQ), the coffee growers in India were entitled to sell 30 per cent (or 50%) of their production within the country or in the world, both directly and individually. An important implication of the ISQ or FSQ was the introduction of greater market competition or reduced state monopoly in the marketing of coffee in India. The changes in marketing structure within the country and changes in world market conditions, determined the market price of coffee in India. The competitive conditions such as supply and demand in the world and domestic markets also influenced the pricing mechanism.

Reardon and Barret (2000) suggested that with market reforms, the rise in commodity prices would stimulate an increase in production, especially of the export-oriented crops. The increasing market prices would facilitate the establishment of super market chains, cooperatives, export-oriented schemes, processing zones and general stimulation of agro-industrialization in developing countries.

Ponte (2002) examined the dynamics of coffee-market reforms in three East African countries against the background of restructuring of the global coffee-marketing chain and found that contractual/power relationships in the marketing chain and quality parameters in commodity trade determined the trajectories of domestic market reforms.

Pelupessy (2007) studied the world coffee market and inferred that the occurrence of imbalance between raw material exploitation and final consumption of coffee would not be matched by interventions in individual segments of the coffee chain. Coffee institutions in producing countries had an important role in production of public goods needed to support growers and to adjust and differentiate their products in accordance with the trends of different consumer preferences.

Wollini and Zeller (2007) identified the factors that determine farmers' participation in specialized markets and whether the participation in these markets led to higher prices for farmers in Costa Rican coffee markets. A two-stage model was employed to analyze the farmers' marketing decisions and their effect on the prices received. The results indicated that farmers participating in the specialty coffee segment received higher prices than those using the conventional channels. Additionally, they found that participation in cooperatives had a positive impact on the probability that a farmer chooses to grow specialty coffee.

Angie *et al.* (2012) assessed the socio-economic impact of coffee marketing chains in Peru. The survey was conducted among 60 producers from Villa Rica in Peru, which had several coffee marketing channels namely intermediaries, private companies, cooperatives and associations. A binary logistic model was employed to assess the factors which affected the farmers' choice of marketing channels. The results demonstrated that farmers who received technical assistance participated in marketing organizations and these organizations helped the smallholder farmers through training and knowledge transfers.

Amamo (2014) examined Ethiopia's coffee economy and stated that low quality coffee was supplied to Ethiopian local markets, while price of coffee in the local market was usually higher than export prices. It had seasonal and auction markets with poor fair-trade system. The Ethiopian coffee market system consisted of commodity exchanges, international markets, value chain, small-scale and private owned farms and state firms. Certification and verification schemes were utilized as powerful tools for value addition of Ethiopian coffee to earn better foreign exchange.

Harbig (2017) studied the sustainability of marketing in green coffee markets. The world coffee industry had experienced grave market distortions that have led to economic, ecologic and social problems. The coffee market was characterized by relatively low-price elasticities of supply and demand.

Thanuja and Singh (2017) studied the major marketing channels and marketing margin of coffee in Kodagu district of Karnataka. The marketing channels found were channel-I (producer, commission agent, processing unit and consumer) and channel-II (producer, commission agent and consumer). Channel-II was found to be the best in terms of producer’s share in consumer rupee. The producer’s share in consumer rupee of channel- I and II were 71.27 per cent and 74 per cent respectively. The net margin earned by middlemen was ₹7314.5 per MT in channel-I, while that earned by the processing unit was ₹35703.5 per MT in both channels.

Murtiningrum and Gabrienda (2019) identified and analyzed the coffee marketing channels in Bengkulu province of Indonesia. Among the five coffee marketing channels *viz*., (1) coffee farmers - home industries, 2) farmers - collecting traders- large traders -traders outside the region - exporters, 3) farmers - large traders - exporters, 4) farmers - traders - large inter-regency traders - traders outside the region, 5) farmers - collectors - large district traders - inter-regency traders - exporters), channel-I had the highest marketing efficiency of 98.65 per cent in terms of producer’s share in consumer rupee.

Rao and Rao (2019) studied the marketing of coffee in high altitude zones of Visakhapatnam. The two important marketing channels identified for coffee berries were, channel-I: producer-village trader- girijan cooperative-coffee units- consumer and channel-II: producer- girijan cooperative-coffee units- consumer.

Around 90 per cent of coffee was routed through channel-I. Though the producer's share was high in channel-II, farmers preferred channel I due to the delayed direct payment by girijan cooperative in Channel -II.

2.4 CONSTRAINTS IN COFFEE PRODUCTION

Umadevi *et al*. (2003) studied the constraints in production and marketing of coffee in Visakhapatanam district of Andhra Pradesh. The study revealed that low price in the domestic market, lack of efficient domestic market, unsatisfactory local environment, climatic problems and trade exploitation were the predominant problems existing in the study area.

Belachew (2010) examined the major constraints faced by coffee production sector in Ghana and stated that the lack of an internal marketing system, low and fluctuating coffee prices, low productivity of major varieties grown in the area, lack of efficient extension service by government, poor coffee quality and frequent rejections in international markets, lack of government support in the form of subsidies, inefficient export and domestic policies and, extreme competition from other crops like cocoa were constraining coffee production in Ghana.

Upendranadh (2010) surveyed the small coffee growers in Karnataka and Kerala states to understand the production and marketing constraints of coffee plantations in India. He observed the prime constraints such as labour shortage, high wage rate, plateaued productivity levels, incidence of pests, climate vulnerability and food safety or pesticide residue issues. Among these constraints, labour shortage, high wage rate and climatic vulnerability were found to cause heavy financial loss to coffee growers.

Baruah *et al.* (2014) studied the plantation crops in North Eastern India and sorted out the constraints and strategies for the enhancement of production. They employed various ranking methods to find out the most backward pulling factors among the list of limiting factors. The lack of information and extension system, inefficient processing facilities and lack of modern knowledge in agronomic practices were ranked as the first, second and third backward pulling factors respectively. In addition to this, inadequate training and skill development and ineffective planning strategies were also found to be restricting the development of plantation crops in North Eastern India.

Tolera (2015) studied the opportunities and constraints of coffee production in West Hararghe, Ethiopia by surveying 170 households. The study showed that disease incidence, pest attack, poor access to market information, lack of physical infrastructure, lack of improved coffee varieties and weak extension services were the major constraints for enhancing coffee production as well as productivity.

Ospina (2017) listed out the main challenges faced by coffee producers in France. The major constraints were identified as drastic climatic fluctuations, labour problems due to the poor payment or low wage problems, pest and disease incidence, labour shortage, extreme price fluctuations and unstable income.

Pyk (2017) identified the determinants of performance of fair-trade coffee mechanism in Tanzania and concluded that the lack of financial support from the government and inefficient extension services were the major constraints experienced by Tanzanian coffee growers. In addition to the low yield resulting from the small size of farms, poor infrastructure facilities, instability in credit access and drastic effects of climate change were also found to influence the performance of Tanzanian coffee growers.

Coloumbian Central Statistical Division (CCSD) sorted out various constraints faced by coffee farmers in Coloumbia for ensuring the economic viability and sustainability of coffee production and the major constraints identified were unstable domestic as well as international coffee prices, occurrence of negative climatic events, low labour wage, lengthy market chains and large number of market intermediaries (CCSD, 2019).

Tadesse *et al*., (2020) conducted a study on production constraints in four zones of Southern Ethiopia. The most important constraints identified in coffee production system were biotic factors such as diseases, insect pests, weed species and vertebrate animals, and abiotic factors such as recurrent drought, frost, fluctuating rainfall pattern, high humidity, high temperature, low moisture, hail, storm, wind and reduced soil. These factors caused a yield loss about 70 per cent.

An experiment conducted by Kath *et al., (*2020) reveled that even though the Robusta coffee was considered to be the most heat tolerant coffee, the yield potential of coffee declined by 14 per cent when temperature increased by one per cent.

2.5 PRICE VOLATILITY

Satheesh *et al*. (1988) examined the retail prices of beef, chicken and pork using the Generalized Autoregressive-Conditional Heteroscedasticity (GARCH) model. The estimated results rejected the assumption of constant conditional variance.

Volatility is referred to as the uncertain movement of a random variable over a period of time. Volatility in agricultural commodity prices assumes a lot of significance, since it is associated with major factors affecting the income security of producers and traders through the performance of agriculture (World bank, 1997; FAO, 2011).

Yang *et al*. (2001) studied the impact of the radical, agricultural liberalization policies on the price volatility of agricultural commodities using Generalized Autoregressive Conditional Heteroscedasticity (GARCH) models. The final outcome of the study implied that agricultural liberalization policy had caused an increase in price volatility for three major commodities such as corn, soybean and wheat; a less than proportionate increase in the volatility of oats and a decrease in the volatility of cotton.

A study conducted by Rapsomanikis and Sarris (2006) revealed that price volatility affected the income of producer households and their vulnerability led to poverty and food insecurity. The vulnerability also depends on household diversification pattern and the degree of exposure to market system. The market and non-market uncertainties significantly affected the households specialized in some specific or single commodities due to the higher income variability.

Gemech and Struthers (2007) conducted an experiment to understand the influence of market reform programmes in Ethiopia on the coffee prices and its volatility using the Generalized Autoregressive Conditional Heteroscedasticity (GARCH) model during the period from 1982 to 2001. The study found that Ethiopia had experienced a significant increase in volatility of coffee prices after the implementation of the market-oriented reforms.

Jordaan *et al*. (2007) estimated conditional volatility in the spot prices of yellow, maize, white maize, wheat, soybean and sunflower seed traded on the South African Futures. Exchange. They used GARCH approach because the volatility in the prices of crops had been found to vary over time. The analysis showed that white maize price was found to be the most volatile, followed by yellow maize, sunflower seed, soybean, and wheat respectively.

The impact of price change on farm level decision making was assessed by Mehta (2009). The farm level decisions were found to be much responsive to price changes in high value crops/ plantation crops than the price changes in food grains. The study inferred that the decision on crop shift was not only based on prices but also based on aggregate farm returns.

Gilbert and Morgan (2010) studied price volatility in agricultural commodities and inferred that under-investment in agriculture as well as low commodity inventory levels in recent years were as the major contributory factors of price volatility. The factors such as change in world money supply, change in value of dollars or rupees, climate change, trade policies, price expectations, market responses, speculation in future markets and option trading markets cause price volatility in agricultural and allied commodities and, the commodity driven markets.

Roache (2010) stated that price swings had negative effect on imports, exports, balance of payments, government budget, inflation and poverty status of the economy.

Bourdon (2011) anlysed the agricultural commodity price volatility in the United States. A sharp increase in food and agricultural raw material prices was observed during the years from 2006 to 2008 and a similar trend was also observed in earlier decades. A typical pattern of high price followed by sharp drop in the commodity price in the subsequent year was a common phenomenon that occurred in the US. The statistical analysis suggested that there was no increasing tendency in price volatility over the past 50 years from January 1957 to January 2010. The study also inferred a positive relationship between the prices of crude oil and fertilisers with that of agricultural commodities.

A study by Ibrahim and Bruno (2011) modeled and forecasted volatility in the global commodity prices of wheat, rice, sugar, beef, coffee and groundnut using standard GARCH (1,1) model. They concluded that the volatility in futures prices of wheat, rice, beef and coffee exhibited short memory behavior.

Maurice and Davis (2011) examined the causes of price volatility in world coffee and cocoa markets. The coffee price volatility had uneven or varied impact depending on the nature of the market shocks.

Mustaq *et al.* (2011) examined the volatility in agricultural commodity prices in developing countries and inferred that price volatility of agricultural commodities are determined by high energy costs, high oil prices, weather conditions, exchange rate, monetary interest rates and fertilizer prices which pre-existed and are still existing in the economy.

Worako *et al.* (2011) attempted to quantify the volatility of coffee price in Ethiopia, using ARCH and GARCH methodology by considering producer, wholesale and export prices from October 1981 to September 2006. The GARCH

(1, 1) model was fitted for each price series separately and the results revealed that coffee prices in Ethiopia were more volatile than the prices in Brazil.

Ramdas *et al.* (2013) estimated the degree of price volatility in the spot market of wheat and maize using a GARCH (2,1) model and found that none of the spot prices were volatile, indicating the effectiveness of futures trading. The study also revealed that volatility in the present-day prices was dependent on the volatility in the prices of the previous day.

Sundaramoorthy *et al.* (2014) estimated the volatility persisting in groundnut markets of Hyderabad and Rajkot using GARCH model. The GARCH (1,1) model was selected in both the markets and the study revealed that groundnut prices in Hyderabad exhibited a high and persisting volatility as compared to that in Rajkot. The sum of α and β coefficients of GARCH model for Hyderabad and Rajkot markets were 0.41 and 0.20 respectively.

Paul *et al*. (2015) estimated price volatility of bengal gram in Delhi markets, lentil in Indore markets and rapeseed and mustard oil in Sri Ganganagar markets using the daily spot prices from 1st January 2007 to 31st July 2013. The analyses revealed that the price level of these three commodities had increased over time and showed wide fluctuations.

Sabu (2015) studied the impact of price volatility on black pepper producers of Kerala and inferred that vulnerability to price volatility reduced with factors such as age, education and experience of the farmer. The factors such as family size and income share from black pepper increased their vulnerability to price volatility. The study also stated that factors such as income, savings, borrowing, decision making on land, labour, capital or investment and management practices in black pepper were affected by price volatility.

Beddington *et al.* (2016) studied how food price volatility can be managed. and the study inferred that the sudden changes in the food prices of developing countries increased uncertainties regarding both the production and consumption.

The decline in farmers' price led to sharp fall in income and the rise in consumer price reduced the quantity and quality of food consumed and all these led to poor nutrition status of citizens.

Ulrik *et al*. (2016) studied coffee price volatility and intra-household labour supply in Vietnam using panel data analysis. The households in Vietnam coped with lower coffee price by substituting adult labour in the farm with children and adolescents. The author observed that coffee price volatility had significantly high elastic incidence on the intra household labour supply in Vietnam.

According to Lanna *et al.* (2018), the economies of developing countries or small producer economies were heavily dependent on income generated by coffee production and its trade. Generally, coffee price volatility was extreme when the flowering period coincided with fog in Colombia, Brazil and Vietnam.

2.6 PRICE INTEGRATION AND TRANSMISSION

Indira (1988) determined the relationship between the coffee prices in three major wholesale markets namely Bangalore, Vijayawada and Coimbatore. The prices in Vijayawada and Coimbatore markets showed a positive relationship during the study period. When compared to Vijayawada market, the price of Bangalore market had lesser influence on Coimbatore prices.

Baharumshah and Habibullah (1994) used co-integration.technique.to examine the long run relationship among black pepper prices in six different. Malaysian markets. The co-integration technique was applied to weekly pepper prices for the period from 1986 to 1991. The empirical results of the study showed that regional markets of black pepper in Malaysia were highly.co-integrated and it was also observed that the prices tend.to move homogeneously across spatial markets, which was an indication of the competitive pricing behavior.

Nasurudeen and Subramanian (1995) analyzed the integration of oil and oilseed prices in Bombay market. In castor oil, the assumption of complete price integration could not be fully accepted and the belief of impact of groundnut oil prices on all edible oil prices was also established. The results of the analysis established the hypothesis that changes in oilseed price was related to changes in oil and. oilcake prices.

Phillips and Perron (1998) developed a generalization for Dicky-Fuller procedure that allowed fairly mild assumptions concerning the distribution of the errors. The Phillip and Perron (PP) test, unlike the Augmented Dicky-Fuller (ADF) test, allowed the disturbance to be weakly dependent and heterogeneously distributed and its modification of ADF test statistics that process a restrictive nature of the error process. For further cointegration analysis, Johansen (1988) Maximum Likelihood Estimation instead of Engle and Granger (1987) two step procedure was used with Vector Error Correction Mechanism (VECM).

Rapsomanikis *et al.* (2003) assessed the market integration and price transmission in selected food and cash crops markets in developing countries. The data collected from 16 countries were used to assess the market integration. Auto regressive distributed lag models, error correction models, causality tests and asymmetric transmission models were employed and found that African markets were characterized by more incomplete price transmission compared to Latin American and Asian markets.

Kumar and Sunil (2004) used the Johansen co-integration technique to analyze the efficiency of spot and futures markets for five commodities in six Indian commodity exchanges. They confirmed inefficiency of futures market based on the inability of these markets to fully incorporate information. The results of the analysis concluded that the futures markets of agricultural commodities in India were not yet mature and.efficient.

Krivonos (2005) studied the impact of coffee market reforms on producer prices and transmission of prices on coffee growers in the major coffee producing countries during the late 1980s and early 1990s. Cointegration analysis was used and the results showed that in most of the countries, the long-term producer price share had increased substantially after liberalization. The error correction model

(ECM) revealed that short run price transmission signals from the world market to domestic market had improved and some evidence of transmission of asymmetric change in world price to domestic price was also reported from the study.

Basu (2006) made an attempt to examine potato market integration in Hooghly district of West Bengal using co-integration test. The analysis was framed at two levels, by considering wholesale markets and retail markets. The existence of integration between potato wholesale and retail markets, between wholesale markets and between retail markets were observed throughout the district. These results had important implications in policy formulation and market liberalization programmes framed in India.

A study conducted by Lokare (2007) found that almost all the commodities in Indian commodity markets showed an indication of co-integration, between spot and future prices, enlightening the attainment of improved operational efficiency, though at a slower rate.

Worako and Schalkwyk (2008) examined the producer price and price transmission in deregulated Ethiopian coffee markets. The cointegration analysis and Error Correction Model (ECM) model were employed and found that the short run transmission of price signals from world market to domestic market had improved, but remained weak in both auction to world markets and producer to auction markets. The study concluded that after reforms, domestic coffee prices adjusted rapidly to changes in world prices.

Acharya and Chand (2012) examined the market integration and price transmission of wheat and rice markets in India with special reference to world food crisis of 2007-08. Augmented Dicky-Fuller test and Phillips-Perron test were applied to check the stationarity of the time series data and vector error correction model (VECM) and asymmetric error correction models were employed to examine the cointegration of price in domestic and international markets. The ECM indicated the speed, in which a variable return to its path of long run relationship with another variable. The speed of adjustment depended on whether the variable was subjected to negative or positive shocks. The asymmetric response to deviations from the long run path depended on whether the variable was above or below the long run path. The positive and negative deviations from a simple OLS estimate were incorporated into the VECM as a dummy variable. The study inferred that there was no cointegration between domestic and international rice and wheat prices and observed a general long run equilibrium relationship between domestic rice and wheat markets.

Acharya *et al.* (2012) found that a significant increase in oil prices in the international market directly affected the cost of fertilizers, which led or indirectly caused food price hike of about 205 per cent in the Indian markets during the 2005 -2008 period. The monthly index numbers and domestic prices of both rice and wheat had been almost in the opposite direction despite the global food crisis, which were assessed using Johanson cointegration method. The chances of changes in international prices creeping into the domestic economy depended on several factors *viz*., quality of grains, distance and transportation cost and most importantly, the trade policy wedges.

Kuruvila *et al.* (2012) assessed the transmission of international price volatility to the domestic market of plantation crops using cointegration analysis and causality test. The study found existence of transmission, co-movement and causality of prices between the Indian and international markets in both pre-WTO and post-WTO periods.

Nirmala *et al.* (2015) studied cointegration between the future price and spot price of cardamom to determine whether cardamom future market serves as a price discovery mechanism for spot market prices and vice versa. The study involved the use of econometric tools like Augmented Dickey Fuller (ADF) test, Granger Causality test and co-integration technique for the analysis of data from January 2012 to December 2013. The results of the ADF test revealed that time series data was stationary at first difference and not at levels. The co-integration test showed that cardamom futures and spot prices were co-integrated and it confirmed the long-term relationship between futures and spot price series.

Awasthi *et al*. (2016) studied the market integration and price volatility across soyabean markets in central India (Madhya Pradesh) based on the monthly time series data on prices and arrivals of soybean from five major soyabean markets of Madhya Pradesh namely Ashtha, Dewas, Indore, Mandsaur and Shajapur' for the period from 2001-02 to 2013-14. The stationarity of the series was tested using Augmented Dickey-Fuller test (ADF) which showed that the prices of soybean were non-stationary and became stationary after taking the first difference. The soybean markets in Madhya Pradesh were found to be spatially integrated.

Naveena *et al.* (2016) analyzed the impact of world coffee price on Indian coffee price by considering monthly wholesale prices of Arabica coffee and Robusta coffee from 1999 to 2013. The results of ADF test showed that all the price series were non-stationary at levels, but first differences of the series made the series stationary. Johansen's cointegration test was carried out to find the long run relationship between Indian and world coffee markets and a long run association between prices of Indian arabica and world arabica coffee, as well as between Indian robusta and world robusta coffee prices were established.

Paul *et al.* (2016) studied the price transmission and integration between major markets of pulses in India. The Johansen cointegration and ECM were employed for the analysis. For the major pulses, both wholesale and retail prices exhibited a strong cointegration, while the VECM showed that the disequilibrium in the system got corrected, thus restoring the equilibrium situation.

Ahamed and Singla (2017) studied the market integration and price transmission between major onion markets in India. Johansen cointegration analysis, Granger causality test and impulse response functions were employed to study the cointegration and interdependence of onion markets. The regional markets of onion were strongly cointegrated, that allowed private traders and restricted the role of government interventions. From the impulse response functions, it could be inferred that all the selected markets responded well to shock given in any of the market.

Balakrishnan and Chandran (2018) analyzed the price integration among major coffee consuming centers in India. The VECM was employed to study the degree of spatial market integration and price transmission between the important coffee consuming centres in India using monthly wholesale prices of Arabica coffee. It was found that there was a long run cointegration between Hyderabad and Bangalore markets and other subordinate markets. Co-integration coefficients were found to be positive and significant at one per cent level.

Prices of arabica coffee from January 1973 to March 2017 were used to understand the role of coffee futures market in discovering prices in Latin America. The existence of a stable long run relationship between futures and producer prices was observed and cointegration and co-movement of prices in all the Latin American countries were observed (ICO, 2018).

Saji (2018) studied the characteristics of price transmission between Indian and world natural rubber markets. The author observed a relation between long run integration of Indian rubber price with global price and a higher degree of price integration between domestic and international rubber markets until recession. The rubber price elasticity coefficient was almost halved during the resilient phase, which was partially due to the measured use of low-cost synthetic substitutes to natural rubber. Initiatives like Goods and Service Tax (GST) and demonetization affected the degree of market integration negatively.

2.7 EXPORT PERFORMANCE AND COMPETITIVENESS

Hazel *et al.* (1990) examined the relationship between the world price instability and farm prices in developing countries using post-war data on individual commodity prices. It was found that traditionally the world price for agricultural commodities were unstable and the domestic market arrangements and government interventions were the factors controlling the movement of price in support of producers.

Veena (1992) studied the Indian coffee export and inferred that the price instability was the major factor leading to instability in the total export earnings of Indian coffee and the abolition of international coffee agreements significantly affected price instability.

Selvaraj *et al.* (1999) assessed the protection for various crops in Tamil Nadu using Nominal Protection Coefficient (NPC), Effective Protection Coefficient (EPC), and Domestic Resource Cost Ratio (DRCR) and stated that sugarcane and groundnut were the highly protected commodities, whereas rice and cotton were unprotected commodities.

Balakrishnan (2000) calculated the competitiveness of Indian tea using Nominal Protection Coefficient (NPC) and Domestic resource Cost Ratio (DRCR). The value of NPC below one under importable as well as exportable hypothesis indicated that Indian tea was an effective import substitute. The DRCR value of less than one indicated that the amount spent by the tea growers on production was less than one-rupee equivalent of foreign exchange. Similarly, Indian tea was an effective export commodity as it was competitive in the international market.

Rajesh (2002) found improvement in competitiveness of Indian cardamom export in 2000-2001 as compared to 1999-2000 using NPC. The Gulf countries, Europe and Japan were the traditional major export markets of Indian cardamom, while China and Tanzania were emerging markets for Indian cardamom

Bhalla (2004) studied the competitiveness of Indian agricultural trade in relation with trade liberalization. The study found that the measures such as Nominal Protection Coefficient (NPC), Effective Protection Coefficient (EPC), Effective Subsidy Coefficient (ESC) and Domestic Resource Cost Ratio (DRCR) for most of the Indian agricultural commodities were unfavourable and less competent in nature.

Raju (2008) assessed the export performance and prospects of Indian coffee under liberalized regime and reported that India was one of the largest exporters of coffee and 80 per cent of total production was exported. Indian coffee was exported to more than 40 countries. The Markov chain analysis was assigned to understand the changing direction of Indian coffee exports. NPC, EPC, DRC were used to study competitiveness. The volume of coffee exported have increased after liberalization. Even though the market share of Indian coffee in US markets increased significantly, in all other pre-existing markets it decreased significantly. The estimated NPC, EPC and DRC were average and positive, but less than one in all the observed markets, even though the comparative advantage of Indian coffee enabled India to specialize in coffee production.

Shinoj and Mathur (2008) studied the comparative advantage of India's agricultural exports in the post reform period. India had comparative advantage in tea, spices, cashew and coffee exports even when it was declining over the years. At the same time, India's export of oil meals strengthened over the years in international market. India had negative comparative advantage in the case of fresh fruit and vegetables. The study inferred that trade policy reforms adversely affected the export of tea, cashew and coffee.

Nagoor (2010) stated that the export competitiveness of Indian plantation sector declined over the years due to the increased domestic demand, emergence of low-cost producers like Vietnam, preference of value-added products, logistic problems and high transaction cost.

Bastine *et al.* (2010) estimated the NPC for black pepper in India for the years 2009-10, 2010-11 and 2011-12 as 0.973, 0.966 and 0.899 respectively and found that India was competitive in the exports of black pepper. The '1-EPC' values, though positive were only marginal, indicating the sensitivity of the domestic producers against their foreign competitors. The DRCR values of less than one indicated efficient and internationally competitive production.

Chinappa and Rajashekhar (2012) studied the export performance of Indian coffee and realized that the price realization of coffee depends on the international market as 70 percent of the coffee produced in the country was exported. The author analyzed the performance of coffee exports from India for the period from 1996-97 to 2010-11 and found that Italy was the strong partner with four percent compound annual growth rate. Ukraine and Finland were the small importers and exports to Ukraine and Finland grew at 38 percent and14 percent respectively. The exports to USA, Russian Federation, Germany and Japan declined over the period. The Markov chain analysis indicated that Italy retained 50 percent of the market share of the previous year and Japan, Russian Federation and Germany retained 80 percent, 39 percent and 32 percent respectively. USA, Greece, Spain, Belgium and other countries were not found to be loyal export market destinations for India. The study inferred that the strategies for diversification of India's coffee exports by increasing India's exports to the loyal importers and identification of new markets were the only ways to sustain in the international export market.

Veeramani (2012) analyzed the competitive structure of plantation commodity exports from India and found that major exporters of coffee hold world coffee market power and subordinate mechanisms revolve around these powerful countries. India's export performance in international coffee market made India a powerful decision maker in the system. India was not a passive price taker in the international market and India clearly acted as a capable decision maker who predominantly influenced the international market.

David and Christian (2013) studied the competitiveness and determinants of coffee exports from Ethiopia. The export performance, competitiveness, magnitude and effects of key economic determinants of coffee exports were estimated with the support of Revealed Comparative Advantage (RCA), Revealed Symmetric Comparative Advantage (RSCA) and comparative advantage analysis. The study found positive RCA and RSCA and inferred that Ethiopia had comparative advantage in the export of coffee.

Deepika (2015) examined the export performance and factors affecting export competitiveness of plantation commodities in India. The price preference of Indian coffee in international coffee market was comparatively poor. The poor price performance was a reflection of lower value addition and poor quality of Indian coffee against the competitors in the world coffee market.

According to Gurusamy and Yamakanith (2015), the export performance of Indian coffee was found to be good and could be improved by adding value to the coffee beans at the point of origin and by improving the efficiency of the value chain.

Sharma *et al.* (2016) evaluated the trade competitiveness of Indian coffee through RCA analysis. The author reported that India enjoyed comparative advantage in coffee during the past decade. Several factors were responsible for the distinctiveness and high demand of Indian coffee in the world coffee market. The minor fluctuations in the coffee production were due to the erratic climate change experienced in the Indian subcontinent.

George and Cherian (2017) reported the competitive factor as the most dominant and influential factor in the international spice market. The components of the competitive factor were the international and domestic competitions, speculative practices, government policies and promotional activities.

Naik and Nethrayini (2018) studied the changing direction and magnitude of Indian coffee export in the post liberalization era. The study revealed that barring the year 1997, coffee was perfectly competitive with its NPC value being less than unity till 2000. From 2000 onwards, the domestic price for coffee in India was more competitive than the international price. The Markov chain analysis showed that among the exporting countries, Spain was the least stable importer.

Arul (2019) studied coffee exports from India and stated that the market for fair trade coffee and organic coffee increased in recent years. India showed a positive export performance in Indian coffee, specialized fair-trade coffee and organic coffee in 2018.

Methodology

3. METHODOLOGY

Logical researches which bring out meaningful conclusions need to be carried out methodically and hence for the current study, an appropriate methodology was adopted based on the review of literature. The research methodology and analytical framework of the present research are discussed in this chapter. In brief, the study area, sources and types of data, sampling methodology, data collection methods and tools used for analyses are presented systematically in this chapter.

3.1. Types of data

3.2. Sources of data and period of study

3.3. Sampling design

3.4. Description of the study area

3.5. Tools of analysis

3.1 TYPES OF DATA

The current research is based on both primary and secondary data. Time series data on coffee prices and other relevant secondary data were collected from various organizations to assess the magnitude of price volatility and macro level implications of price volatility, price formation and transmission between Indian and international markets, export performance and export competitiveness of Indian coffee.

The primary data was collected from randomly selected coffee households and market intermediaries in Wayanad district of Kerala state, to estimate the economics of cultivation and marketing and, to assess the micro level implications of price volatility.

3.2 SOURCES OF DATA AND PERIOD OF STUDY

The details of secondary data collected along with the sources and period for which the data were collected are presented here. The major observations were annual and monthly data on Indian and international prices of coffee from 1994-95 to 2019-20, annual data on area, production and productivity of Indian coffee from 1980-81 to 2019-20, annual data on quantity, value and unit value of export and import from India and world from 1980-81 to 2019-20. These data were collected from various sources such as Coffee Board, Directorate of Economics and Statistics, World Integrated Trade Solutions and International Coffee Organization. In addition to these, primary data on costs incurred and others details on production and marketing pertaining to the year 2019-20 were collected from coffee farmers, market intermediaries and exporters in Wayanad district.

3.3 SAMPLING DESIGN

The micro-level study was conducted in Wayanad district. The district was selected purposively for farm level study as the district accounted for 79.87 per cent of the area under coffee cultivation in Kerala during 2019-20. Two blocks in the district with the maximum area under coffee *viz.*, Kalpetta and Sulthan Bathery, were purposively selected for the study. From each of the selected block, two Panchayats *viz.,* Muttil and Meppadi from Kalpetta block and Nenmeni and Ambalavayal from Sulthan Bathery block were randomly selected from the list of coffee growers obtained from the field offices of Coffee Board and Krishi Bhavans. The data on details of the farm households, production, marketing and consumption were collected from 40 coffee growers from each of the panchayat, making a total sample size of 160. The data on trade and marketing aspects were also collected from randomly selected market functionaries *viz.,* seven village traders, three wholesalers, three exporters and two representatives of cooperative societies. Primary data pertaining to the year 2019-20 were collected from 160 coffee households and 15 market intermediaries using pretested interview schedules.

Plate 1 Map of the study area

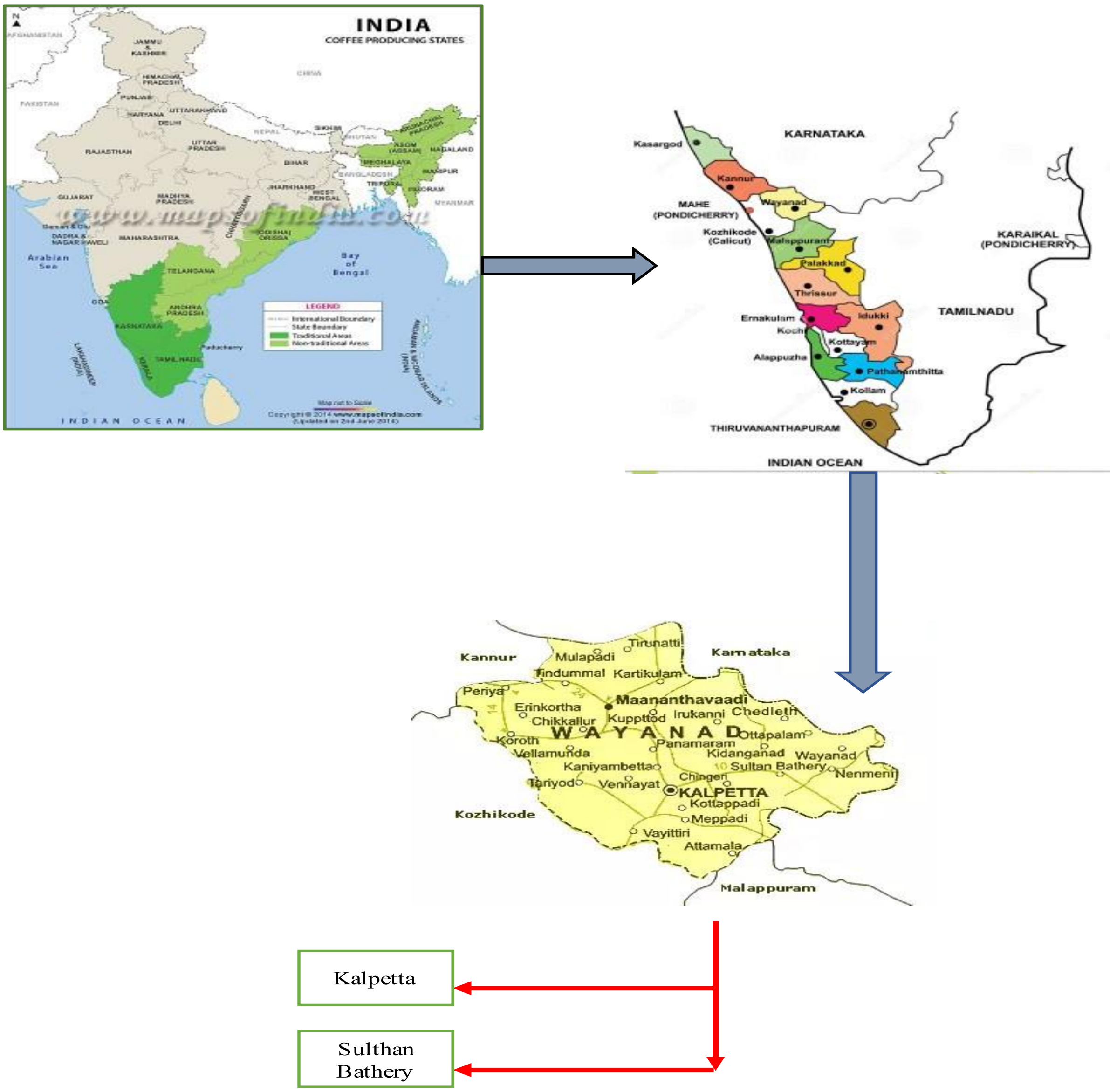


Table 3.1 Distributions of sample farmers in Wayanad district

Sl. No.	Block	Panchayat	Number of farmers	Total sample size
1	Kalpetta	Muttil	40	160
		Meppadi	40	
2	Sulthan Bathery	Ambalavayal	40	
		Nenmeni	40	

3.3.1 Collection of Data

The personal interview method was employed to collect farm-level data from the respondents by using a well-structured and pre-tested interview schedule. The information on the socio-economic profile of the sample farmers and data on input use, input price, production, costs of cultivation/production, price of output, income particulars and marketing aspects were collected from the farm households. The data on marketing cost, margin and related aspects were also collected from the market intermediaries.

3.4 DESCRIPTION OF THE STUDY AREA

The primary level study was conducted in Wayanad district of Kerala state as the district accounted for the largest share in area (79.35%) and production (84.62%) of coffee in Kerala state during the Triennium Ending 2019-20.

3.4.1 Wayanad District

Wayanad, the green paradise and highest foreign exchange earner of Kerala state came into existence on 1st November, 1980 as the 12th district of Kerala (GOK, 2020). The total area of the district is 2130 sq. km, accounting for 5.48 per cent of the total geographical area of the state. Wayanad is a high range district of Kerala with forested hills and plateaus. The district consists of Mananthavady, Sulthan Bathery and Vythiri taluks. The culture of Wayanad is tribal oriented and featured with coffee-based farming system. Agriculture is the principal occupation of the people of this district. The major crops cultivated in the district are paddy, black pepper, coffee, tea, cardamom, banana, coconut and rubber. The Karapuzha irrigation project and Banasurasagar multipurpose irrigation project are providing water for meeting the irrigation requirements of the district. Hill and agricultural products are the major commodities traded in the district. As per 2011 census, the district accounts for 2.45 per cent of the total population of the state and remained as the least populated district in the state.

3.4.1.1 Location

Wayanad district lies between 11^{o}27’ and 11^{o}58’35” of North latitude and 75^{o}47’50” and 76^{o}26’35” of East longitudes. The district is situated on the eastern side of Kerala state. Geographically, the district is bounded in the north by Kodagu district of Karnataka state, in the East by Mysore district of Karnataka state and Nilgiri district of Tamil Nadu state, in South by Nilambur Taluk of Malappuram district and Kozhikode taluk of Kozhikode district and in the west by Quilandy and Vadakara taluks of Kozhikode district and Thalassery taluk of Kannur district.

3.4.1.2 Land utilization pattern

The land utilization pattern of Wayanad district in 2019-20 is presented in Table 3.2. The net area sown in the district was around 53 per cent of the geographical area, while the area sown more than once was 26 per cent of the total geographical area. While forests accounted for 37 per cent of the area in the district, the share of land put to non-agricultural uses was only 5.5 per cent.

3.4.1.3 Topography and climate

Wayanad is a picturesque plateau situated at an altitude between 700 and 2100 meters above mean sea level. According to the topographic classification of Census Organization, Wayanad consists of two sub-micro regions called Wayanad forested hills and Wayanad plateau. Geologically, it is charnockite with forest loam and laterite soil. The region consists of deep valleys, mountains, ravines and terrains with frequent landslides during rainy season.

Table 3.2 Land utilization pattern of Wayanad district in 2019-20

Sl. No.	Particulars	Area (hectares)	Per cent to total geographical area
1	Total geographic area	212966	100
2	Forest	78787	36.99
3	Land put to non-agricultural uses	11722	5.50
4	Barren and uncultivable land	97	0.045
5	Permanent pastures and other grazing land	0	0
6	Land under miscellaneous tree crops	43	0.020
7	Cultivable waste	1095	0.51
8	Fallow land other than current fallow	1246	0.58
9	Current fallow	2437	1.14
10	Marshy land	0	0
11	Still water	4047	1.90
12	Water logged area	19	0.009
13	Social forestry	66	0.03
14	Net sown area	113407	53.25
15	Area sown more than once	55257.09	25.94
16	**Total cropped Area**	**168664**	**79.19**

Source: Agricultural Statistics 2019-20, Directorate of Economics and Statistics, Kerala.

The district is characterized with a pleasant climate. The mean average rainfall of the district is 2322 mm, with a decreasing trend in rainfall over the past ten years. Wayanad consists of high rainfall areas like Lakkidi, Vythiri and Meppadi, which are having an average annual rainfall of 3000-4000 mm. The southwest monsoon in the district is characterized by high velocity winds, while dry winds blow in March-April. The relative humidity of the district becomes as high as 95 per cent during the South-West monsoon. The average temperature of the district ranges between 18^0C and 29^oC.

3.4.1.4 Demographic features

The population of Wayanad district as per 2011 census is 8,17,420 people. The density of population was 384 inhabitants per square kilometer. The district has a sex ratio of 1035 females for every 1000 males. Wayanad, with a literacy rate of 89.32 per cent, has the lowest literacy level in the state. Population in the district is characteristically featured with large tribal population. The tribal population in the district constitutes 18.5 per cent of the district population and 36 per cent of the tribal population in the state. According to 2011 census, the total number of workers in the district was 3,40,077, comprising of 2,63,455 main workers and 76,632 marginal workers. There were 1,01,630 agricultural labourers in the district, out of which 60,593 were male workers and 41,037 were female workers.

3.4.2 Description of the selected Blocks

Kalpetta and Sulthan Bathery were the two blocks having maximum area under coffee in Wayanad district. Kalpetta block had an area of 16,655 ha under coffee, while Sulthan Bathery block was having a coffee area of 9,316 ha. These two blocks were purposively selected for the study.

3.4.2.1 Block-wise distribution of land

The block-wise distribution of area according to the types of land is presented in Table 3.3. As evident from the table, more than 45 per cent of the total land area in Kalpetta block was dry land, where as it was more than 58 per cent in

Sulthan Bathery block. Out of the total land area in Kalpetta and Sulthan Bathery blocks, about 11.15 per cent and 4.11 per cent of the area respectively were under plantation crops.

Table 3.3 Selected Block-wise area according to type of land

Block	Area in Hectares					
	Wetland	**Dry land**	**Poramboke land**	**Forest**	**Others (Plantation)**	**Total**
Kalpetta	18182.67 (12.61)	65054.20 (45.13)	4395.07 (3.04)	40431.71 (28.05)	16071.10 (11.15)	144134.75 (100)
Sulthan Bathery	17068.77 (24.25)	41365.97 (58.77)	4105.36 (5.83)	4937.29 (7.01)	2898.62 (4.11)	70376.01 (100)

Source: Block-Level Statistics, 2011, Wayanad

Note: Figures in parentheses indicate per cent to row total

3.4.2.2 Cropping pattern

The details of the crops cultivated in the selected blocks are presented in Table 3.4. It could be observed from the table that among the crops grown in the selected blocks, coffee, coconut, arecanut and black pepper accounted for the major share in the total cropped area. The area is characterized with homestead farms, especially multiple cropping in coffee or pepper-based homesteads. The major share of the land area was occupied by non-food crops and the major crops cultivated were paddy, coffee, tea, black pepper, arecanut, rubber, coconut, tapioca, banana, ginger and teak.

3.4.3 Description of the selected Panchayats

Ambalavayal and Nenmeni (Sulthan Bathery Block), Muttil and Meppadi (Kalpetta Block) were the four panchayats randomly selected for the study. The panchayat-wise distribution of land area is presented in Table 3.5. As evident from the table, dry land accounted for more than 55 per cent of the total area in all the selected panchayats in both the blocks. More than 80 per cent of the land area in Ambalavayal panchayat is dry land. Among the selected panchayats, Meppadi has the least area under wetland condition.

Table 3.4 Cropping pattern in selected blocks (2019-20)

Crop	**Area in Hectares**	
	Kalpetta	**Sulthan Bathery**
Rice	1138.98 (4.08)	3268.32 (13.13)
Pepper	1532.06 (5.49)	2582.42 (10.37)
Ginger	193.14 (0.69)	914.44 (3.67)
Arecanut	3005.42 (10.76)	3753.95 (15.08)
Banana	2682.12 (9.60)	1723.35 (6.92)
Cashew	34.62 (0.12)	89.40 (0.36)
Tapioca	438.32 (1.57)	350.48 (1.41)
Coconut	2108.83 (7.55)	2624.90 (10.54)
Cocoa	93.70 (0.34)	102.44 (0.41)
Teak	36.53 (0.13)	89.81 (0.36)
Coffee	16655.09 (59.64)	9316.83 (37.42)
Tea	8.94 (0.03)	82.32 (0.33)
Gross cropped area	**27,927.75 (100)**	**24,898.66 (100)**

Note: Figures in parentheses indicate per cent to column totals
Source: Agricultural Statistics 2019-20, Directorate of Economics and Statistics, Kerala.

Table 3.5 Panchayat-wise distribution of land area

Block	**Panchayat**	**Area in Hectares**			
		Wetland	Dry land	Others (Plantation)	Total
Kalpetta	Meppadi	1393.67 (7.84)	10163.57 (57.2)	6198.72 (34.91)	17755.96 (100)
	Muttil	2832.39 (25.90)	7540.74 (68.95)	562.47 (5.14)	10935.6 (100)
Sulthan Bathery	Ambalavayal	2433.36 (16.39)	11887.43 (80.10)	518.29 (3.49)	14839.08 (100)
	Nenmeni	5114.23 (30.94)	10185.95 (61.62)	1227.80 (7.42)	16527.98 (100)

Source: Panchayat- Level Statistics, 2011, Wayanad

Note: Figures in parentheses indicate per cent to row total

3.4.4 Description of the selected coffee households

The sample size consists of 160 coffee growers randomly selected from four panchayts of Kalpetta and Sulthan Bathery blocks. All the farmsteads were having coffee-based farming system. All the selected farmsteads were cultivating only Robusta coffee. Other than coffee, most of the households had coconut and black pepper in their farms. Sample farmers included small, medium and large farmers.

3.5 TOOLS OF ANALYSES

The tools used for analyses in the study are discussed below under different sub-headings:

3.5.1 Economics of coffee production

The present study analyses the economics of coffee production in Kerala. Coffee is a perennial crop and has an economic life span of 30 years, with the yielding phase starting from the fifth year onwards. The first four years of coffee cultivation is considered to be the gestation period or the period incurring higher cost. The traditional tools like cost of cultivation, cost of production, gross returns and net returns were used to understand the economics of coffee production in Kerala. The total establishment cost was also amortised to spread the cost throughout the entire life span of the crop.

3.5.1.1 Cost of cultivation

The cost of cultivation refers to the total expenses incurred in cultivating one hectare of a crop. The cost of cultivation was estimated by classifying costs into two categories *viz*., establishment cost and maintenance cost. The establishment or investment cost includes the expenses incurred during the first four years. It is comprised of the costs incurred for land preparation, digging and filling pits, shade tree planting and planting materials, manures and fertilizers, plant protection chemicals, irrigation, weeding and others during the gestation period or pre-bearing phase.

The expenses on soil works/conservation practices, FYM and other organic manures, fertilizers, plant protection chemicals and various farm operations such as land tilling, pruning, irrigation, mulching, fencing, gap filling, shade regulation, weeding and harvesting in the bearing stage from the fifth year to the end of economic life span of 30 years were categorized separately under the maintenance costs.

In order to calculate the total cost of cultivation, the total establishment cost was amortized to spread it throughout the entire life span of the crop as given below.

$$A_i = [i(1+i)^n]/[(1+i)^n\text{-}1]$$

Where,

i = rate of interest, n = life span of coffee

It was then added to the annual maintenance cost and interest on working capital at seven per cent to arrive at the total cost of cultivation of coffee.

3.5.1.2 Cost of production

The cost of production refers to the cost incurred in producing unit quantity of a commodity or crop during a specified period of time.

$$\text{Cost of production} = \frac{\text{Total cost (Rs per ha per Year)}}{\text{Productivity (Kg per ha per Year)}}$$

3.5.1.3 Gross and net returns

The gross return refers to the total revenue or returns obtained by a farmer before deducting any of the incurred costs, whereas net returns refer to the returns obtained after deducting the cost incurred from the gross returns.

$$\text{Gross returns} = \text{Average yield (kg per ha)} \times \text{Average price (Rs per kg)}$$

$$\text{Net returns} = \text{Gross returns (Rs per ha)} - \text{Total cost (Rs per ha)}$$

3.5.2 Economics of coffee marketing

The economics of coffee marketing was estimated using the methodologies described by Acharya and Agarwal (1987). It includes identifying the marketing channels and the estimation of marketing cost, marketing margin, price spread and marketing efficiency in these channels.

3.5.2.1 Marketing channels

The marketing channel is a path traced in the direct or indirect transfer of the title of a commodity, as it moves from a producer to the ultimate consumer or industrial users. It refers to the chain of intermediaries through whom the commodity is marketed. The structure of coffee market and different marketing channels of coffee in Wayanad district were identified through the primary survey conducted among the sample farmers and different intermediaries. The intermediaries identified in the marketing channels of coffee were village traders, wholesalers, exporters, cooperatives, export agents and retailers.

3.5.2.2 Marketing cost

The marketing costs are the actual expenses incurred in transferring the goods and services from the producer to the consumer. It includes the handling charges, assembling charges, transportation costs and others expenses incurred by the producers and intermediaries in the marketing channel.

Marketing Cost (MC) = $C_p + C_{m1} + C_{m2} + \ldots + C_{mn}$

Where,

C_p = Cost incurred by the producers, and

C_{mi} = Cost incurred by the i^{th} middleman in buying and selling the product.

3.5.2.3 Marketing margin

The marketing margin is the actual/net income obtained by the intermediaries in the marketing process.

Absolute margin of i^{th} middleman (Am_i) = Ps_i - (Pp_i + Cm_i)

Percentage margin of i^{th} middleman (Pm_i) = ((Ps_i - (Pp_i + Cm_i)/ Ps_i) x 100

Where,

Ps = Selling price

Pp = Purchase price

Cm = Marketing cost

3.5.2.4 Price spread

The price spread is defined as the difference between the price paid by consumer and the net price received by the producer for an equivalent quantity of farm produce. The price spread includes the marketing costs and marketing margins and it determines the share of the producer in the consumer rupee. The producer's share in the consumer's rupee was estimated using the formula:

Price spread= (P_F/P_R) x 100

Where,

P_F = Price received by producer

P_R = Retail price

3.5.2.5 Marketing efficiency

The information on marketing costs, marketing margins and price spread were used to estimate the marketing efficiency by using the formula:

Marketing efficiency = (C/M) – 1

Where,

C = Consumer's price

M = Total marketing cost + Total margin

3.5.3 Constraints in coffee production

To identify the major constraints in coffee production, Garret ranking technique was used. The major problems faced by coffee growers in production and marketing were identified through a pilot survey and listed. The respondents were asked to rank the constraints during the survey according to their perception of the severity of the issues. Based on the ranks given by sample respondents, major constraints were identified by using the formula to find out the per cent position as suggested by Garret (Garret and Woodworth, 1969). The formula is expressed in terms of percentage and is given below:

$$\text{Per cent position} = \frac{100(\mathrm{R_{ij}} - 0.5)}{\mathrm{N_j}}$$

$\mathrm{R_{ij}}$ = Rank given for $\mathrm{i^{th}}$factor by $\mathrm{j^{th}}$individual

$\mathrm{N_j}$ = Number of factors ranked by $\mathrm{j^{th}}$individual

Here 0.5 is subtracted from each rank because the rank is an interval on a scale and its midpoint best represents the interval. Then, the percentage positions were transformed into scores on a scale of 100 points by referring to the table given by Garret and Woodworth (1969). From the scores so obtained, the mean scores were derived and the constraints were ranked based on the mean score level.

3.5.4 Volatility of Commodity Prices

The fluctuation in prices is a common phenomenon in the commodity market. When the fluctuations become volatile (unexpected and large), it will have serious effects on the economy (FAO, 2016).

3.5.4.1 Intra-annual volatility

The intra-annual price volatility or within a year fluctuation in monthly prices was measured as the intra-annual standard deviation of changes in log prices (Gilbert, 2010), which was defined as,

$S_{YM} = \sqrt{\frac{1}{11}\sum_{m=1}^{12}(\ln P_{y,m} - \ln P_{y,m-1} - \delta y)^2}$ for year y,

Where $\delta y = \frac{1}{12}(\ln P_{y,12} - P_{y,0})$ is the yth year drift and $P_{y,0}=P_{y-1,12}$

This estimate was scaled on to an annual basis using the factor $\sqrt{12}$ (Parkinson 1980, Garman and Klass 1980).

3.5.4.2 Inter-annual volatility

The inter-annual volatility measure or the scaled inter-annual range is known as the Parkinson's measure. This measure was used to estimate the inter-annual price volatility of monthly prices or between the year fluctuations in monthly prices.

Parkinson's measure is defined as $S_y^p=(\frac{\left(\ln P_y^H - \ln P_y^L\right)}{2\sqrt{\ln 2}})$

Where, $P_y^H = Max_{m-1}^{12} P_{y,m}$, was the highest monthly average price in the year, and $P_y^L = Min_{m-1}^{12} P_{y,m}$, was the lowest monthly average price in the year. These unbiased estimates assume a random walk for the price process.

3.5.4.3 Instability in annual price

The volatility or instability indices were used to examine the extent of fluctuations associated with the annual coffee prices.

3.5.4.3.1 Cuddy-Della Valle Index

The Cuddy-Della Valle Index was used to measure the instability in annual coffee prices (Cuddy and Della Valle. 1978), which was given as,

$\text{Cuddy} - \text{Della Valle Index}(\%) = \text{CV} \times \sqrt{(1 - \overline{\text{R}}^2})$, where CV is the coefficient of variation in per cent and $\overline{\text{R}}^2$ is the coefficient of determination adjusted with degrees of freedom.

3.5.4.3.2 Coppocks Instability Index

The instability in annual coffee prices was also measured using Coppock's Instability Index (CII). It was calculated as the antilog of the square root of the logarithmic variance using the given formula.

$$\text{Coppocks Instability Index} = [(\text{Antilog})\sqrt{[\text{V log} - 1]} \times 100$$

Where,

$$\text{V log} = \frac{1}{N-1}\sum(\log\ P_{t+1} - \log\ P_t - M)^2$$

$$M = \frac{1}{(N-1)}\sum(\log\ P_{t+1} - \log\ P_t)$$

N= Number of years

P= Annual price of coffee

V log= logarithmic variance of price series

A higher value of the CII indicates a higher instability in the prices.

3.5.4.4 Significance of Price volatility - Generalized Autoregressive Conditional Heteroscedasticity (GARCH)

The GARCH models were specifically employed to capture the unexpected price movements, because of its heteroscedastic nature or non-constant conditional variance. These models are well known as the model of non-constant volatility. GARCH (1,1) model (Bollerslev, 1986; Gujarati *et.al*.,2009) is one among the simplest models used to identify the periods of high volatility. This is the widely used tool for dealing with heteroscadastic time series models. After fitting the model, the model adequacy was verified by Akaike Information Criterion (AIC)) and Bayesian Information Criterion (BIC).

GARCH (p, q) model: $\sigma^2_{i.t} = \omega + \sum_{i=1}^{p} \beta_i \sigma^2_{t-1} + \sum_{i=1}^{q} \alpha_i \varepsilon^2_{t-1}$

GARCH (1, 1) model: $Y_{i\,t} = a_0 + b_1 P_{t-1} + b_2 P_{t-2} + \varepsilon_t$; t=1,2,…..,t

$\sigma_{i,t}^2 = \theta + a_i\varepsilon_{i,t}^2 + \beta_i\sigma_{i,t-1}^2$

Where,

P_t = Price in time t

σ_t^2 = Error variance in time t

$\alpha_i + \beta_i$ = Degree of volatility persistence in price series

$\alpha_i + \beta_i \approx$
1, indicates greater the tendency of volatility to persist for longer time

$\alpha_i + \beta_i > 1$, greater tendency to meander away from mean value, which is indicative of an explosive series.

3.5.4.5 Reasons for price volatility

The volatility conditions in the domestic market clearly depend on the market demand and supply of coffee. These market determinants are influenced by weather conditions such as summer showers, frost, temperature and other factors such as domestic production, import, consumption and price of substitute commodity like tea.

3.5.4.5.1 Step-wise linear regression analysis

To understand the reasons or causes of price fluctuation in the coffee market, several models were fitted. The large number of independent variables and occurrence of high multicollinearity with several regression equations, lead to decrease in accuracy and mask the significance of the model. Among the fitted models, a liner regression model with numerically transformed variables was found to be the most appropriate one with a good fit and statistical significance. A step-wise regression was attempted in the study. The price volatility (Coefficient of variation in wholesale prices of coffee) was hypothesized as a function of coffee production in Kerala and India, weather parameters in Wayanad, annual import of coffee and annual consumption of coffee in India. The specified linear regression function is given below:

$Y = b_0 + b_1X_{1t} + b_2X_{2t} + b_3X_{3t} + b_4X_{4t} + b_5X_{5t} + b_6X_{6t} + b_7X_{7t} + b_8X_{8t} + b_9X_{9t} + b_{10}X_{10t} + b_{11}X_{11t} + b_{12}X_{12t} + b_{13}X_{13t} + b_{14}X_{14t} + b_{15}X_{15t} + b_{16}X_{16t} + b_{17}X_{17t} + b_{18}X_{18t}$

$Y =$ Coefficient of Variation of coffee wholesale price

$b_0 =$ Intercept

$b_1 \rightarrow b_{18} =$ Regression coefficients

$X_{1t} =$ Coffee production in India duringt^{th}year

$X_{2t} =$ Coffee production in Wayand during t^{th} year

$X_{3t} =$ Quantity of coffee exported during t^{th}year from India

$X_{4t} =$ Quantity of coffee imported during t^{th}year by India

$X_{5t} =$ Quantity of coffee consumed in India during t^{th}year

$X_{6t} =$ Temperature in first quarter in the study area during t^{th}year

$X_{7t} =$ Temperature in second quarter in the study area during t^{th}year

$X_{8t} =$ Temperature in third quarter in the study area during t^{th}year

$X_{9t} =$ Temperature in fourth quarter in the study area during t^{th}year

$X_{10t} =$ Rainfall in first quarter in the study area during t^{th}year

$X_{11t} =$ Rainfall in second quarter in the study area during t^{th}year

$X_{12t} =$ Rainfall in third quarter in the study area during t^{th}year

$X_{13t} =$ Rainfall in fourth quarter in the study area during t^{th}year

$X_{14t} =$ Relative humidity in first quarter in the study area during t^{th}year

X_{15t} = Relative humidity in second quarter in the study area during t^{th}year

X_{16t} = Relative humidity in third quarter in the study area during t^{th}year

X_{17t} = Relative humidity in fourth quarter in the study area during t^{th}year

X_{18t} = Average exchange rate of Indian rupee against US Dollar during t^{th}year

first quarter(Q_1) = January − March

Second quarter(Q_2) = April − June

Third quarter(Q_3) = July − September

Fourth quarter(Q_4) = October − December

3.5.4.5 Micro level implication of price volatility

The farm level factors affected by the changes in farm gate prices were land area, replanting, management practices, labour hours, capital/investment, savings, borrowings and income. The farm level decision on each of these factors are related with changes in prices (Sabu, S.,2014). The micro level implication of price volatility of coffee on farm households were determined with the support of primary data gathered from coffee households by giving four different hypothetical price situations (P_1 (50 per cent increase in price), P_2 (25 per cent increase in price), P_3 (50 per cent decrease in price) and P_4 (25 per cent decrease in price). The data obtained were analyzed using tabular and percentage analyses and meaningful conclusions were drawn.

3.5.4.5.1 Percentage and tabular analyses

The percentage and tabular analyses were employed to understand the socio-economic characteristics of 160 randomly selected coffee households and also to identify the micro-level implications of price volatility on these farm households.

3.5.5 Price formation, direction and transmission

The price formation of a commodity in a market is the result of various economic, political, physical and social processes and also from its relation with other commodities or markets. The price transmission between two spatially separated markets is defined as a situation where changes in one price are completely and instantaneously transmitted to the other price (Rapsomanikis *et al*., 2003). The price formation or determination and the extent and, direction of price transmission between Indian and International markets were studied using pair-wise and multiple cointegration analysis, Error Correction Model and causality tests.

The term market integration is defined as the relationship between prices existing in spatially separated markets or similar patterned price movement of related commodities over a longer period of time. Market integration implies that markets operate as a single market system (Barrett, 2001).

3.5.5.1 Cointegration analysis

The integration between two spatially separated markets was empirically evaluated by pair-wise or multiple cointegration analysis. The Maximum Likelihood (ML) method of cointegration developed by Johansen (1988), later modified by Johansen and Juselius (1990), was employed to examine whether the domestic and international markets were linked together into a single economic market. This method treats all the variables as explicitly endogenous and allows to test for multiple co-integrating vectors. Cointegration denotes long run interdependence between markets. This long run relationship is given as:

$$P_{1t} = \alpha_0 + \alpha_1 P_{2t} + \varepsilon_t$$

P_{1t} = Price of coffee in market 1 at time t

P_{2t} = Price of coffee in market 2 at time t

ε_t = Error term, Independently and identically distributed (iid)

If P_{1t} and P_{2t} are stationary variables, then the test of market integration is straightforward. Hence, it is important to check whether the variables are stationary or not.

3.5.5.1.1 Testing stationarity

The appropriateness of a model is tested based on the time series characteristics. Testing the characteristics of time series data involves test for integration or stationarity test. Dickey Fuller (DF) and Augmented Dickey Fuller (ADF) unit root tests were the most widely used tests for checking stationarity. The ADF test is the improved version of simple DF test. ADF test is augmented by adding lagged values of the first difference of the dependent variable, which is required to account for possible occurrence of autocorrelation. The ADF test was employed to check the stationarity. The ADF test was run with the following hypothesis and equations:

$\mathrm{H_0}: \delta = 0$; signifying unit root, time series is nonstationary

$\mathrm{H_1}: \delta < 0$; signifying that the time series is stationary

$$\Delta P_t = \beta_1 + \delta P_{t-1} + \beta_2 t + \alpha_i \sum_{i=1}^{P} \Delta P_{t-i} + \varepsilon_t$$

Where,

ΔP_t (first difference) $= P_t - P_{t-1}$

ΔP_{t-I} (i^{th} difference) $= P_{t-i} - P_{t-i-1}$

P_t = Price at time t

ε_t = Gaussian white noise

ADF test indicates whether the time series is integrated or not.

3.5.5.1.2 Johansen's cointegration test

After establishing the stationarity of the series, the test for the number of cointegrating relationships is carried out. When there are two (pair) or more than two (multiple) series of variables, the most popular method used is the vector autoregression (VAR) framework using the Johansen Maximum likelihood procedure.

Johansen Maximum likelihood procedure (Johansen and Juselius, 1990), is based on canonical correlations that provides two likelihood ratio (LR) tests. In the specified VAR model (Johansen Maximum likelihood method), all the variables are treated as endogenous, and the cointegrated system is expressed as:

$$P_t = \mu + A_1 P_{t-1} + \cdots\cdots\cdots + A_i P_{t-i} + \varepsilon_t$$

Where,

P_t, is an n × 1 vector of variables that are integrated of order one (I (1)) and ε_t is an n × 1 vector of error terms.

$$\Delta P_t = \mu + \Pi_k P_{t-1} + \sum_{k=1}^{i-1} \acute{\Gamma}_k \Delta P_{t-k} + \varepsilon_t$$

Where,

$$\Pi = \sum_{k=1}^{i} A_k - I, \qquad \acute{\Gamma}_k = -\sum_{j=k+1}^{i} A_j$$

Here, ΔP_t and ΔP_{t-I} variables are I (0). As the equation get balanced when Π P_{t-j} is 1(0), Π matrix is considered to convey information on the long run relationship between the variables in P_t. The number of co-integrating vectors is determined by the rank of Π, which determines the number of linear combinations of P_t which are to be stationary. When 0< rank (Π) = k<n, and there exists n x k matrices ά and β such that $\Pi = \alpha\beta'$, then it indicates k co-integrating relations. The property of co-integrating vector β is that even if P_t itself is non-stationary, βP_t tends to be stationary. The ά matrix, which represents the speed of adjustment parameters, indicates the strength of co-integrating vectors in the ECM.

Johansen proposed two different likelihood ratios. The first one, the trace test, examines the hypothesis that there are utmost 'r' cointegrating vectors, and the second test, *viz*., the maximum eigen value test, tests the null hypothesis that there are ‘r’ cointegrating vectors against the alternative hypothesis that there are ‘r+1’ cointegrating vectors.

Trace test (J_{trace}) $= -T \sum_{i=r+1}^{n} \ln(1-\lambda_i)$

Maximum Eigen value test (J_{max}) $= -T \ln(1-\lambda_{r+1})$

$T =$ Sample size, $\lambda_i = i^{th}$ largest canonical correlation,

$r =$ number of cointegrating vectors

The rank of Π can be obtained by using trace test or maximum eigen value test. This rank indicates the number of cointegrating vectors and a higher rank implies greater strength and stability of price linkages.

3.5.5.1.3 Vector Error Correction Model

A vector error correction (VEC) model is a restricted VAR that has cointegration restrictions built into the specifications, so that it is designed to use with nonstationary series that are known to be cointegrated. The VEC specification restricts the long run behavior of the endogenous variables to converge to their cointegrating relationships, while allowing a wide range of short run dynamics. The cointegration term is known as the error correction term since the deviation from long run equilibrium is corrected gradually through a series of partial short run adjustments. Or simply, VECM allows estimating how the variables adjust their short run disequilibrium or deviations towards the long run equilibrium.

$$\Delta P_t = \mu + \Pi_k P_{t-1} + \sum_{k=1}^{i-1} \acute{\Gamma}_k \Delta P_{t-k} + \varepsilon_t$$

Π: Information on long run adjustment to change in P_t,

$\acute{\Gamma}$: Information on short run adjustment to change in P_t

$\Pi = \alpha\beta'$, $\alpha =$ Speed of adjustment

$\beta' =$ Matrix of long run coefficients

$\Pi = \sum_{k=1}^{i} A_k - I, \qquad \acute{\Gamma}_k = -\sum_{j=k+1}^{i} A_j$

3.5.5.4 Granger Causality Test

The Granger causality test provides evidence for the presence and direction of price transmission between two price series. If two markets are integrated, then price in one market is commonly found to granger cause the price in other market or vice versa. The causation of P_1 on P_2 and vice versa is given below:

$$P_{1t} = \sum_{i=1}^{n} \alpha_i P_{2t-i} + \sum_{j=1}^{n} \beta_j P_{1t-j} + \varepsilon_{1t}$$

$$P_{2t} = \sum_{i=1}^{n} \gamma_i P_{1t-i} + \sum_{j=1}^{n} \lambda_j P_{2t-j} + \varepsilon_{2t}$$

P_2 does not 'Granger cause' P_1 if, and only if $\alpha_i = 0$, for all i

P_1 does not 'Granger cause' P_2 if, and only if $\gamma_i = 0$, for all i

If the lagged terms (P_{2t-i}, P_{1t-i}) have significant non-zero coefficients (α_i, γ_i), then there is causality.

3.5.6 Export performance

3.5.6.1 Analysis of growth in exports-Compound Annual Growth Rate

The growth rates measure the performance of economic variables in relation with the previous years. The exponential growth model (Gujarati and Sangeetha, 2007) was utilized to study the trend in export of coffee from India during the period from 1980-81to 2019-20. The Compound Annual Growth Rates (CAGRs) of export in terms of quantity, value and unit value were estimated as follows,

$$E = ab^t e_t \qquad \leftrightarrow \qquad \ln E = \ln a + t \ln b$$

Where,

$E =$ Variable for which growth rate is to be estimated

$a =$ Intercept $\qquad b =$ regression coefficient

t = Time variable $\qquad$ e = Error term

$$\text{Compound growth rate } (r) = ((\text{Anti} \ln b) - 1)) \times 100$$

$$\text{t statistics (significance)} = r/SE(r)$$

Where,

$$SE(r) = [100b \times SE(\ln b)]/\ln e$$

3.5.6.2 Analysis of instability in exports-Coppock's Instability Index

The instability in exports causes serious consequences to the economy as well as the economic development of a country. The instability in export of Indian coffee from 1980-81 to 2019-20 was assessed using Coppock's instability index (CII) (Coppock, 1962). A higher CII implies a higher instability. The formula for CII is given as:

$$\text{Coppock's instability index} = \text{Antilog}\sqrt{V\log - 1} \times 100$$

$$V\log = \frac{1}{N-1}\sum(\log x_{t+1} - \log x_t - M)^2$$

Where,

X_t = Value or quantity of exports in year t

N = Number of years considered

M = Arithmetic mean of the difference between the logs of X_t and X_{t+1}

V log = Logarithmic variance of the export

3.5.6.3 Decomposition of sources of growth and variability in exports

In the study, Hazell's decomposition model (Hazell, 1982) was employed to find out the sources of growth and variability in export of coffee from India. The mentioned decomposition model is as follows:

The average export value (EV) is decomposed as,

$$E(EV_I) = \bar{Q}_I\bar{P}_I + Cov(\bar{Q}_I, \bar{P}_I)$$

$$E(EV_{II}) = \bar{Q}_{II}\bar{P}_{II} + Cov(\bar{Q}_{II}, \bar{P}_{II}) \quad , \quad \bar{Q}_{II} = \bar{Q}_I + \Delta\bar{Q} \quad , \quad \bar{P}_{II} = \bar{P}_I + \Delta\bar{P}$$

$$E(EV_{II}) = (\bar{Q}_I + \Delta\bar{Q})(\bar{P}_I + \Delta\bar{P}) + Cov(Q_I P_I) + \Delta Cov(Q, P)$$

$$\Delta E(EV) = E(EV_{II}) - E(EV_I)$$

Export Value (EV) = $\bar{Q}_I\Delta\bar{P} + \bar{P}_I\Delta\bar{Q} + \Delta\bar{Q}\Delta\bar{P} + \Delta Cov\ (Q, P)$

Where,

$\bar{Q}_I$= Average export quantity of coffee in first period,

$\bar{Q}_{II}$= Average export quantity of coffee in second period.

$\bar{P}_I$ = Average unit value of export in first period,

$\bar{P}_{II}$= Average unit value of export in second period,

$\Delta\bar{Q}$= Change in export quantity ($\bar{Q}_{II} - \bar{Q}_I$), and

$\Delta\bar{P}$= Change in unit value of export ($\bar{P}_{II} - \bar{P}_I$).

The various components of the change in average value of export were estimated as shown in Table 3.6.

Table 3.6 Components of change in export value of coffee

Source of change in export		
Description	**Symbol**	**Components of change**
Change in mean export unit value	$\Delta\bar{P}$	$\bar{Q}_I\Delta\bar{P}$
Change in mean export quantity	$\Delta\bar{Q}$	$\bar{P}_I\Delta\bar{Q}$
Interaction between change in mean quantity and mean unit value	$\Delta\bar{P}.\Delta\bar{Q}$	$\Delta\bar{Q}\Delta\bar{P}$
Change in quantity - unit value covariance	$\Delta Cov\ (Q, P)$	$\Delta Cov\ (Q, P)$

There are four sources of change in value of exports between two periods. $\Delta\bar{P}$ and $\Delta\bar{Q}$ are the changes in the export unit value and export quantity. They are the pure effects and arise even in the absence of any other changes. $(\Delta\overline{P}.\Delta\overline{Q})$ is the interaction effect, which is due to the occurrence of changes in quantity and unit value of export simultaneously. The term $\Delta\,\mathrm{Cov}(Q,P)$ indicates the changes in variability of export value due to changes in the correlation between export quantity and unit value.

3.5.6.4 Analysis of degree of geographical concentration of export

The Hirschman Index (Mikic and Gilbert, 2007) is an export diversification indicator, which indicates the degree of geographical concentration of export. The increased geographic concentration increases the instability and thereby the increases the risks in export earnings. The HI was used to measure the geographic concentration in the export of Indian coffee.

Hirschman Index, HI = $100\sqrt{\sum_{i=1}^{n}(X_{it}/X_t)^2}$

Where,

X_{it} = the value of coffee export from India in year t to the i^{th} market,

X_t = the total value of export of coffee from India in year t and

n = number of countries importing coffee from India.

The maximum value of the index is 100, which is obtained when the country exports to only one market. A lower value of HI indicates larger number of export markets and hence, lower will be the risk.

3.5.6.5 Analysis of structural change in exports

The Markov-chain analysis is employed to examine the structural change in any system in which the progress through time can be measured in terms of a single outcome variable (Dent, 1967). In the present study, the dynamic nature of trade patterns, i.e, the stable markets, gains and losses of international markets by Indian coffee were examined using the Markov chain model. The analysis involves the estimation of the transition probability matrix 'P', whose elements P_{ij} implies the probability of export shifting from country i to country j over a period of time. The diagonal elements in the transition probability matrix indicate the probability of retaining the export share of a country, and thus it helps to identify the loyal importers of a particular country's commodity export (Atkin and Blandford, 1982).

In this study, the structural change was treated as random process and average export of coffee from India to importing countries in any period was assumed to depend only on the export in the previous period and this dependence was same among all the periods. This is algebraically expressed below as:

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

Where,

E_{jt} = Export of coffee from India to j^{th} country during the year t

E_{it-1} = Export of coffee from India to i^{th} country during the year t-1

P_{ij} = The probability of shift in coffee export from i^{th} country to j^{th} country

e_{jt} = Error term and

r = Total number of countries importing coffee from India

The transition probabilities (P_{ij}) is arranged in a (c x r) matrix and it has the following properties

$$\sum_{i=1}^{r} Pij = 1 \text{ and } \quad 0 \leq P_{ij} \leq 1$$

The share in exports expected from each country in any particular period t was estimated by multiplying the transition probability matrix with the exports to that country in the previous time period (t-1). The probability matrix was estimated for the period 1980-81to 2019-20.

The Linear programming (LP) framework was employed to estimate the transition probability matrix by using a method referred to as the minimisation of Mean Absolute Deviation (MAD).

3.5.7 Export competitiveness

The trade competitiveness is a dynamic phenomenon, which depends upon the changes in international and domestic prices, demand and supply of commodities and market conditions. The trade competitiveness basically depends upon the level of the domestic price relative to the international price. The export competitiveness can be measured by comparing domestic prices with international prices expressed in terms of freight, transport and related costs involved in taking the produce from the exporting country to the importing country. If domestic price of any commodity is lower than the net export price, then the commodity is export competitive, otherwise it is not export competitive. There are several global competitiveness indices available to measure export competitiveness. Among these indices, Nominal Protection Coefficient (NPC) was used in this study.

3.5.7.1 Nominal Protection Coefficient (NPC)

The NPC indicates the export competitiveness of a commodity and measures the degree of protection provided to the commodity domestically. In the computation of NPC, wholesale price was considered as the domestic price, while the world price was represented by the international price of the commodity adjusted for the costs incurred in transportation, marketing and processing. The Nominal Protection Coefficient of the i^{th} commodity is calculated as,

$$NPC_i = P_i^d / P_i^w$$

Where,
P^d = Domestic price
P^w = World reference price, adjusted for transportation, handling and marketing expenses

A value of greater than one for the NPC indicates the prevalence of domestic protection to the commodity when compared to the situation of free trade, while a value of less than one indicates that the commodity is not protected. When the domestic price of a commodity is equal to its border price (CIF or FOB), the value of NPC tends to be equal to one. The NPC examines the competitiveness of a commodity from the trader's point of view, as the production aspects are taken into account while calculating this competitiveness index (Datta *et al*., 2001).

Results and discussion

4. RESULTS AND DISCUSSION

The present study was carried out within the framework of the defined objectives and specified methodologies. The overall objective of the research was to study the coffee economy of Kerala. The micro level study was carried out in Wayanad district of Kerala. The macrolevel-secondary data-based study was carried out using price data in Indian and international coffee markets. The systematic models and methods mentioned in the methodology were employed to derive the empirical results. The results obtained from the study are presented and discussed in this chapter, with the support of previous findings. This chapter is organized under the following sub-headings.

4.1 Socio-economic profile of sample farmers

4.2 Economics of production and marketing of coffee

4.3 Constraints in production of coffee

4.4 Micro level implications of price volatility

4.5 Magnitude of price volatility

4.6 Determinants of price volatility

4.7 Behavior, integration and transmission of coffee prices

4.8 Export performance and competitiveness of Indian coffee

4.1 SOCIO-ECONOMIC PROFILE OF SAMPLE FARMERS

Farmers are the basic component of any civilization (Thrall *et.al*, 2010) and hence, the present discussion also begins with the farmers. The small coffee growers are the backbone of coffee cultivation in India (Girippa, 1995). The micro level study was conducted in Wayanad, the coffee capital of Kerala, by conducting a primary survey of 160 coffee farmers. This section is intended to draw basic understanding about the socio-economic characteristics of the sample coffee farmers from Kerala. The sample farmers were purposively selected from two blocks (Kalpetta and Sulthan Bathery) of Wayanad district, as these blocks had the highest area under coffee cultivation and all the selected coffee farmers were cultivating only Robusta coffee in their farmsteads.

4.1.1 Age

When farmers age and gain experience, he or she may become more productive with enhanced managerial ability (Tauer,1995). The FAO (2014) conceptualized rural youth as the future of food security and hence, the age has a significant role in farming. The sample coffee growers were stratified into five groups based on their age and are presented in Table 4.1.

Table 4.1 Age-wise distribution of sample respondents

Age (years)/ Block	**Kalpetta Block**	**Sulthan Bathery Block**	**Total sample**
30-39	2 (3)	1 (1)	3 (2)
40-49	16 (20)	6 (8)	22 (14)
50-59	31 (39)	41 (51)	72 (45)
60-69	20 (25)	26 (33)	46 (29)
>69	11 (14)	6 (8)	17 (11)
Total	80 (100)	80 (100)	160 (100)

Note: Figure in parentheses indicate per cent to column total

It is evident from the table that majority of the coffee growers in both the blocks were aged above 50 years. In Kalpetta block, 78 per cent of the sample respondents were in the categories above 50 years, while in Sulthan Bathery block, 92 per cent of the 80 sample farmers were aged above fifty years. As per the national youth policy (2014), youth is defined as those aged between 15 and 29. It could be observed from the table that none of the sample farmers were aged less than 30 years. It indicates the reluctance of youth towards farming, specifically to coffee farming. The lack of enthusiasm among youth in taking up farming as a profession is considered as the major problem confronting the agricultural sector in Kerala state (Sabu, 2015). Findings of the current study are also in-line with the observations of Sabu (2015) and the mentioned pattern of reluctance towards agriculture is also reflected in coffee farming in the state.

4.1.2 Gender

Most often, gender is represented by a dichotomous variable with the possible responses of woman/man or female/male, although gender is not a binary variable (Anna *et.al*, 2020). In this study, sample respondents were categorized into three groups *viz.,* male, female and others. The gender-wise classification of the sample farmers are presented in Table 4.2.

Table 4.2 Gender-wise distribution of sample respondents

Gender/Block	**Kalpetta Block**	**Sulthan Bathery Block**	**Total sample**
Male	69 (86)	72 (90)	141 (88)
Female	11 (14)	8 (10)	19 (12)
Others	0 (0)	0 (0)	0 (0)
Total	80 (100)	80 (100)	160 (100)

Note: Figure in parentheses indicate per cent to column total

From the above table it is evident that 88 per cent of the sample coffee farmers were males. Even though 12 per cent of the respondents were females, few of them were cultivating coffee in the real sense because though the ownership of the land was with them, cultivation activities were carried out by males in the family. These facts agree with the findings of Farnworth *et.al*., (2016) regarding the existence of gender-gap in agriculture. The unequal access of females to key agricultural activities contribute to the persistence of this gap.

4.1.3 Education

UNESCO (2001) stated that the basic education has strong influence on agricultural productivity. Even though most of the farmers in India are illiterate

(Srisha *et.al*.,2016), the state of Kerala is the most literate state in India with a literacy rate of 96.2 per cent. In the case of Wayanad district, 89.32 per cent of the population was literate (PIB, 2020). The educational status of the sample respondents is presented in Table 4.3.

Table 4.3 Educational status of sample respondents

Education/Block	**Kalpetta Block**	**Sulthan Bathery Block**	**Total sample**
Primary	14 (18)	26 (33)	40 (25)
Upper Primary	27 (34)	16 (20)	43 (26)
High school and Higher secondary	23 (29)	29 (36)	52 (33)
Degree	13 (16)	8 (10)	21 (13)
Professional degree	2 (3)	1 (1)	3 (2)
Post-graduation	1 (1)	0 (0)	1 (1)
Total	80 (100)	80 (100)	160 (100)

Note: Figure in parentheses indicate per cent to column total

It could be observed from the table that all the sample respondents were literate and 33 per cent of the farmers were in the high school and higher secondary category. Among the six categories, 25 per cent respondents had education above or up to degree level. Education has greater power to impart social and economic development in farming community through technology adaption and upgradations (Gohain, 2017). This impact of education was quite visible during the field level survey and it was found that some of the educated coffee farmers were practicing multi-grafting in coffee plants for better productivity and quality. Some of the farmers were practising efficient irrigation practices like drip and sprinkler irrigation and were also undertaking soil testing before fertilization and replanting. Most of the farmers followed guidelines from Coffee Board, and Department of Agriculture and Farmers Welfare while undertaking cultivation practices like mixed farming and also for availing various subsides for their farming activities. It could be concluded that education had positive implications on farming.

4.1.4 Experience in farming

The productivity of the farmer and knowledge on farming increase with years of experience. The knowledge derived from experience persistently contribute to the overall productivity (Tauer, 1995). Farming experience of sample coffee farmers are summarized and presented in Table 4.4.

Table 4.4 Distribution of sample farmers according to farming experience

Years of experience/ Block	Kalpetta Block	Sulthan Bathery Block	Total sample
<20	8 (10)	13 (16)	21 (13)
20-30	29 (36)	22 (28)	51 (32)
>30	43 (54)	45 (56)	88 (55)
Total	80 (100)	80 (100)	160 (100)

Note: Figure in parentheses indicate per cent to column total

The respondents were divided into three categories based on years of experience. It could be observed that 55 per cent of the sample farmers had more than 30 years of farming experience. Out of the 160 sample respondents, only 13 per cent had less than 20 years of farming experience. From the field visit it was understood that even though ageing creates physical difficulties to farmers, their farming experience helped them to obtain profitable level of output. In addition, experience in farming provide expertise to farmers for experimenting innovative activities in the farm.

4.1.5 Occupation

In 2020, 41 per cent of the population in India were occupied in the agriculture sector (MoAFW, 2020). In Wayanad district, 15.51 per cent of the population were engaged in agriculture as cultivators (Census, 2011). The distribution of respondents based on their primary occupation is presented in Table 4.5.

Table 4.5 Distribution of sample respondents based on their occupation

Occupation/Block	**Kalpetta Block**	**Sulthan Bathery Block**	**Total sample**
Agriculture	54 (67)	61 (76)	115 (72)
Public sector	2 (3)	1 (1)	3 (2)
Aided/Semi governmental	5 (6)	3 (4)	8 (5)
Private sector	8 (10)	10 (13)	18 (11)
Self employed	11 (14)	5 (6)	16 (10)
Total	80 (100)	80 (100)	160 (100)

Note: Figure in parentheses indicate per cent to column total

Among the five categories of occupation, 72 per cent of the respondents were cultivators and the remaining 28 per cent of the respondents were engaging in agriculture as their secondary occupation. Out of the 160 respondents, 10 per cent were self-employed and majority of them worked as market intermediaries like wholesalers, retailers and commission agents in agricultural markets. Only two per cent of the respondents had primary occupation in the public sector. In line with the occupational trend at the national level, majority of the respondents in the study area also relied on agriculture as their primary occupation.

4.1.6 Land holding pattern

The small and marginal holdings (less than 2 ha) constituted 86.21 per cent of the total agricultural land holdings in India and Kerala had the lowest average operational land holding size of 0.18 hectares (Krishnan, 2018). More than 90 per cent of the Wayanadan coffee farmers were marginal or small land holders (Joy, 2004). The distribution of coffee farmers based on the size of their operational holdings is presented in Table 4.6.

Table 4.6 Distribution of sample respondents according to size of landholding

Size of land holding/Block (Area in hectares)	Kalpetta Block	Sulthan Bathery Block	Total sample
<1	33 (41)	29 (36)	62 (38)
1-2	13 (16)	16 (20)	29 (18)
2-3	6 (8)	11 (14)	17 (11)
3-4	12 (15)	15 (19)	27 (17)
4-5	9 (11)	5 (6)	14 (9)
>5	7 (9)	4 (5)	11 (7)
Total	80 (100)	80 (100)	160 (100)

Note: Figure in parentheses indicate per cent to column total

As per the categorization by the Government of India, farmers with land holding of less than one hectare are marginal farmers, one to two hectares are small farmers, two to four hectares are medium farmers and more than four hectares are large farmers (PIB,2019). It could be observed from the table that 93 per cent of the sample coffee growers had a land area of less than five hectares. Out of the 160 farmers, 57 per cent had holdings of less than two hectares. Hence, it could be concluded that the sample consisted of 38 per cent of marginal farmers, 18 per cent of small farmers, 17 per cent of medium farmers and 16 per cent of large farmers. The average size of coffee landholdings of the selected respondents was 3.21 acre and all the farmers were commercially cultivating Robusta coffee in their farms. The common Robusta varieties grown in study area were S.274 and CxR.

4.1.7 Annual income

The annual income of the respondents was estimated by accounting income from all the sources during a period of one year. Majority of the sample respondents were cultivators by primary occupation and hence the major share of their income was from agriculture. As most of the farmers were following mixed cropping, the income generated from various crops were summed up with other incomes and categorized under five classes. The distribution of sample respondents in five categories of income are presented in Table 4.7.

The table reveals that 56 per cent of the sample respondents received an average annual income of ₹3-5 lakhs during the previous crop year. Among the respondents, three per cent received an average annual income of more than ₹9 lakhs during the last crop year from various crops and business activities, while 22 per cent of the respondents received less than ₹3 lakhs as their average annual income.

Table 4.7 Distribution of sample respondents based on their annual income

Annual income (₹)/Block	**Kalpetta Block**	**Sulthan Bathery Block**	**Total Sample**
<300000	13 (16)	21 (26)	34 (22)
300001-500000	48 (60)	42 (52)	90 (56)
500001-700000	15 (19)	11 (14)	26 (16)
700001-900000	3 (4)	2 (3)	5 (3)
>900001	1 (1)	4 (5)	5 (3)
Total	80 (100)	80 (100)	160 (100)

Note: Figure in parentheses indicate per cent to column total

4.2 ECONOMICS OF PRODUCTION AND MARKETING OF COFFEE

4.2.1 Economics of coffee cultivation

The cost of production and cultivation of coffee in Kerala were computed by considering the establishment and maintenance costs separately. The economic life span of coffee is 30 years and the yielding phase begins from the fourth year. Therefore, in the present study, the sample farmers were categorized based on the age of the crop in their fields. The categorization based on the age of the crop were as follows: (i) Establishment phase (1st to 4th year), (ii) Yield increasing phase (5th

Plate 2 Discussion with coffee farmers

Note: Discussion with innovative farmer award winner Mr. A P Paulose

Note: Discussion with Mr. Krishnan Nair -Cultivating three varieties of coffee

Plate 3 Discussion with coffee farmers

Note: Mr.E A Devasia Erath with his multi-grafted coffee plant

Note: Mr. Sadanandan V C with his 28-year-old coffee plant to 9th year), (iii) Yield stabilizing phase (10th to 25th year), and (iv) Yield declining phase (26th to 30th year). Based on the age of the crop, four respondents were in establishment phase, 47 respondents were in yield increasing phase, 105 respondents were in yield stabilizing phase and 13 respondents were in yield declining phase. 9 respondents had crop in two different age categories, they were included in both the age groups. The establishment cost is the sum of the expenses incurred during the first four years of planting of coffee and its management. It includes the expenditure on land preparation, digging and filling of pits, planting materials, shade management, manures and fertilizers, plant protection chemicals, initial irrigation and weeding, pruning and land tilling activities.

The maintenance cost was estimated from the fifth year onwards. All kinds of costs incurred up to the fourth year were included in the establishment cost. The costs incurred from the fifth year to the end of the crop or the end of the economic life span (30 years) is considered as the maintenance cost. It includes costs incurred for land tilling, pruning, soil works, manures, fertilizers, plant protection chemicals and the expenditure on all kinds of farm operations.

4.2.1.1 Cost structure of coffee plantations during establishment phase (1-4 years)

4.2.1.1.1 Operation-wise establishment cost

The details of the cost incurred during the establishment phase is furnished in Table 4.8. The total establishment cost per hectare of coffee in Kerala was estimated as ₹4,22,696, while the costs incurred from the 1st to 4th year of establishment were estimated as ₹1,65,935, ₹75,198, ₹94,078 and ₹87,485 respectively.

While considering the four years of establishment, the first year was the costliest year among the four years. The establishment activities in coffee plantations such as land preparation, digging and filling of pits, planting, pegging and shade management initiatives are taken up in the first year. Among the twelve mentioned establishment operations, application of chemical fertilizers and soil ameliorants for pit filling and basal application accounted for the major share (34.5 per cent) in the establishment cost incurred during the first year. The operations

Table 4.8 Operation-wise establishment cost of coffee cultivation in Kerala (₹/ha)

Sl No	Particulars	I year	II year	III year	IV year	Total
1	Land preparation	25025 (15.1)	0 (0)	0 (0)	0 (0)	25025 (5.9)
2	Digging & filling	17875 (10.8)	0 (0)	0 (0)	0 (0)	17875 (4.2)
3	Planting	23105 (13.9)	810 (1.1)	42 (0.04)	0 (0)	23957 (5.7)
4	Staking/pegging	7190 (4.3)	913 (1.2)	0 (0)	0 (0)	8103 (1.9)
5	Weeding	2550 (1.5)	2700 (3.6)	3633 (3.9)	3250 (3.7)	12133 (2.9)
6	Organic manure application	20420 (12.3)	11075 (14.7)	13910 (14.8)	13100 (15)	58505 (13.8)
7	Application of chemical fertilizers & soil ameliorants	57250 (34.5)	51300 (68.2)	54833 (58.3)	55850 (63.8)	219233 (51.9)
8	Application of plant protection chemicals (Pesticides & fungicides)	2520 (1.5)	1450 (1.9)	2593 (2.8)	1965 (2.2)	8528 (2)
9	Pruning	0 (0)	1950 (2.6)	5417 (5.8)	3725 (4.3)	11092 (2.6)
10	Land tilling	0 (0)	0 (0)	13650 (14.5)	8775 (10)	22425 (5.3)
11	Irrigation	10000 (6)	5000 (6.6)	0 (0)	0 (0)	15000 (3.5)
12	Harvesting	0 (0)	0 (0)	0 (0)	820 (0.9)	820 (0.2)
13	Total	165935 (100)	75198 (100)	94078 (100)	87485 (100)	422696 (100)

Note: Figure in parentheses indicate per cent to column total

such as land preparation, digging and filling, planting and staking were together called as planting operations. The cost incurred for planting operations accounted for 44.1 per cent of the total cost incurred in the first year of establishment. The land preparation and digging of pits were done manually in some of the farms and by using machines in other farms. Even though the cost incurred were almost similar in both the approaches, engaging machines for land preparation helped to reduce the total time taken for the operation. The hilly topography of the study area also influenced the time and efficiency of the works. Due to the undulating topography, it was impossible to carry out the operations in the study area by using machines alone. Hence, most of the farmers preferred using both machine and human labour. Irrigation is very important for coffee plantations and sprinkler system was found to be the most preferred method of irrigation. The installation of irrigation system in coffee plantations was laborious and involved a very high cost. Out of the 160 sample respondents, none of the farmers established a permanent irrigation system in their coffee gardens. Most of the coffee plantations were following a purely rainfed based cultivation. During the first two years of establishment, if rainfall was inadequate, the farmers used to provide temporary irrigation facilities to sustain the coffee plants.

Considering the four years of establishment, the highest cost was incurred in the first year. The main activities in the establishment phase such as land preparation, digging and filling of pits, planting, pegging and shade management were taken up in the first year. Among the twelve mentioned establishment operations, application of chemical fertilizers and soil ameliorants for pit filling and basal application accounted for the highest share of 34.5 per cent in the establishment cost during the first year. Land preparation, digging and filling, planting and staking are together called as planting operation and the total cost incurred for planting operation accounted for 44.1 per cent of the total cost incurred in the first year of establishment.

The total operational cost incurred during the second year of establishment was estimated as ₹75,198 per hectare. Among the various operational activities, application of chemical fertilizers and soil ameliorants constituted 68.2 per cent of the operational cost incurred in the second-year of establishment. Most of the farmers heavily relied upon chemical fertilizers, especially in the initial stages. Even though the Cooperatives and Coffee Board recommended organic cultivation of coffee, the higher cost as well as the higher quantitative requirements of organic inputs, constrained the farmers from practising 100 per cent organic cultivation.

Though organic coffee fetches 15-30 per cent higher price than the inorganic one, the yield obtained by the farmers was 30-40 per cent lower than that of the latter. Hence, most of the farmers were making intensive use of chemical fertilizers during the establishment phase and subsequently, a combination of organic and inorganic fertilizers was used in coffee plantations. The application of chemical fertilizers and soil ameliorants contributed the highest share in the operational cost during the third and fourth years, accounting for 58.3 per cent and 63.8 per cent of the total operational cost respectively. During the establishment phase of four years, organic manure application accounted for an amount of ₹ 58,505 per hectare.

4.2.1.1.2 Input-wise establishment cost

The input-wise cost incurred during the establishment phase of coffee plantation is presented in Table 4.9. It could be observed from the table that 44.8 per cent of the total input cost in the establishment phase was accounted by chemical fertilizers and soil ameliorants, followed by human labour, with a contribution of 39.3 per cent. The organic manures accounted for 10.6 per cent of the establishment cost. While considering the four years of the establishment phase, it could be observed that the cost incurred for human labour was highest in the first year of establishment, with more than 50 per cent share in the input-wise cost. In the remaining three years of the establishment phase, chemical fertilizers and soil ameliorants together contributed the major share in input-wise cost of cultivation of coffee in Kerala.

In the first year, 8.2 per cent of the establishment cost was incurred for planting materials. Planting materials include coffee seedlings as well as seedlings of shade trees. As per the Package of Practices Recommendation for Crops (PoP) of Kerala Agricultural University (KAU), 440-640 Robusta coffee plants can be grown in one acre of land. But in most of the sample coffee plantations, the growers were having 380 to 590 plants per acre and most of them were following a spacing of 3.0m X 3.0m. The average number of coffee plants per acre among the sample farms in the study area was 503 plants. In the total input-wise establishment cost, chemical fertilizers and soil ameliorants accounted for the highest share of around

45 per cent and was followed by human labour, which contributed around 39 per cent. Among the six input components, the lowest shares in total establishment cost were accounted by planting materials (3.3 per cent) and plant protection chemicals (1.1 per cent).

Table 4.9 Input-wise establishment cost of coffee cultivation in Kerala (₹/ha)

Sl no	Particulars	I year	II year	III year	IV year	Total
1	Human labour	84535 (50.9)	23025 (30.6)	32716 (34.8)	25995 (29.7)	166271 (39.3)
2	Planting materials	13670 (8.2)	160 (0.2)	42 (0.04)	0 (0)	13872 (3.3)
3	Stakes/Pegs	3790 (2.7)	63 (0.1)	0 (0)	0 (0)	3853 (0.9)
4	Organic manures	15220 (9.2)	7500 (10)	11527 (12.3)	10500 (12)	44747 (10.6)
5	Plant protection chemicals (Weedicide, Pesticide & Fungicide)	1220 (0.7)	950 (1.3)	1460 (1.6)	990 (1.1)	4620 (1.1)
6	Chemical fertilizers & Soil ameliorants	47500 (28.6)	43500 (57.8)	48333 (51.4)	50000 (57.2)	189333 (44.8)
7	Total	165935 (100)	75198 (100)	94078 (100)	87485 (100)	422696 (100)

Note: Figure in parentheses indicate per cent to column total

4.2.1.2 Cost structure of coffee plantations during yielding phase (5-30 years)

4.2.1.2.1 Operation-wise maintenance cost

In the case of coffee plantations, the yielding phase was characterized by various operations like land tilling, weeding, pruning, harvesting and other common practices like application of manures, fertilizers and plant protection chemicals. The operation wise average annual maintenance cost in the sample coffee gardens is presented in Table 4.10. The total economic life span of a coffee plant is divided into three stages *viz.*, yield increasing phase (5^{th} to 9^{th} year), yield stabilizing phase (10^{th} to 25^{th} year) and yield declining phase (26^{th} to 30^{th} year).

Table 4.10 Operation-wise annual maintenance cost of coffee cultivation (₹/ha)

Sl no.	Particulars	Yield increasing phase	Yield stabilizing phase	Yield declining phase	Weighted mean
1	Land tilling	9710 (10.4)	11694 (11.2)	9496 (12.8)	10910 (11.1)
2	Weeding	2315 (2.5)	1966 (1.9)	1925 (2.6)	2046 (2.1)
3	Organic manure application	11675 (12.5)	9279 (8.8)	5934 (8)	9416 (9.6)
4	Application of chemical fertilizers & Soil ameliorants	58876 (63.1)	62997 (60.1)	44107 (59.3)	59436 (60.7)
5	Application of plant protection chemicals (Pesticides & fungicides)	777 (0.8)	147 (0.1)	43 (0.1)	288 (0.3)
6	Pruning	2845 (3.1)	3315 (3.2)	2256 (3)	3057 (3.1)
7	Harvesting	6493 (7)	14909 (14.2)	10059 (13.5)	12189 (12.5)
8	Transportation	560 (0.6)	565 (0.5)	550 (0.7)	562 (0.6)
9	Total	93251 (100)	104872 (100)	74370 (100)	97903 (100)

Note: Figure in parentheses indicate per cent to column total

The total cost incurred for maintaining coffee garden during the yielding increasing phase was estimated as ₹93,251 per hectare, where as in the yield stabilizing and declining phases, the costs were ₹1,04,872 and ₹74,379 per hectare respectively. In all the yielding phases, application of chemical fertilizer was the major operational cost component accounting for the highest share in the cost. The sixth column of Table 4.10 depicts the weighted means of the maintenance cost in all the three yielding phases and it could be observed from the table that the weighted average annual maintenance cost of coffee during the yielding phase was ₹97,903 per hectare. It could be observed from the weighted mean maintenance cost that 60.7 per cent of the total maintenance cost was contributed by the application of chemical fertilizer and soil ameliorants. Among the three yielding phases, the lowest maintenance cost was incurred during the yield declining phase. In Kerala (Wayanad), most of the farmers were practising replanting in coffee plantations mostly once in every 15-20 years. It was observed that only few farmers maintained their coffee plantations and most of the plants were aged more than 25 years. It was maintained because these aged coffee plants still exhibited high productivity. As discussed earlier, in all the phases, application of chemical fertilizers and soil ameliorants together contributed the major share in the maintenance cost, but in yield stabilizing and yield declining phases, farmers were found to be utilising more quantity of soil ameliorants than fertilizers. The weighted organic manure application cost during the yielding phase was worked out as ₹9,416 per hectare, which was 9.6 per cent of the weighted average total maintenance cost.

Pruning (Kavath), land tilling (Varandi kootal) and weeding (Kadu vettal) are the most important farm practices which determine coffee yield. The pruning was done twice in a year, while tilling of land and weeding were carried out only once in coffee plantations. The contribution of these yield determining practices (pruning, land tilling and weeding) in the weighted average annual maintenance cost was estimated as ₹3,057 (3.1 per cent), ₹10,910 (11.1 per cent) and ₹2,046 (2.1 per cent) per hectare respectively.

The cost incurred for harvesting was found to be the highest in the yield stabilizing phase and was estimated as ₹14,909 per hectare, which happened to be 14.2 per cent of the total maintenance cost during the yield stabilizing phase. For harvesting, till 2018, the labourers in Wayanad were being paid wages on a per day basis. It was reported that due to the fixed wages per day, labourers were slow in harvesting and tried to extend the days of harvest for getting more days of employment and wages. To overcome this, cultivators introduced the new system in which the quantity harvested by a labourer was made the basis for payment of wages. The farmers testified this system as much efficient than the earlier daily wage rate system. Labourers were paid based on the quantity harvested per day and ₹4.5-6 per kg was the standard rate prevailing in the study area. Most of the farm labourers in the study area were tribals and compared to any other state in India, plantation workers in Kerala including the tribals are being paid well. Some of the farmers/ plantation owners reported the high wage rates prevailing in Wayanad as a major constraint for their farming activities.

4.2.1.2.2 Input-wise maintenance cost

The inputs required for management of coffee plantations are human labour, organic manures, plant protection chemicals, chemical fertilizers and soil ameliorants. The input-wise annual maintenance cost of coffee cultivation in different yielding phases and their weighted mean are presented in Table 4.11.

Table 4.11 Input-wise annual maintenance cost of coffee cultivation (₹/ha)

Sl no	Particulars	Yield increasing phase	Yield stabilizing phase	Yield declining phase	Weighted mean
1	Human labour	33242 (35.6)	42608 (40.6)	29803 (40.1)	38581 (39.4)
2	Organic manures	9498 (10.2)	7516 (7.2)	5137 (6.9)	7681 (7.8)
3	Plant protection chemicals (Weedicide, Pesticide& fungicide)	361 (0.4)	92 (0.1)	80 (0.1)	156 (0.2)
4	Chemical fertilizers & soil ameliorants	50150 (53.8)	54656 (52.1)	39350 (52.9)	51484 (52.6)
5	Total	93251 (100)	104872 (100)	74370 (100)	97903 (100)

Note: Figure in parentheses indicate per cent to column total

It could be observed from the table that the average total input cost during yield increasing, yield stabilizing and yield declining phases were ₹93,251, ₹1,04,872, ₹74,370 per hectare respectively. Among the above-mentioned inputs, chemical fertilizers and soil ameliorants together contributed 52.6 per cent of the total input cost in the weighted mean for all the yielding phases. Chemical fertilizers and soil ameliorants together contributed more than 50 per cent of the total input cost in all the yielding phases. While considering the other input components, it could be observed that human labour contributed 39.4 per cent of the total input cost, while organic manures contributed 7.8 per cent. From the study, it is clearly evident that most of the farmers were intensively utilizing chemical fertilizers throughout the economic life span of coffee plants. More than 50 per cent of the annual establishment as well as the annual maintenance costs could be attributed to the chemical fertilizers and soil ameliorants and, their application. Even though the initiatives from Coffee Board and other cooperatives have made the farmers to move away from the intensive use of chemicals, the comparatively lower productivity in organic cultivation is also acting as an encouraging factor for farmers to continue the application of chemicals.

4.2.1.3 Cost of cultivation of coffee

The cost of cultivation of coffee refers to the total expenses incurred by the growers for cultivating one hectare of coffee. Being a perennial crop with a life span of 30 years, the cost of cultivation was worked out by considering the overall economic life span, by amortizing the establishment cost and adding it to the average annual maintenance cost. The estimated cost of cultivation is presented in Table 4.12.

Table 4.12 Cost of cultivation of coffee in Kerala (₹/ha)

Sl no	**Particulars**	**Cost(₹/ha)**
1	Establishment cost	422696
2	Amortized value @10%	46141
3	Annual maintenance cost	97903
4	Interest on working capital @ 8%	7832
5	Total cost	1,51,877

The total establishment cost incurred in coffee cultivation was ₹4,22,696 per hectare, which was about four-fold higher than the annual maintenance cost of ₹97,903 per hectare. For computing the total cost of cultivation, the establishment cost of ₹4,22,696 per hectare was amortized at the rate of 10 per cent and the amortised value of the establishment cost was ₹46,141 per hectare per year. This amortised value was summed up with the estimated annual average maintenance cost and interest on working capital at eight per cent and thus, the total cost of cultivation was obtained as ₹1,51,877 per hectare. As discussed earlier, the major shares in the establishment cost as well the maintenance cost were contributed by chemical fertilizers and labour employed for farm activities. The higher labour cost, intensive application of chemical fertilizers and soil ameliorants and high cost of organic manures were the reasons for the high cost of coffee cultivation of coffee in Kerala.

4.2.1.4 Cost of production of coffee

The cost of production per kilogram of coffee in Kerala was calculated by dividing the total cost per hectare by the average productivity of coffee in the sample farms and the results are presented in Table 4.13.

Table 4.13 Cost of production of coffee in Kerala (₹/kg)

Sl No	**Particulars**	**Yield increasing phase**	**Yield stabilizing phase**	**Yield declining phase**	**Weighted average**
1	Establishment cost (₹/ha)				422696
2	Amortized value (₹/ha)	46141	46141	46141	46141
3	Annual maintenance cost (₹/ha/year)	93251	104872	74370	97903
4	Interest on annual maintenance cost (₹/ha)	7460	8390	5950	7832
5	Total cost (₹/ha/year)	146852	159403	126461	151877
6	Average productivity (kg/ha)	1854	2535	2362	2250
7	Cost of production (₹/kg)	79	63	54	67

The average total cost of production was computed as ₹67 per kg and the production cost was found to be higher during the yield increasing phase. The least production cost (₹54 per kg) was observed in the yield declining phase. From the table it is evident that the average productivity of coffee in the study area was 2,250 kg per hectare and the cost of production during yield stabilising phase was ₹63 per kg of coffee beans.

4.2.1.5 Returns from coffee cultivation

The estimated gross and net returns obtained from coffee cultivation in Kerala are presented in Table 4.14. The gross return was estimated based on the average productivity of coffee plants in the study area. The average price received by farmers were computed based on the field level data collected during the primary survey in Wayanad district. The net return was arrived after deducting the total cost of cultivation per hectare from the gross returns per hectare. The gross and net returns were estimated as ₹1,93,529 and ₹41,652 per hectare respectively.

Table 4.14 Net returns from coffee cultivation in Kerala

Sl no	Particulars	Quantity/value
1	Average productivity(kg/ha)	2250
2	Average price received by farmers (₹/kg)	86
3	Gross returns (₹/ha)	1,93,529
4	Total cost (₹/ha)	1,51,877
5	Net returns (₹/ha)	41,652

The cost of cultivation, cost of production and net returns of coffee cultivation in Kerala were worked out as ₹1,51,877 per hectare, ₹67 per kg and ₹41,652 per hectare respectively. The summary table depicted above indicates the requirement of high initial investment in coffee cultivation. The intensive use of inputs and laborious farm activities have resulted in high cost of cultivation. In spite of the higher cost of cultivation, coffee farming in Kerala state was found to be profitable, with a farmer earning on an average of ₹41,652 per hectare. The farmgate prices of coffee are volatile and during the survey period it was comparatively very low. Even with a low farmgate price, the farmers have obtained reasonable net returns. These findings were in line with the observations of Kumar (2004) that the coffee cultivation is both labour and chemical input intensive.

4.2.2 Marketing of coffee

Agricultural marketing is a long process which begins with farm production and ends with the consumer. Marketing of coffee refers to all the activities involved in the movement of coffee from the farm to the ultimate consumer through different marketing channels. The marketing channel for coffee consists of many intermediaries like village traders, wholesalers, exporters, curers, processors, cooperative institutions, retailers and Multi-National Companies (MNCs).

Coffee is an export-oriented commodity and the export price is highly dependent on the quality of coffee beans. In addition to the varietal differences, significant variation in quality of beans is observed with different geographical conditions and farming practices. Before 1993, Coffee Board was the sole authority for coffee marketing in India. The introduction of free sale quota into the system changed the entire gamut of coffee marketing system in India. Presently, the coffee production is intensively concentrated in South Indian states like Karnataka, Tamil Nadu and Kerala. The major domestic coffee markets for coffee in India are located in Bangalore, Chennai and Hyderabad. The Indian coffee is also sold at the New York as well as London international coffee markets. In Kerala, majority of the coffee markets are located in Wayanad district and many people in the district are solely dependent on production and marketing of coffee.

4.2.2.1 Marketing behavior of coffee farmers

The choice of the farmer regarding the buyer of his produce is a sole discretion of the farmer. Many intermediaries are working in different levels of coffee marketing in Wayanad district. Small scale coffee procurement agents, village traders and their stalls are very common in all the small towns of Wayanad district. Several exporters and Cooperative societies are also engaged in coffee trade. Among the Cooperatives, the Wayand Social Service Society (WSS) and Brahmagiri Development Society (BDS) are holding the major shares in coffee trade. Based on the selling habit, coffee farmers were categorized into five categories and the details are presented in Table 4.8.

The high price quotations, comparatively feasible quality criteria (zero tolerance towards chemical pesticides) and provision of other benefits (subsidized inputs, farm equipment, etc.,) provided by Cooperative societies like WSS and BDS have attracted more farmers towards their marketing channels. Among the sample respondents, 52 per cent of the farmers sold their produce to WSS. BDS started procurement from farmers only in 2018. Within a short period, even with the covid related constraints in coffee trade, it could be observed from the table that the produce from 19 per cent of the sample respondents were procured by BDS. Out of the 160 respondents, 21 per cent sold their produce to village traders. Only four per cent of the sample respondents sold to exporters even when they were quoting high prices. As most of the exporters were following very high-quality standards including zero tolerance towards chemical inputs, the farmers were finding it difficult to sell their produce to the exporters. Wholesalers and wholesale procurement shops were located in most of the major towns in Wayanad district. The farmers of a particular locality had greater access to these wholesalers and were getting better prices for their produce in comparison to the price quoted by village traders. Among the sample respondents, it was found that only four per cent directly sold their produce to wholesalers.

Table 4.15 Distribution of farmers based on selling behavior

Market functionaries	**Distribution of farmers**
Village traders	33 (21)
Wayanad Social Service Society	83 (52)
Brahmagiri Development Society	30 (19)
Exporters	7 (4)
Wholesalers	7 (4)
Total	160 (100)

Note: Figure in parentheses indicate per cent to column total

4.2.2.2 Marketing channels

Marketing channels can be defined as the structured network of interconnected market components and their subsidiaries participating in the movement of the commodities from the producers to the final consumers in the raw or processed or consumable forms. The chain consists of producers, village traders, wholesalers, exporters, cooperatives, export agents, upcountry wholesalers, multi-national companies and retailers. Most of the upcountry wholesalers, exporters and cooperatives take over the function of processing along with the traditional functions.

Producers

Producers are farmers and in the present study producers are coffee farmers. The marketing of any commodity begins with the producers. The flow of produce in the marketing channel is determined by the sole decision of farmers, even though the decision is also dependent on various socio-economic factors.

Village traders

Village traders procure the produce directly from farmers. In the study area, farmers delivered their produce at the village trader's gate. The transportation cost for delivering the produce was borne by the farmers. The village traders preferred purchase of dried bean over freshly harvested bean in order to avoid the drying activities near their trading centres or shops.

Wholesalers

Wholesalers usually purchase coffee from the village traders and farmers nearby. Most of the wholesalers in Wayanad district practice drying, grading and sorting activities. Wholesalers sell the produce to processors, exporters, upcountry wholesalers, MNCs and small beverage outlets.

Upcountry wholesalers

Upcountry wholesalers are the wholesalers located in Bangalore, Chennai, Hyderabad, Kochi and other major cities. The product from wholesalers in Kerala are purchased by these upcountry wholesalers and they in turn sell it to the industries and retailers.

Exporters

Coffee exporters purchase produce directly from farmers. They carry out minimal to advanced levels of processing according to the requirement. The exporters sell the processed products outside the country. The coffee exporters from Kerala usually have tie-up with Japan and European countries for the trading of coffee. Most of the exporters were trading coffee in the international market as processed coffee beans, without roasting and powdering. It is because, European coffee consumers do not prefer the method of roasting of coffee followed in India. Most of the importing countries prefer organic coffee and it fetches a better price in the international market.

Export agents

Export agents are acting as commission agents in the export marketing channels. Traders without export license hand over their export quality coffee to these export agents and they help in exporting coffee from India to the destination countries. Most of the agents were charging an average commission of 10 per cent of the value of the total produce. All the documents required for exporting were prepared and submitted by the export agents.

Retailers

Retailers are the most common and important intermediary in the marketing system of coffee. They purchase products from wholesalers and sell to the ultimate consumer through traditional local markets as well as through online markets. Among the market intermediaries, retailers are the final connecting point with the consumers.

Cooperatives

A cooperative is an autonomous association of persons, united voluntarily to meet their common economic, social and cultural needs and aspirations through jointly owned and democratically controlled enterprises (ILO,2020). Cooperatives are major players in Kerala’s coffee trade and are multifunctional in nature. The Cooperatives like WSS and BDS take up multiple roles and act as producer, wholesaler, retailer, processor as well as exporter. They provide many services to coffee farmers and support them through various incentives and subsidies. They procure quality beans from farmers and adhere zero tolerance to pesticide residues. Most of the time, the cooperatives quoted higher prices than the local market price offered for dried coffee beans.

The five major marketing channels identified in Kerala's coffee trade during the field survey are mentioned below,

Channel I: Farmer – Wayanad Social Service Society – Consumer

Channel II: Farmer – Village trader – Wholesaler – Upcountry wholesaler – Retailer – Consumer

Channel III: Farmer – Brahmagiri Development Society – Consumer

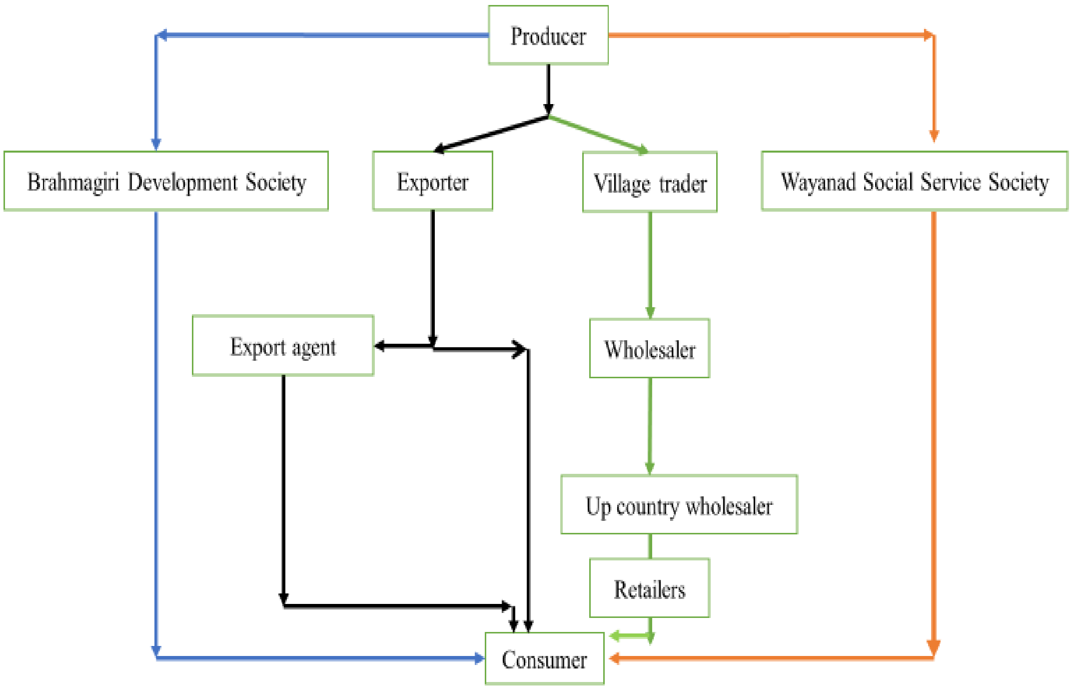
Channel IV: Farmer – Exporter – Consumer

Channel V: Farmer – Exporter – Export agent – Consumer

Among the five marketing channels, channel two was considered to be the longest one. Channel one consisted of producer, WSS and consumer. The WSS acted as a wholesaler, processor and exporter in this case. The WSS has wide range of coffee products ranging from unroasted minimal processed Robusta coffee priced at ₹149 per kg to superior quality organic yoga coffee, priced at ₹1800 per kg. The WSS is acting as a major player in Kerala's coffee economy.

The longest channel identified in the study area was the second channel and it consisted of intermediaries like village traders, wholesalers, upcountry wholesalers and retailers. Most of the wholesalers in this channel sold their produce to upcountry wholesalers located in the industrial capital of Kerala, Kochi. In line with the first channel, in the third channel also consumers and producers were connected by the sole intermediary, BDS, a multi-purpose cooperative society which has expanded its functional area into coffee in 2018-19. The fourth marketing channel also consisted of only a single intermediary. The exporters were directly procuring coffee from farmers and were selling in the international market, whereas in the fifth channel, the coffee procured by the exporters was exported to the international market with the help of export agents.

Plate 4 Marketing channels



4.2.2.3 Marketing cost

The marketing costs are the actual expenses incurred in bringing a good or service from the producer to the consumer. The marketing cost (₹/kg) of coffee in different marketing channels are presented in Table 4.16. The market functionaries incurred cost in various marketing activities such as loading and unloading, transportation, grading, processing, storage, packing, documentation for exporting and other miscellaneous activities. The cost incurred for each of the activities are listed in the table. While considering all the marketing activities and channels in coffee, processing was found to be the most important function and the highest cost was incurred for processing. The cost of processing also varied with the variation in quality requirements or specifications provided by the of the consumer.

Table 4.16 Marketing costs in different marketing channels of coffee (₹/kg)

Market functionaries	**Items**	**I**	**II**	**III**	**IV**	**V**
Farmer	Loading & unloading	0.5	0.5	0.5	0.5	0.5
	Transportation	0.25	0.5	-	1	1
	Grading	0	0	-	-	-
	Processing	0	0	-	-	-
	Storage	0.5	0.5	0.5	0.5	0.5
	Miscellaneous	1	1	1	1	1
Village trader	Loading & unloading	-	0.25	-	-	-
	Transportation	-	0	-	-	-
	Grading	-	-	-	-	-
	Processing	-	-	-	-	-
	Storage	-	1	-	-	-
	Miscellaneous	-	2	-	-	-
WSS	Loading & unloading	1	-	-	-	-
	Transportation	1.5	-	-	-	-
	Grading	10.12	-	-	-	-
	Processing	54.5	-	-	-	-
	Storage	4	-	-	-	-
	Miscellaneous	20	-	-	-	-
BDS	Loading& unloading	-	-	0.5	-	-
	Transportation	-	-	2	-	-
	Grading	-	-	13	-	-
	Processing	-	-	61	-	-
	Storage	-	-	6	-	-

	Miscellaneous	-	-	25	-	-
Wholesaler	Loading& unloading	-	0.5	-	-	-
	Transportation	-	1	-	-	-
	Grading	-	3	-	-	-
	Processing	-		-	-	-
	Storage	-	1	-	-	-
	Miscellaneous		5	-		
Upcountry wholesaler	Loading& unloading	-	0.25	-	-	-
	Transportation	-	0.5	-	-	-
	Grading	-	5	-	-	-
	Processing	-	36	-	-	-
	Storage	-	2	-	-	-
	Miscellaneous	-	10	-	-	-
Exporter	Loading& Unloading	-	-	-	3	2
	Transportation	-	-	-	1.35	2.25
	Grading	-	-	-	21	15
	Processing	-	-	-	93.25	76
	Storage	-	-	-	15	17
	Miscellaneous		-	-	28	20
Export agent	Loading& unloading	-	-	-	-	-
	Transportation	-	-	-	-	-
	Grading	-	-	-	-	-
	Processing	-	-	-	-	-
	Storage	-	-	-	-	-
	Miscellaneous	-	-	-	-	4.7
Retailer	Loading& unloading	-	1	-	-	-
	Transportation	-	0	-	-	-
	Grading	-	-	-	-	-
	Processing	-	-	-	-	-
	Storage	-	1	-	-	-
	Miscellaneous	-	3	-	-	-
Total marketing cost		93.37	71.75	109.5	164.6	139.95

Note: ‘I to V’ indicates channel I to V

Among the different marketing channels, highest marketing cost was incurred in channel IV in which exporters employed high quality machines and complicated processes to maintain the quality of the produce, which in turn resulted in a higher marketing cost. The least marketing cost was observed in channel II. It was the longest marketing channel in the study area in which the products were sold in the domestic market itself and the minimal processing with local requirements led to a lower marketing cost in this channel.

4.2.2.4 Marketing margin

The marketing margin can be defined as the net income or net gain obtained by the market intermediaries during the marketing process. The marketing margins obtained by various intermediaries in different marketing channels were calculated and from the marketing cost, marketing margin and prices received and paid by the producer and consumer respectively, the price spread in different channels were estimated and the results are presented in Table 4.17.

In channel I, WSS earned the maximum marketing margin of ₹138.88 per kg of coffee, whereas in channels II, III, IV and V the highest marketing margins earned were ₹85 by retailers, ₹162.5 by BDS, ₹161.6 by exporters and 114.75 by exporters respectively. While considering the marketing, it could be observed that the channel I, III and IV were the shortest channels with a single intermediary between farmers and consumers. In the longest channel with four intermediaries between the farmer and consumer, village traders received the lowest marketing margin of ₹0.75 per kg of coffee. From the table it is clearly evident that all the market intermediaries were gaining sufficient income from coffee trade. While comparing the marketing margin taken up by coffee intermediaries of Kerala state with that of the intermediaries in other state, it could be observed that the intermediaries of Kerala were extracting comparatively lower market margins (Thanuja and Singh, 2017).

Table 4.17 Price spread in different marketing channels of coffee (₹/Kg)

Sl no	Price spread	I	II	III	IV	V
1	Farmer’s selling price	80	68	90	78	75
	Marketing cost	2.25	2.5	2	3	3
	Net price received by farmer	77.75	65.5	88	75	72
2	Village traders selling price	-	72	-	-	-
	Marketing cost	-	3.25	-	-	-
	Marketing margin	-	0.75	-	-	-
3	WSS selling price	310	-	-	-	-
	Marketing cost	91.12	-	-	-	-
	Marketing margin	138.88	-	-	-	-
4	BDS selling price	-	-	360	-	-
	Marketing cost	-	-	107.5	-	-
	Marketing margin	-	-	162.5	-	-
5	Wholesaler's selling price	-	95	-	-	-
	Marketing cost	-	10.5	-	-	-
	Marketing margin	-	12.5	-	-	-
6	Upcountry wholesaler's selling price	-	220	-	-	-
	Marketing cost	-	53.75	-	-	-
	Marketing margin	-	71.25	-	-	-
7	Exporters selling price	-	-	-	340	322
	Marketing cost	-	-	-	161.6	132.25
	Marketing margin	-	-	-	100.4	114.75
8	Export agent selling price	-	-	-	-	350
	Marketing cost	-	-	-	-	4.7
	Marketing margin	-	-	-	-	23.3
9	Retailers’ sale price	-	310	-	-	-
	marketing cost	-	5	-	-	-
	Marketing margin	-	85	-	-	-
10	Consumers purchase price	310	318	360	340	322
	Total marketing margin	138.88	169.50	162.5	100.4	138.05
	Total marketing cost	93.37	71.75	109.5	164.6	139.95
	Producers share in consumer rupee	**25.81**	**21.38**	**25.00**	**22.94**	**23.29**

4.2.2.5 Price spread

The price spread observed in different marketing channels are summarized and presented along with the details of producer's share in consumer rupee in Table 4.17. While estimating price spread and marketing efficiency, the final product considered for the estimation is coffee beans before roasting and powdering. The price spread indicates the difference between price paid by the final consumer and price received by the farmer for an equivalent quantity of the commodity. Based on the purchase price paid by the consumer, total marketing cost and margin, the producer's share in consumer rupee was computed. It is clearly evident from the table that the producer's share in consumer rupee was very low in all the five marketing channels. The coffee farmers are getting only a very low price for their produce, while the consumers purchased coffee for consumption at a very high price. Even though processing incurs high cost, the price received by the farmers were not at all reasonable. While considering all the five marketing channels, channel I with WSS had the highest producer's share in consumer rupee of 25.81 per cent. Almost all the channels showed a similar producer's share in consumer rupee. The low producer's share in consumer rupee or the high price spread value indicates that even with the participation of cooperatives in coffee trade, the farmers were not getting a reasonable price, especially in comparison with the price paid by the consumers for coffee. These results of low producer share in consumer rupee in Kerala's coffee trade was contrary to the observations made by Thanuja (2017) in Karnataka state, where a higher producer share in consumer rupee in coffee trade was observed and in-line with the findings of the study conducted by Joy (2004) in Wayanad district.

4.2.2.6 Marketing efficiency

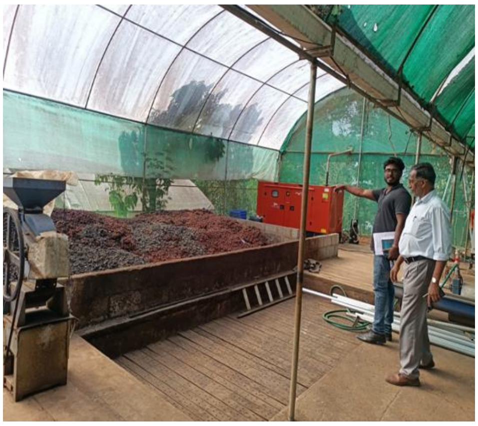
The marketing efficiency of coffee in different marketing channels were estimated based on the marketing cost and margin and the estimates are presented in Table 4.18. The marketing values were estimated using Acharya's as well as Shepherd's approaches. The study found that all the marketing channels were inefficient in coffee trade because farmers were getting only a very nominal portion of the price paid by consumers. The total marketing cost was found to be highest in channel IV, whereas the highest marketing margin was observed in channel II. Among the estimated marketing efficiencies, channel I showed the highest marketing efficiency of 0.34 (Acharya's approach) and 1.33 (Shepherd's formula), while it was found to be the lowest in Channel V, which could be attributed to the presence of a larger number of intermediaries.

Table 4.18 Marketing efficiency of coffee in different marketing channels

Sl no	Particulars	I	II	III	IV	V
1	Total marketing margin	138.88	169.50	162.50	100.40	138.05
2	Total marketing cost	93.37	71.75	109.50	164.60	139.95
3	Producer's share in consumer rupee	25.81	21.38	25.00	22.94	23.29
3	Producer price	80.00	68.00	90.00	78.00	75.00
4	Consumer price	310	318	360	340	322
	Marketing efficiency ((CP/(TMC+TMM))-1) Shepherd's formula	0.33	0.32	0.32	0.28	0.16
	Marketing Efficiency (FP/TMC+TMM) Acharya's approach	0.34	0.28	0.33	0.29	0.27
	Marketing efficiency ((CP/(TMC+TMM))) Shepherd's formula	1.33	1.32	1.32	1.28	1.16

On comparing the estimated values of marketing efficiencies by Shepherd's and Acharya's formula, it could be observed that higher values were observed in channel I (0.34), III (0.33), IV (0.29) and V (0.27), while estimating with Acharya's approach. With Shepherd's approach, higher values for the estimates were observed in channel II alone. The estimations using both the approaches indicated the market inefficiency prevailing in the domestic coffee markets. Even with lower number of intermediaries in channel I, III and IV, the study couldn't find any significant improvement in marketing efficiency. The higher marketing margin claimed by market intermediaries, lack of proper infrastructure, high concentration of market power in hands of very few intermediaries and lack of transparency in price setting have contributed significantly to the inefficiency in the marketing of coffee. All the above discussed facts clearly indicate the inefficiency in marketing of coffee in Kerala as well as in the country and it could be concluded that for the betterment of

Plate 5 Discussion with coffee exporters



Note: Discussion with Managing Director and field visit at Vanamoolika Herbals (exporter)

Note: Heap of collected coffee waste : Handful of graded coffee

coffee farmers, transparency of the marketing system needs to be improved and farmer-oriented trade policies also have to be developed.

4.3 CONSTRAINTS IN PRODUCTION OF COFFEE

The constraints in the production of coffee indicate the limitations or restrictions which makes coffee farming difficult. Based on the pilot survey, major constraints faced by the coffee farmers of Wayanad were listed out. These constraints were subjected to a ranking methodology during the field survey. The ranks assigned for the constraints were analyzed using Garret's ranking technique and the results are presented in Table 4.19.

The eleven constraints identified from the farm level survey are listed in the descending order of the Garret score. Low price of produce (58.02), climatic issues (54.93), irrigation problems (51.83), high wage rate (50.54), price volatility (48.72), high input cost (45.71), labour shortage (45.40), disease and pest incidence (44.00), wild animal attack (43.71), lack of government support (42.02), and non-availability of planting material (35.81) were the constraining factors in coffee cultivation.

Among the eleven constraints confronted by coffee farmers of Kerala, low farmgate price of coffee, with a Garret score of 58.02, was found to constrain the farmers critically. During the study of marketing, it was clearly observed that farmers were getting only very low price when compared to the price paid by the consumers. The period of study also coincided with the lowest farmgate price during the last four years in the study area. The intermediaries were the winners in coffee trade and, they were found to grab a lion share of the gains in prices in the markets. This trend in low farmgate price was seen throughout India. A similar finding was also reported by Tejaswi *et al.,* (2005) in Chikmangalur, Karnataka.

Climatic aberrations or fluctuations (Garret score:54.93) are the second most important constraint in coffee cultivation. Climatic disturbances lead to yield fluctuations in almost all coffee growing areas. Rising temperature makes the coffee growing areas unsuitable for cultivation and moreover, it degrades the quality of coffee beans (Gokavi and Mote,2020). These findings are in accordance with the farmer’s statement during the field level survey in Wayanad district regarding the climatic issues. Most of the farmers reported the quality deterioration of coffee beans due to fluctuations in temperature.

Table 4.19 Constraints in production of coffee

Constraints	**Garret score**	**Rank**
Low price of produce	58.02	1
Climatic issues (Inadequate rainfall & increase in temperature)	54.93	2
Irrigation problems	51.83	3
High wage rate	50.54	4
Price volatility	48.72	5
High input cost	45.71	6
Labour shortage	45.40	7
Disease and pest incidence	44.00	8
Wild animals attack	43.71	9
Lack of government support	42.02	10
Non availability of planting material/quality material	35.81	11

Inadequate and irregular rainfall in the study area also had negative impact on coffee yield. The irregular and inadequate blossom showers (rainfall during February- April at the time of flowering) and backing showers (at the time of fruit setting) have caused lower yield in coffee. This situation can only be overcome with proper and adequate irrigation. In the study area, not a single farmer was practicing irrigated cultivation of coffee due to the heavy initial investment requirement for the irrigation structures. The sample respondents reported irrigation problems (Garret score of 51.83) as the third important constraint.

The daily wage rate of coffee plantation workers of Kerala, at over 350 rupee per day in 2020 was the highest in India (PIB, 2020). But this study was confined only to the homestead coffee farmers in Kerala and the large plantations were not considered in the study. The wage paid by the coffee farmers for the daily activities in the farms was equivalent to the normal wage rate prevailing in Kerala. The per day rate of wages for men was ₹600, while for women it was ₹500 during

2020. While comparing with other coffee growing areas in India, the wage rate was very high, in turn resulting in higher production cost in Kerala. Most of the sample farmers reported the higher wage rate (Garret score of 50.54) prevailing in Wayand as one of the major constraints.

Coffee prices are highly volatile and the domestic price varies with changes in the international prices (Krivonos, 2005). The farmers in the study area were also affected by the fluctuations in coffee prices. The sample respondents also reported that the period of study also coincided with the lowest quoted farmgate price (Garret score of 48.72) for their produce in the last three years.

The increase in input price, with a Garret score of 45.71, was also reported as a constraint in coffee cultivation. This increase in input price directly increases the cost of production. But the farmers did not gain a proportionate rise in coffee prices in the market. These market situations make coffee cultivation more difficult and lead to shift from coffee to more profitable and low risk crops like black pepper.

The constraints like labour shortage (Garret score:45.40), diseases and pest incidences (Garret score:44.00), wild animal attack (Garret score:43.71), lack of government support (Garret score:42.02) and non-availability of quality coffee planting materials (Garret score:35.81) also significantly affected the coffee cultivation in Kerala.

4.4 MICRO LEVEL IMPLICATIONS OF PRICE VOLATILITY

The implications of price volatility on farm level decision making is discussed in this section. The farm level factors affected by changes in farm gate prices were allocation of land area, replanting decisions, capital/investment decisions, management practices, labour hour employed, savings, borrowings and income. The farm level decision on each of these factors were related with price changes (Sabu, S., 2014). In this study, the sample respondents were subjected to four different price situations and asked to mention their farm level decisions on each decision-making variable. The different price changes (50 per cent increase and decrease and 25 per cent increase and decrease) were formulated by keeping the average annual price of coffee in 2020, ₹86 as the base price. The hypothecated decisions are increase, decrease and no change in the decision variables. The results obtained are presented as frequency tables from Table 4.20 to 4.29.

The identified farm and household level priority decisions were decisions on planting area, wage, labour deployment, input allocation, special monetary benefits to the labour and household decisions such as expenditure on food, education, health care, savings and borrowings. In the short run, there were no significant changes observed in the identified factors except decisions on savings and borrowings. Some interesting decisions like increasing labour deployment and input usage with decline in price of coffee in the domestic market based on the expectation of increase in price of coffee in the subsequent year was also observed during the study period. Coffee is a perennial crop and the short run market changes are not capable to make abrupt and significant changes in the decisions on planted area, labour wages, labour deployment and other household expenditure decisions.

4.4.1 Farm level decisions on planting area

The allocation of land for annual crops varies with changes in price (Worakko, 2011), whereas the area under perennial crops don't immediately change with changes in price (Winkler *et al*.,2013).

From the summary table (Table 4.20), it is clearly evident that even a 25 per cent or 50 per cent changes in price were not causing any changes in decisions on planting area. Coffee is a perennial plant with 30 years of economic life and hence, most of the farmers took decisions on area allocations or changes in area only based on the age and productivity of the coffee plants. Some of the farmers have shifted from pure coffee plantations to mixed farming with other crops such as black pepper based on comparative advantage and also as a measure to reduce the risk by increasing the diversity of crops grown. Hence, it could be concluded that the price volatility was not a determining factor in short run on the area allocation decisions of coffee farmers.

Table 4.20 Distribution of respondents based on land area/replanting decisions in relation to price changes.

Price changes / Implications	Land area/replanting-decisions			
	Increase	**No change**	**decrease**	**Total**
50 per cent decrease	0 (0)	160 (100)	0 (0)	160 (100)
25 per cent decrease	0 (0)	160 (100)	0 (0)	160 (100)
25 per cent increase	0 (0)	160 (100)	0 (0)	160 (100)
50 per cent increase	0 (0)	160 (100)	0 (0)	160 (100)

Note: Figure in parentheses indicate per cent to row total

4.4.2 Farm level decisions on labour deployment

The implications of price volatility on labour deployment decisions are presented in Table 4.21. More than 90 per cent of the farmers reported that they were not making any decisions on labour based on the changes in the price of coffee. Few of the farmers decreased the number of labourers with decrease in prices of coffee by 25 or 50 per cent. Whenever the decision to reduce the deployment of hired labour was made, the farmers were found to increase the proportion of family labour employed. Interestingly, few farmers increased the inputs like chemical fertilizers and also employed more labour for intercultural operations like weeding, tilling and pruning with the expectation of getting a higher price for the produce in the subsequent year.

When prices increased by 25 per cent, not a single farmer made any change in employment of labour. But when the prices increased by 50 per cent, eight per cent of the farmers were found to employ more labour for their farming activities. Even though the price changes influenced the labour decisions in the short run, the study could not find any significant changes in labour deployment with changes in price.

Table 4.21 Distribution of respondents based on labour deployment decisions in relation to price changes.

Price changes / Implications	Labour deployment decisions			
	Increase	No change	decrease	Total
50 per cent decrease	3 (2)	151 (94)	6 (4)	160 (100)
25 per cent decrease	3 (2)	157 (98)	0 (0)	160 (100)
25 per cent increase	0 (0)	160 (100)	0 (0)	160 (100)
50 per cent increase	12 (7)	148 (93)	0 (0)	160 (100)

Note: Figure in parentheses indicate per cent to row total

4.4.3 Farm level decisions on inputs

The resources that are used in farm production are called inputs. The basic input are the resources like fertilizers, seeds, pesticides etc., whereas the capital inputs indicate the resources like machineries, instruments and farm equipments. The distribution of respondents based on the decisions on the use of these inputs because of the volatility in prices is presented in Table 4.22.

Sophisticated machines or equipments were not utilized for coffee cultivation by the sample farmers. Hence, the table discusses about decision making on basic inputs such as fertilizers, seeds and pesticides. A 50 per cent decline in farmgate price of coffee significantly affected the input purchasing decisions of farmers and it was found that 13 per cent of sample farmers decreased their input use or money spend on inputs when coffee prices changed in the lower direction. In a similar way, when there was a 50 per cent increase in price, nine per cent of the farmers increased their spending on inputs like fertilizers, soil ameliorants and plant protection chemicals. The study found the interesting fact that some of the farmers even increased their spending on inputs when the farmgate price of coffee decreased with the expectation of a higher price in the subsequent crop years.

Table 4.22 Distribution of respondents based on decisions on input use in relation to price changes

Price change / implication	Input-decisions			
	Increase	No change	Decrease	Total
50 per cent decrease	3 (2)	137 (86)	20 (12)	160 (100)
25 per cent decrease	1 (1)	151 (94)	8 (5)	160 (100)
25 per cent increase	0 (0)	160 (100)	0 (0)	160 (100)
50 per cent increase	14 (9)	146 (91)	0 (0)	160 (100)

Note: Figure in parentheses indicate per cent to row total

4.4.4 Farm level decisions on wages

The farm level decision making on labour wages based on price changes is presented in Table 4.23. Kerala is a labour-oriented economy and the labour wages in the study area were predetermined due better bargaining power of labourers and it was not changed according to the changes in farmgate prices. So, the price volatility had no direct role in wage determination. But severe price changes were found to influence the number of days of employment, which indirectly influenced the income of labour.

Table 4.23 Distribution of respondents based on decisions on wages disbursed in relation to price changes

Price changes/ Implications	Wage-decisions			
	Increase	No change	Decrease	Total
50 per cent decrease	0 (0)	160 (100)	0 (0)	160 (100)
25 per cent decrease	0 (0)	160 (100)	0 (0)	160 (100)
25 per cent increase	0 (0)	160 (100)	0 (0)	160 (100)
50 per cent increase	0 (0)	160 (100)	0 (0)	160 (100)

Note: Figure in parentheses indicate per cent to row total

4.4.5 Farm level decisions on special benefits

Plenteous crop and bumper price coincide rarely in agriculture. Some special benefits (cash, dress, groceries, liquor etc.) were given to the permanent labourers based on the profit earned by the farmers. The profits usually increase with increase in price and yield. The distribution of sample respondents based on special benefits distributed in relation to changes in prices is summarized in Table 4.24.

Table 4.24 Distribution of respondents based on additional or special benefit decisions in relation to price changes

Price changes/ implications	Other employment benefit -decisions			
	Increase	**No change**	**Decrease**	**Total**
50 per cent decrease	0 (0)	160 (100)	0 (0)	160 (100)
25 per cent decrease	0 (0)	160 (100)	0 (0)	160 (100)
25 per cent increase	16 (10)	144 (90)	0 (0)	160 (100)
50 per cent increase	43 (27)	117 (73)	0 (0)	160 (100)

Note: Figure in parentheses indicate per cent to row total

All the farmers were found to be very conscious in keeping their permanent labourers satisfied about the wages received from the farm. It was found that 43 per cent of the farmers were giving special benefit to labourers during high price as well as during periods of higher yields. The interesting fact observed was that, when price increases, special benefits were distributed to labourers. But when prices declined to lower levels, still farmers were maintaining the labourers without reducing any benefits which they have been already receiving. So, the price change in the positive direction had significant implications on the special benefits distributed to the permanent labourers.

4.4.6 Decisions on food expenditure

The implications of price volatility on food expenses in the short run is presented in Table 4.25. Up to 50 per cent increase or decrease in price was not exerting any influence on the food expenses or habits of farmers in short run. The farmers met the household requirements by taking personal loans from neighbours and friends in the short run.

Table 4.25 Distribution of respondents based on food expenditure decisions in relation to price changes

Price changes/ implications	Food expenses			
	Increase	**No change**	**Decrease**	**Total**
50 per cent decrease	0 (0)	160 (100)	0 (0)	160 (100)
25 per cent decrease	0 (0)	160 (100)	0 (0)	160 (100)
25 per cent increase	0 (0)	160 (100)	0 (0)	160 (100)
50 per cent increase	0 (0)	160 (100)	0 (0)	160 (100)

Note: Figure in parentheses indicate per cent to row total

4.4.7 Decisions on educational expenses

The distribution of respondents based on decision regarding expenses on education in relation to price changes in coffee is presented in Table 4.26.

Table 4.26 Distribution of respondents based on educational expense decisions in relation to price changes

Price changes/ implications	Education expenses			
	Increase	**No change**	**Decrease**	**Total**
50 per cent decrease	0 (0)	160 (100)	0 (0)	160 (100)
25 per cent decrease	0 (0)	160 (100)	0 (0)	160 (100)
25 per cent increase	0 (0)	160 (100)	0 (0)	160 (100)
50 per cent increase	0 (0)	160 (100)	0 (0)	160 (100)

Note: Figure in parentheses indicate per cent to row total

As similar to the pattern of behaviour observed in food expenses, educational expenses made by farmers were also not affected by the volatility of coffee prices in the study area. Not a single farmer changed the educational expenses in line with the changes in price. Most of the sample farmer families have at least one student member (1st standard to Ph. D.) and most of them enjoyed the public education system provided by Government of Kerala.

4.4.8 Decisions on health care expenses

The household level decisions on the expenses related to health in relation to fluctuations in coffee prices is presented in Table 4.27. As similar to the previous patterns observed for expenditure in education and food, it was observed that majority of the farmers were consistent in their health expenses even with the occurrence of extreme fluctuations in prices. It was found that three per cent of the farmers decreased their health expenses when the farmgate prices of coffee declined by 50 per cent. They clearly stated that the severe negative changes in coffee prices significantly influenced their income and subsequently their expenditure on health. It was also found that 21 per cent of the farmers increased their health expenses when prices of coffee increased by 50 per cent. With an increased income, farmers were ready to spend more on medical expenditure.

Table 4.27 Distribution of respondents based on decisions on health care expenses

Price changes/ implications	**Health**			
	Increase	**No change**	**Decrease**	**Total**
50 per cent decrease	0 (0)	157 (98)	3 (2)	160 (100)
25 per cent decrease	0 (0)	157 (98)	3 (2)	160 (100)
25 per cent increase	17 (11)	143 (89)	0 (0)	160 (100)
50 per cent increase	21 (13)	139 (87)	0 (0)	160 (100)

Note: Figure in parentheses indicate per cent to row total

4.4.9 Decisions on savings

The decisions on savings depend on the net income received and attitude towards saving. The income earned by a farmer is determined mainly by the price of the commodity sold. The changes in the saving habits in relation to the changes in price of coffee is presented in Table 4.28.

Table 4.28 Distribution of respondents based on saving decisions in relation to price changes

Price changes/ implications	Savings			
	Increase	No change	Decrease	Total
50 per cent decrease	0 (0)	47 (29)	113 (71)	160 (100)
25 per cent decrease	0 (0)	92 (58)	68 (42)	160 (100)
25 per cent increase	30 (19)	130 (81)	0 (0)	160 (100)
50 per cent increase	87 (54)	73 (46)	0 (0)	160 (100)

Note: Figure in parentheses indicate per cent to row total

A 50 per cent decrease in price of coffee was found to decrease and affect the savings of 71 per cent of the farmers. They spend from their savings to meet the current requirements as well as the crop requirements in the subsequent year. In a similar way, 54 per cent of the farmers increased their savings, when price increased by 50 per cent. Most of the farmers were keeping savings accounts in the local cooperative banks as well as investing in small chits and non-banking financial institutions. Few of the farmers purchased gold as well as land from the profit gained from coffee cultivation. These facts indicate the saving habits prevalent among coffee farmers in Kerala.

4.4.10 Decisions on borrowings

As discussed earlier, when price increases savings also increase, in a similar way when price decreases savings deteriorate and farmers are forced to borrow credit. These changes in credit behaviour in relation to price changes is presented in Table 4.29.

From the table it is evident that for 76 per cent of the sample farmers borrowing of credit increased when prices of coffee decreased by 50 per cent. When price increased by 50 per cent, the indebtedness of the 58 per cent of the sample respondents decreased significantly. As similar to the savings, the borrowing of credit has significant relation with the price received by the farmers. During the field study, farmers stated that if price of coffee increased by 50 per cent, then they were freed from the burden of credit. It was found that all the sample respondents were indebted to institutional credit agencies and have either borrowed from nationalized banks or cooperative banks.

Table 4.29 Distribution of respondents based on borrowing decisions in relation to price changes

	Credit/Loan			
Price changes/ implications	**Increase**	**No change**	**decrease**	**Total**
50 per cent decrease	122 (76)	38 (24)	0 (0)	160 (100)
25 per cent decrease	94 (59)	66 (41)	0 (0)	160 (100)
25 per cent increase	0 (0)	122 (76)	38 (24)	160 (100)
50 per cent increase	0 (0)	67 (42)	93 (58)	160 (100)

Note: Figure in parentheses indicate per cent to row total

4.5 MAGNITUDE OF PRICE VOLATILITY

Volatility is the variability of commodity prices around the trend, while wide price movements over a short period of time typify the term "high volatility" (Deaton, 1999). The inter-annual and intra-annual price volatility indices were used to analyse the magnitude of price volatility in different price series of coffee.

4.5.1 1ntra-annual volatility

The intra-annual volatility implies the dispersion of prices within a year. The monthly coffee prices in different markets were used for the analysis of intra-annual volatility in prices. The results of the price volatility analysis are presented in Table 4.30. While considering the overall time period from 1994 January to 2019 December, the highest intra-annual price volatilities were observed for ICE New York future market price in rupees and Arabica plantation price in US dollars in Hyderabad, with a volatility of 7.47 and 7.56 respectively. The general patterns visible in both international and Indian markets were that of decreased volatilities in second and third periods in comparison to the first period. Few exceptional trends were observed as in the case of ICO indicator price of Robusta in rupees, and London future price in rupees as well as US dollars. In these three series, a nominal increase in price volatility was seen in period II when compared to period I.

From the table it could be observed that the intra-annual volatility indices of domestic price in rupees was highest for Arabica plantation Chennai during period I and III, where as in period II, the intra-annual price volatility was highest for Robusta cherry Chennai. In the international market prices, the intra annual volatility indices for prices in rupees were highest for ICO indicator price-Arabica, London (LIFE) future market price and ICE (New York) market price in period I, II and III respectively.

When the intra-annual volatility of market prices in US dollar in different domestic and international markets were considered for period I, it was found to be highest in the domestic market for Arabica coffee in Hyderabad market, while among the international market prices, ICE (New York future market) exhibited the highest intra-annual volatility. In period II, Robusta cherry Bangalore prices and ICO indicator price of Robusta cherry in the international market exhibited the highest intra-annual instabilities. Arabica cherry price in the Chennai and ICE (New York) markets were found to be the price series with highest intra-annual volatilities in period III.

The intra-annual volatility indices for monthly coffee prices in Indian and international markets in rupees as well as US dollar from 1994 to 2019 are plotted in Figure 1 and 2. It could be observed from the figures that an overall decrease in intra-annual price volatilities in all the price series were observed from 1994 (the period of liberalization) to 2019. A high intra-annual price volatility could be observed for most of the price series during the years from 1994 to 1999 period (Period I). The plotted figures show extreme peaks and dips during several years, which indicate the extreme intra-annual price volatilities of coffee prices in domestic as well as international markets.

There were no significant trend variations observed between intra-annual price volatility indices for prices in rupees and US dollar. Considerable spikes in intra-annual price volatilities were observed in 1997, 2005 and 2014, whereas extreme dips in intra-annual volatilities were observed in 2003, 2010 and 2017 for the price series in rupees. Almost a similar trend could be observed for price series in US dollars also. After the trade liberalization in Indian coffee, the extremities in intra-annual price volatility of coffee prices have considerably reduced. But the seasonal nature and rapid expansion of production capacity in producing countries and slow growth of global consumption have resulted in intra-annual volatility in the system (Abaunza, 2009). In general, it could be concluded that the coffee prices show high intra-annual price volatility and this makes short term market predictions difficult.

The overall time period from 1994 January to 2019 December was considered and the highest intra-annual price volatilities were observed for ICE New York future market price in rupees and Arabica plantation price in US Dollars in Hyderabad, with a volatility index of 7.47 and 7.56 respectively. The general patterns visible in both international and Indian markets were that of decreased intra-annual price volatilities in second and third periods in comparison to the first period for prices in Rupees as well as US Dollars. The increased production with more compatible and efficient storage facilities in both exporting as well as importing points enhanced the stable market condition for coffee (Pradeepa *et al*, 2019). Within the year fluctuation in price have decreased significantly after trade liberalization. The liberalization policies and its supportive measures reduced the abrupt market pressures (Roache, 2010). The stable and significant increase in consumption at traditionally consuming countries as well as the newly emerged coffee consuming countries have opened up a stable demand level for coffee (Sahni, 2014), which caused a stable flow of the produce along with stable price conditions except for some abrupt fluctuations due to the seasonality and climatic abberations. High level of market integration and its subsequent symmetric information transfer after liberalization had also led to the stable and decreased trends in inter -annual price volatility conditions.

Table 4.30 Intra annual volatility indices of coffee prices

Commodity market		Overall	Period I	Period II	Period III
		Prices in Rupees			
India	Arabica Plantation – Bangalore	5.97	8.91	5.34	5.13
	Robusta Cherry – Bangalore	5.56	6.77	6.42	4.10
	Arabica Plantation - Chennai	6.99	9.60	5.75	6.93
	Robusta Cherry – Chennai	6.42	7.74	6.62	5.25
	Arabica Plantation-Hyderabad	7.26	9.38	5.86	6.60
	Robusta Cherry – Hyderabad	6.33	8.98	6.57	4.28
International	ICO composite Indicator Price	6.41	8.04	6.17	5.84
	ICO Indicator Price - Other Mild Arabicas	6.81	9.16	6.28	6.16
	ICO Indicator Price – Robusta	6.30	7.04	7.42	4.81
	ICE (New York)	7.47	9.11	6.96	7.16
	LIFFE (London)	6.59	7.24	7.45	5.40
		Prices in US Dollar			
India	Arabica Plantation – Bangalore	6.39	8.88	5.67	5.62
	Robusta Cherry – Bangalore	5.95	6.87	6.92	4.51
	Arabica Plantation - Chennai	7.44	9.92	6.10	7.04
	Robusta Cherry – Chennai	6.44	7.97	6.66	5.44
	Arabica Plantation-Hyderabad	7.56	9.68	6.35	6.71
	Robusta Cherry – Hyderabad	6.14	8.20	6.90	4.40
International	ICO Composite Indicator Price	6.05	7.56	5.85	5.49
	ICO Indicator Price - Other Mild Arabicas	6.41	8.65	5.89	5.80
	ICO Indicator Price – Robusta	6.03	6.65	7.28	4.46
	ICE (New York)	7.09	8.66	6.59	6.82
	LIFFE (London)	6.27	6.80	7.24	5.11

Note: Over-all period from 1994-95 to 2019-20, Period I from 1994-95 to 1999-2000, Period II from 2000-01 to 2009-10 and Period III from 2010-11 to 2019-20.

Figure 1 Intra-annual volatility of monthly coffee prices in rupees (Per cent)

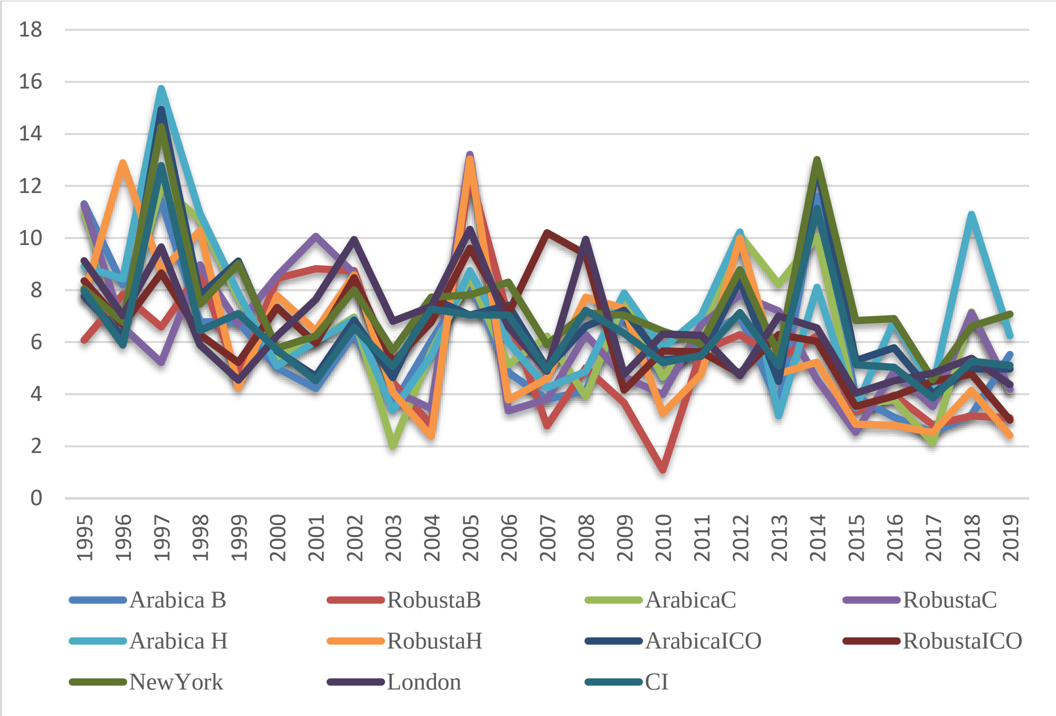
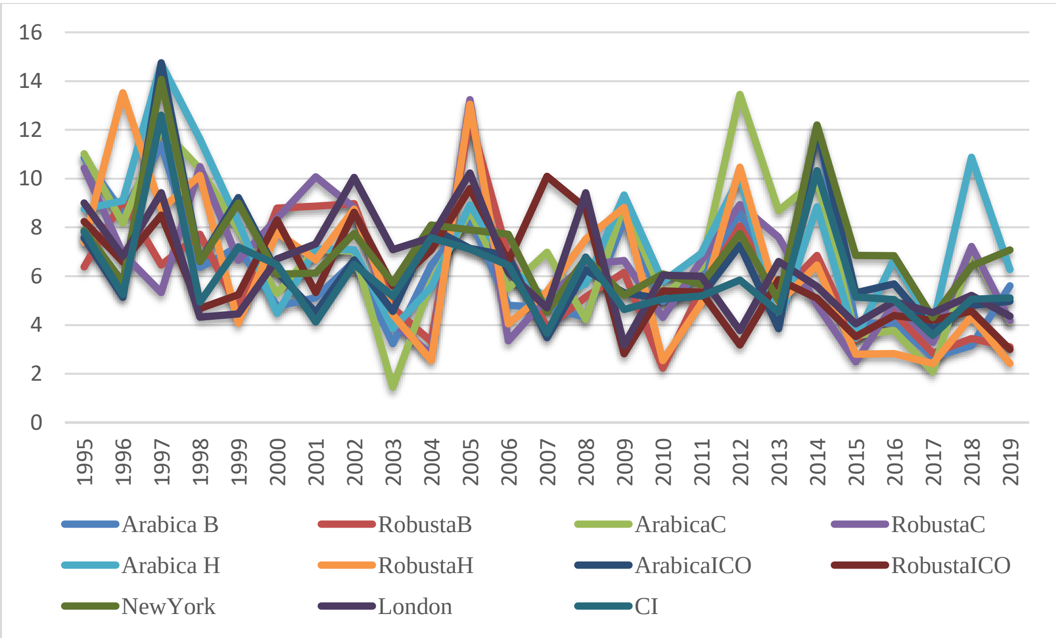


Figure 2 Intra-annual price volatility of coffee price in US dollars (Per cent)



4.5.2 1nter-annual volatility -Parkinson's Index

The inter-annual volatility measures the dispersion of coffee prices between successive years. The monthly coffee prices were used for inter-annual volatility analysis. The estimates of inter-annual volatility of coffee prices in different periods are presented in Table 4.31.

The inter-annual price volatility is estimated by using the Parkinson's index. The highest inter-annual price volatility in domestic market was observed in Hyderabad market for Arabica coffee, whereas the highest inter-annual price volatility in international market was observed for New York future market prices. While comparing the estimated inter-annual price volatility indices in period I, II and III, it could be observed that in general an increasing trend was seen in inter-annual price volatility from period I to III. With increased trade liberalization and integration with the world market, the year-to-year fluctuations in coffee prices have increased in both international and Indian markets and the intra-annual volatility exhibited a similar pattern in both the markets. These findings were in accordance with the observations of Kuruvila *et al.* (2012).

For all the price series, the inter-annual price volatility increased from period I to period II. The highest Parkinson index values were observed for price series in different markets in the third time period. The price series in rupees as well as US dollars followed an approximately similar trend throughout the study period. Among the various price series in different markets, during the overall period, the lowest inter-annual price volatility was observed for prices of Robusta cherry in Bangalore and future market prices in London.

Considering all the coffee price series in domestic as well as international markets in period I, Arabica coffee in Hyderabad showed the highest inter-annual price volatility and Robusta coffee in Bangalore had the lowest inter-annual price volatility index. In period II, Arabica coffee in Chennai has shown the highest index and London future market price showed the lowest index. The Arabica coffee price

Table 4.31 Inter annual volatility indices of coffee prices (Parkinson's index)

Commodity market		Overall	Period I	Period II	Period III
		Prices in Rupees			
India	Arabica Plantation – Bangalore	20.87	16.31	20.65	23.82
	Robusta Cherry – Bangalore	18.75	14.23	18.50	21.70
	Arabica Plantation – Chennai	21.10	15.92	20.82	24.48
	Robusta Cherry – Chennai	19.47	14.55	20.13	21.75
	Arabica Plantation- Hyderabad	21.42	16.59	20.91	24.84
	Robusta Cherry – Hyderabad	19.86	14.66	18.71	21.74
International	ICO Composite Indicator Price	19.80	15.46	19.28	22.92
	ICO Indicator Price - Other Mild Arabicas	20.83	16.49	20.29	23.96
	ICO Indicator Price – Robusta	18.37	14.43	18.29	20.80
	ICE (New York)	20.93	16.22	20.55	23.89
	LIFFE (London)	18.35	14.41	18.31	20.76
		Price in US dollars			
India	Arabica Plantation – Bangalore	21.34	18.26	23.66	24.07
	Robusta Cherry – Bangalore	19.13	17.81	19.77	23.62
	Arabica Plantation – Chennai	22.49	16.81	22.84	25.09
	Robusta Cherry – Chennai	22.51	16.03	21.89	23.84
	Arabica Plantation- Hyderabad	22.87	19.31	22.34	25.93
	Robusta Cherry – Hyderabad	21.44	16.98	20.43	23.19
International	ICO Composite Indicator Price	21.40	17.71	22.03	23.59
	ICO Indicator Price - Other Mild Arabicas	21.77	17.75	22.04	25.64
	ICO Indicator Price – Robusta	20.97	16.69	19.05	23.48
	ICE (New York)	23.44	17.48	21.30	24.56
	LIFFE (London)	21.96	16.66	19.06	22.43

Note: Over-all period from 1994-95 to 2019-20, Period I from 1994-95 to 1999-2000, Period II from 2000-01 to 2009-10 and Period III from 2010-11 to 2019-20.

Figure 3 Inter-annual volatility of monthly coffee price in rupees (Per cent)

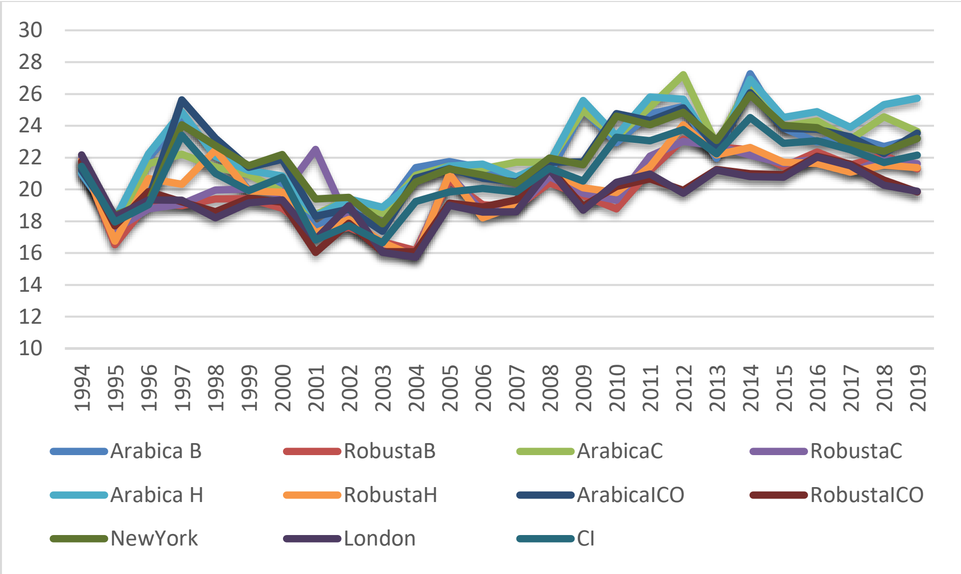
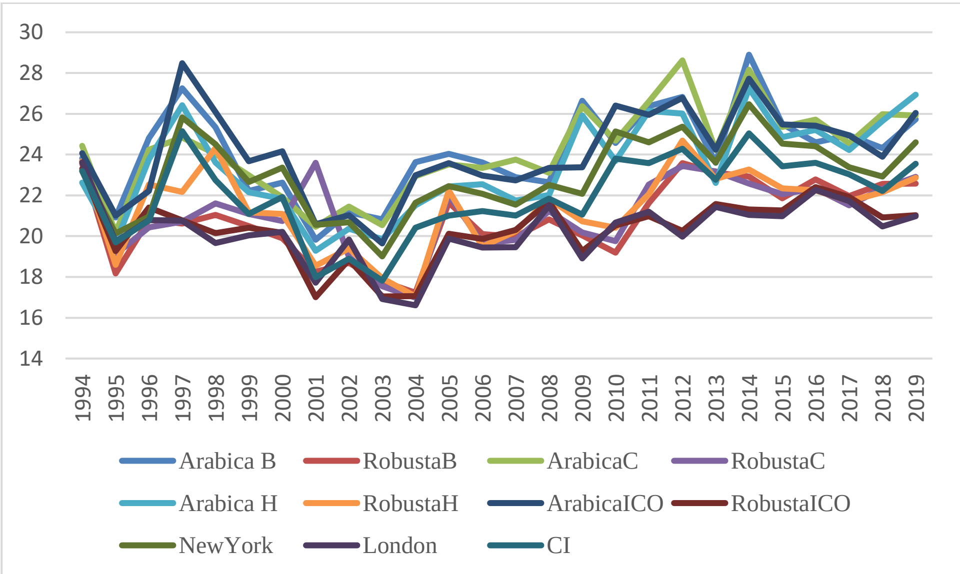


Figure 4 Inter-annual price volatility of coffee price in US dollars (Per cent)



of ICO and London future market prices have shown the highest and lowest inter-annual price volatility respectively in period III.

The inter-annual volatility indices for coffee price in rupees as well as dollar for the period from 1994 to 2019 are plotted in Figure 3 and 4. It could be observed from the figures that the coffee price in all the coffee markets have shown high volatility throughout the study period. While comparing Figures 3 and 4, it could be observed that prices of coffee in both US dollar and rupees have exhibited similar trend throughout the study period. As similar to the intra-annual price volatility, the high inter-annual price volatility was attributed to the increased integration of international market with the domestic coffee markets after the trade liberalization in 1990 (Malladi, 2004). In addition to the implications of trade liberalization in inter-annual price volatility, the frequent production surpluses in the producing countries like Brazil, Vietnam and India, depreciation of producing countries currency against US dollars and involvement of speculative investors in the international market also have influenced the inter annual price volatility of coffee (ICO, 2019).

4.5.3 Annual Price Instability - Cuddy-Della Valle Instability Index

The Cuddy-Della Valle (CDV) index was used to analyse the instability in annual coffee prices and the instability estimates are summarized in Table 4.32 and 4.33. It could be observed from the table that during the overall period, in the domestic market, Arabica coffee prices in Bangalore had relatively high instability, whereas in the international market, London future market price exhibited a relative high instability. A similar trend in instability was also observed for prices in dollar terms also. In the domestic market, all the price series have shown an increase in price instability from period I to period II and decrease in period III. In the international market, with the exception of ICO indicator price of Arabica coffee, all the price series have shown a comparable increasing trend in the CDV index from period I to II and a decrease in period III. It was also observed that the prices in both rupees and US dollar terms have exhibited the similar trends in instability throughout the study period.

While comparing the instability indices of annual price series in domestic market during period I, it was found that the Arabica coffee in Bangalore market had the highest price instability, whereas the lowest price instability was observed for prices of Robusta coffee in Bangalore. In the international market, ICO indicator price for Arabica coffee has shown the highest instability, while the ICO composite indicator price has shown the lowest instability during the same period (Period I). The Arabica coffee in the Hyderabad market had the highest instability in period II, whereas the lowest instability index was observed for prices of Robusta cherry in Chennai market. In the international market, highest instability was observed for London market prices, whereas the lowest was found in the case of ICO composite indicator price series. As similar to period II, in period III, the highest instability indices were exhibited by prices of Arabica coffee in Hyderabad market. The lowest instability in prices during period III in domestic market was observed in Bangalore market for Robusta coffee. While comparing the instability in different sub-periods, it could be concluded that almost all the price series have shown a higher instability in period II in comparison with the instability in period I and III.

The CDV index gives an idea about the instability of average annual coffee prices in different domestic and international markets. The prices in US dollar as well as rupees have revealed almost similar trends throughout the study period. In comparison with the price instability of other crops, coffee prices in domestic as well as international market have high instability throughout the study period. So, it could be concluded that coffee prices are highly unstable in the international as well as in the Indian markets and this trend was reflected even in the domestic price as well as in the microlevel farmgate prices. The existence of high instability in the system was due to the high market integration, technological development and un-interrupted information flow from international market to the domestic market which occurred after liberalization (Joy, 2004).

Table 4.32. Instability of coffee prices in rupees (Cuddy-Della Valle Instability Index in Per cent)

Commodity market		Overall Period	Period I	Period II	Period III
		Prices in Rupees			
India	Arabica Plantation – Bangalore	30.28	20.30	22.48	17.15
	Robusta Cherry – Bangalore	28.55	9.58	21.33	10.77
	Arabica Plantation – Chennai	28.23	15.29	21.51	16.72
	Robusta Cherry – Chennai	27.94	10.27	20.42	11.41
	Arabica Plantation- Hyderabad	29.32	13.31	22.56	17.25
	Robusta Cherry – Hyderabad	29.34	9.78	21.78	12.08
International	ICO Composite Indicator Price	27.75	12.83	14.45	14.27
	ICO Indicator Price - Other Mild Arabicas	28.56	20.27	15.31	15.50
	ICO Indicator Price – Robusta	29.45	13.19	22.69	13.22
	ICE (New York)	28.11	14.98	16.56	17.81
	LIFFE (London)	30.17	13.59	24.06	13.91

Note: Over-all period from 1994-95 to 2019-20, Period I from 1994-95 to 1999-2000, Period II from 2000-01 to 2009-10 and Period III from 2010-11 to 2019-20.

Table 4.33 Instability of annual coffee prices in US Dollar (Cuddy-Della Valle Instability Index in Per cent)

Commodity market		Overall Period	Period I	Period II	Period III
		Prices in US Dollars			
India	Arabica Plantation – Bangalore	34.48	18.26	20.52	17.26
	Robusta Cherry – Bangalore	33.51	10.12	24.01	10.51
	Arabica Plantation – Chennai	31.39	16.51	20.08	16.07
	Robusta Cherry – Chennai	31.06	12.01	22.71	10.38
	Arabica Plantation- Hyderabad	32.04	13.84	20.81	15.94
	Robusta Cherry – Hyderabad	31.79	11.61	22.98	10.80
International	ICO Composite Indicator Price	33.12	13.67	15.66	16.13
	ICO Indicator Price - Other Mild Arabicas	33.41	21.17	15.24	17.76
	ICO Indicator Price – Robusta	35.01	13.85	25.96	11.88
	ICE (New York)	32.72	16.21	17.78	20.35
	LIFFE (London)	36.04	14.55	27.41	12.58

Note: Over-all period from 1994-95 to 2019-20, Period I from 1994-95 to 1999-2000, Period II from 2000-01 to 2009-10 and Period III from 2010-11 to 2019-20.

4.5.4 Annual Price Instability-Coppock's Instability Index

The Coppock's instability index also shows the instability in annual prices of coffee in different domestic and international markets. The estimated instability indices for different time periods are presented in Table 4.34 and 4.35. It could be observed from the table that all the market prices have exhibited high instability index values during the study period which indicate high price fluctuations (increase or decrease) in the market prices of coffee.

In the Indian domestic markets, during the period from 1994-95 to 2019-20, Robusta coffee price in Chennai market showed a relatively lower instability, whereas the Arabica coffee price in the Bangalore market had the highest value for the price instability index. During the same period, in the international market, the London future market price exhibited the maximum instability, while it was lowest for the ICO composite indicator price.

With the exception of few estimates of instability indices, all the market price series expressed a general trend of increasing instability from period I to II, subsequently declining in period III. The highest instability in period I was observed for Arabica coffee in Bangalore market, while it was lowest for Robusta coffee price in the Bangalore market. In the international market, the London future market has shown the highest price instability and the ICO indicator price showed the lowest instability.

The Robusta coffee prices in Hyderabad market was found to have the highest instability in period II, whereas it was lowest in period III. In period II, the lowest instability index value was observed in Bangalore market for Robusta cherry, while the highest instability in period III was observed in Hyderabad market for Arabica coffee.

It was observed that the instability estimates for coffee prices in rupees as well as US dollar terms followed the similar trend throughout the study period. While comparing CDV index and CII, it could be inferred that with minimal exceptions, the instability estimated using both the indices have shown similar

Table 4.34 Instability of annual coffee prices in rupees (Coppock's Instability Index in Per cent)

Commodity market		Overall Period	Period I	Period II	Period III
		Prices in Rupees			
India	Arabica Plantation – Bangalore	24.01	27.25	22.37	24.65
	Robusta Cherry – Bangalore	20.09	14.63	23.11	11.83
	Arabica Plantation – Chennai	22.36	21.54	23.26	23.42
	Robusta Cherry – Chennai	19.70	16.21	24.51	11.20
	Arabica Plantation- Hyderabad	21.16	18.01	24.08	20.73
	Robusta Cherry – Hyderabad	19.81	15.27	25.51	10.79
International	ICO Composite Indicator Price	21.64	20.87	10.13	23.81
	ICO Indicator Price - Other Mild Arabicas	24.16	28.82	17.86	26.76
	ICO Indicator Price – Robusta	23.64	20.10	25.66	16.83
	ICE (New York)	24.94	24.05	21.06	30.21
	LIFFE (London)	25.12	20.45	29.19	18.11

Note: Over-all period from 1994-95 to 2019-20, Period I from 1994-95 to 1999-2000, Period II from 2000-01 to 2009-10 and Period III from 2010-11 to 2019-20.

Table 4.35 Instability of annual coffee prices in USD (Coppock's Instability Index in Per cent)

Commodity market		Overall Period	Period I	Period II	Period III
		Prices in US Dollars			
India	Arabica Plantation – Bangalore	26.16	29.91	23.50	25.45
	Robusta Cherry – Bangalore	22.79	15.25	26.88	11.44
	Arabica Plantation – Chennai	24.37	24.85	24.77	23.61
	Robusta Cherry – Chennai	22.06	17.90	27.62	10.94
	Arabica Plantation- Hyderabad	23.32	20.47	25.75	21.41
	Robusta Cherry – Hyderabad	22.52	15.32	28.07	10.31
International	ICO Composite Indicator Price	24.17	23.74	11.10	23.98
	ICO Indicator Price - Other Mild Arabicas	26.52	32.23	18.79	27.03
	ICO Indicator Price – Robusta	25.74	20.09	28.71	16.30
	ICE (New York)	27.20	27.42	23.02	30.36
	LIFFE (London)	27.52	21.06	32.63	17.74

Note: Over-all period from 1994-95 to 2019-20, Period I from 1994-95 to 1999-2000, Period II from 2000-01 to 2009-10 and Period III from 2010-11 to 2019-20.

pattern of highly unstable coffee prices in both national and international markets during the study period.

4.5.5 Significance and persistence of volatility – Generalized Auto Regressive Conditional Heteroscedasticity (GARCH) model

The estimations of volatility for different price series of coffee were done using various volatility indices in the previous section. Even though the volatility estimates give an idea about the magnitude of volatility, they do not provide any indication of the statistical significance or persistence of volatility in the price series. To discuss about statistical significance as well as persistence of volatility in the prices, a GARCH (1,1) model was fitted for all the price series in domestic as well as international markets. The GARCH (1,1) model was chosen based on the criteria such as heteroscedasticity of price series data (high variability observed in the tail ends, heavier tail ends), residuals are not autocorrelated but residual squares are autocorrelated (conditionality criteria) and a tendency of clustering seen with similar values. Even the high order ARCH model was avoided in the analysis and GARCH models were fitted based on the principle of parsimony (model must be with minimum number of parameters).

A detailed discussion of the results of the GARCH analysis (Table 4.36 to 4.47) of the individual market price series in rupees and US dollar is done below.

The estimates of the fitted GARCH (1,1) model for coffee prices in rupee in Bangalore market are presented in Table 4.36. The GARCH models fitted for Arabica coffee were found to be significant for the overall period as well as all the three sub-periods. The GARCH model for prices of Robusta coffee in the Bangalore market was statistically significant in the overall period. The volatility was computed by the summation of the ARCH and GARCH terms. The $\alpha+\beta$ value of less than 0.4 indicates low volatility, value between 0.4 to 0.7 indicates medium volatility, while values between 0.71 to 0.85 indicates high volatility and a value of greater than 0.86 indicates very high volatility. A value equal to 1 or more than one indicates an explosive volatility condition in the system. During the overall period, Arabica coffee and Robusta coffee prices in Bangalore market showed very high price volatility, which were almost close to explosive volatility. The model was also validated with Ljung-Box test and LM Arch test. A similar pattern of very high price volatility and statistical significance were observed for the price series in US dollar (Table 4.37) also. The volatility of Arabica coffee prices in rupees terms in period I was very high, later declined to medium volatility in period II and it was persistent throughout the third period. The Robusta prices in rupees terms were very high and persistently volatile throughout the study period. Arabica and Robusta prices in dollar terms also were very high volatile throughout the study period, with an exception of comparatively lesser volatility in period III for Arabica coffee. In summary, a highly persistent volatility for Arabica and Robusta coffee prices were observed in Bangalore market.

The estimates of the fitted GARCH (1,1) model for coffee prices in rupee and US dollar in Chennai are presented in Table 4.38 and 4.39. The fitted models were found to be statistically significant for both Arabica and Robusta coffee prices and the model were also validated with Ljung -Box and LM Arch tests. In the overall period, the Arabica coffee prices in rupee as well as US dollar showed very high volatilities, whereas prices of Robusta coffee in rupee exhibited a high volatility, while for the prices in US Dollars, low volatility was observed. While comparing the price volatilities in period, I, II and III in Chennai market, it was found that the volatility in prices of Arabica coffee was very high in period I and declined to medium volatility during the second period and again reverted back to high volatility in the period III, whereas the Arabica coffee prices in US dollar have shown a persistently high volatile condition throughout the study period. The Robusta coffee prices in rupees was found to have a high volatility in period I and III and, a medium volatility in period II, whereas in the case prices in US dollar, the volatility decreased from very high volatility in period I to low volatility in period II and again increased to high volatility in period III.

The coffee prices in Hyderabad market were fitted with a GARCH (1,1) model and the estimates are presented in Table 4.40 and 4.41. The fitted models were found to be statistically significant and were also validated. In the overall period, both the Arabica and Robusta coffee prices were found to be having very high volatility. The volatility of Arabica coffee prices in rupees as well as US dollar have shown a similar trend of very high volatility in period I, declining to high volatility in period II and in turn declining to medium volatility in period III. A general declining trend in Arabica coffee prices were observed for Hyderabad market. The Robusta coffee prices in rupee showed a persistently high volatility in period I and II and declined to medium volatility in period III, whereas for prices in US dollar, the volatility increased from medium in period I to very high volatility in period II and was found to be persistently volatile in third period also.

The GARCH (1,1) models were fitted for international coffee prices such as ICO indicator price for Arabica coffee, ICO indicator price for Robusta coffee and the ICO composite indicator price and the estimates were statistically significant and statistically validated with post hoc tests (Tables 4.42 and 4.45). In the overall period, Arabica and ICO composite indicator prices were found to be exhibiting high volatility, whereas Robusta prices in rupees and US dollar have shown medium and high volatility respectively. The Arabica coffee prices in ICO market exhibited a persistently high volatility during period I and II, while later during period III, the volatility declined and this trend was clearly evident for prices in both rupees and US dollar. The Robusta coffee prices exhibited a very high price volatility in period I and subsequently declined to medium volatility for prices in rupee, while prices in US dollar were found to be high volatile. This trend also continued in period III. The computed volatility for composite indicator price was very high in period I for the prices in both rupees as well as US dollars. During period II, the volatility in rupee prices was persistently high and that for prices in dollar terms declined to high volatility. In period III, all the prices have exhibited low volatilities.

The GARCH (1,1) model fitted for coffee prices in international future markets such as ICE (New York) and LIFE (London) were found to be significant and valid. The New York market was trading in Arabica coffee while Robusta coffee was traded in London market. In the overall period, while the New York market prices exhibited a medium volatility, it was found to be very high volatility for prices in London market. While considering the volatility in different sub-periods, it was found that the New York coffee prices in rupees have shown a high volatility and the prices in US dollars were found to be of medium volatility in period I. Then, the volatility increased to very high and high volatility in period II for prices in rupees and US dollar terms respectively. Later in period III, both dollar and rupee price series were found to exhibit low volatility. The London market prices in rupees have shown a persistent decline in volatility throughout the study period. From very high volatility in period I, it declined to high volatility in period II and yet again declined to medium volatility in period III. The price series in US dollar exhibited a persistent high volatility in period I and II and subsequently declined to a highly volatile state.

It could be concluded from the above analyses that all the GARCH (1,1) models fitted for coffee prices were statistically significant, which were also validated with Ljung Box and LM Arch tests. Most of the domestic as well as international price series of coffee have exhibited a high to very highly persistent and significant price volatility. In some of the cases, the volatilities were highly explosive. All these could be attributed to the unavailability of particular variety of coffee in the international market as the result of reduced production in the producing countries due to weather related constraints such as frost and drought, including drought in Brazil (Damatta, 2006), occurrence of frost in Brazilian coffee belts (ICO, 2021) and sudden export policy shifts like coffee market reforms in Africa (Akiyama *et al.,* 2003)). All these GARCH estimates indicate the persistence of high volatility in coffee markets in the post- liberalization era. While considering the period from 1994 to 2019, it could be concluded that a relative decrease in price volatility and significance was also observed in some of the price series. It was due to the increased production stock and improved inventory management at the domestic points as well as in the importing countries. This situation reduced the pressure on volatility and led to a decline in the significance of price volatility.

Table 4.36 Estimates of the fitted GARCH models for coffee prices (₹) in Bangalore

Particulars	Indian markets							
	Arabica Plantation – Bangalore				Robusta Cherry – Bangalore			
	Overall	Period I	Period II	Period III	Overall	Period I	Period II	Period III
Constant	0.0014** (1.56)	0.013 (0.62)	0.0012** (2.36)	0.00017 (3.12)	0.004** (1.29)	0.0085 (1.65)	0.004** (1.92)	0.0011*** (4.73)
Estimates of ARCH term (α)	0.04** (1.35)	0.02 (1.99)	0.44*** (3.23)	0.07*** (4.13)	0.01** (1.46)	0.01*** (3.35)	0.01 (2.45)	0.05 (1.89)
Estimates of GARCH term (β)	0.82* (2.61)	0.86* (1.96)	0.23*** (3.33)	0.38 (2.76)	0.89* (1.01)	0.90 (0.49)	0.88 (3.65)	0.89 (1.22)
Log likelihood	400.61	57.77	181.65	175.17	422.14	72.29	156.64	206.38
α+β	0.86	0.88	0.67	0.44	0.89	0.91	0.89	0.94
Ljung-Box test	0.01	0.50	0.02	0.56	0.00	0.71	0.43	0.56
LM Arch test	0.97	0.40	0.46	0.90	0.97	0.63	0.96	0.98
Volatility	Very high	Very high	Medium	Medium	Very high	Very high	Very high	Very high

Note: * denotes significant at one per cent level, ** denotes significant at five per cent level, ***denotes significant at ten per cent level, figure in parenthesis indicate calculated z statistics

Table 4.37 Estimates of the fitted GARCH models for coffee prices (USD) in Bangalore

Particulars	Indian markets							
	Arabica Plantation – Bangalore				Robusta Cherry – Bangalore			
	Overall	Period I	Period II	Period III	Overall	Period I	Period II	Period III
Constant	0.0019 (1.36)	0.001 (0.79)	0.0023 (2.11)	0.0012* (2.88)	0.00048 (1.43)	0.0087 (1.57)	0.0008 (1.88)	0.0015 (1.17)
Estimates of ARCH term (α)	0.06** (1.27)	0.02*** (3.22)	0.02 (1.34)	0.50** (1.98)	0.01** (1.59)	0.04 (2.87)	0.06 (2.11)	0.05 (0.99)
Estimates of GARCH term (β)	0.89* (296)	0.97 (2.11)	0.87* (1.31)	0.22** (2.67)	0.90* (0.55)	0.87*** (4.66)	0.90* (1.98)	0.90* (1.19)
Log likelihood	387.40	57.78	128.91	175.77	405.44	72.53	124.15	196.57
α+β	0.95	0.98	0.89	0.73	0.91	0.91	0.96	0.95
Ljung-Box test	0.02	0.48	0.13	0.70	0.05	0.70	0.07	0.16
LM Arch test	0.52	0.27	0.52	0.62	0.96	0.71	0.88	0.49
Volatility	Very high	Very high	Very high	High	Very high	Very high	Very high	Very high

Note: * denotes significant at one per cent level, ** denotes significant at five per cent level, ***denotes significant at ten per cent level, figure in parenthesis indicate calculated z statistics

Table 4.38 Estimates of the fitted GARCH models for coffee prices (₹) in Chennai

Particulars	Indian markets							
	Arabica Plantation – Chennai				Robusta Cherry – Chennai			
	Overall	Period I	Period II	Period III	Overall	Period I	Period II	Period III
Constant	0.0081* (1.02)	0.018*** (3.56)	0.00001 (0.99)	0.0004*** (4.96)	0.0283* (2.87)	0.0024** (2.12)	0.00010 (1.49)	0.0069 (1.01)
Estimates of ARCH term (α)	0.20* (3.21)	0.31*** (4.14)	0.01 (3.11)	0.17** (2.18)	0.28** (1.34)	0.80** (1.78)	0.02** (0.88)	0.01 (3.89)
Estimates of GARCH term (β)	0.70* (2.13)	0.62* (2.64)	0.69*** (4.96)	0.78* (2.36)	0.51 (1.89)	0.03* (2.33)	0.70 (1.42)	0.74*** (3.56)
Log likelihood	353.07	48.99	167.99	144.26	303.70	58.51	167.44	179.20
α+β	0.90	0.93	0.70	0.95	0.79	0.84	0.70	0.75
Ljung-Box test	0.41	0.80	0.51	0.39	0.89	0.90	0.51	0.31
LM Arch test	0.80	0.98	0.14	0.25	0.96	0.84	0.14	0.99
Volatility	Very high	Very high	Medium	Very high	High	High	Medium	high

Note: * denotes significant at one per cent level, ** denotes significant at five per cent level, ***denotes significant at ten per cent level, figure in parenthesis indicate calculated z statistics

Table 4.39 Estimates of the fitted GARCH models for coffee prices (USD) in Chennai

Particulars	Indian markets							
	Arabica Plantation – Chennai				Robusta Cherry – Chennai			
	Overall	Period I	Period II	Period III	Overall	Period I	Period II	Period III
Constant	0.0059** (2.99)	0.0020*** (3.48)	0.0010 (1.01)	0.0036** (2.31)	0.00286* (2.56)	0.0035** (2.01)	0.00709 (1.56)	0.0048 (1.23)
Estimates of ARCH term (α)	0.19* (2.89)	0.25 (2.44)	0.24** (2.95)	0.25**	0.77** (1.96)	0.66** (1.71)	0.19* (0.91)	0.07 (4.21)
Estimates of GARCH term (β)	0.74* (2.17)	0.65* (2.56)	0.68* (3.11)	0.64* (2.16)	0.01 (2.01)	4.29*** 2.12)	0.03 (1.53)	0.78* (1.69)
Log likelihood	343.62	46.59	109.51	146.91	341.95	55.71	106.31	175.15
α+β	0.93	0.90	0.91	0.89	0.78	0.95	0.22	0.84
Ljung-Box test	0.50	0.86	0.88	0.55	0.90	0.81	0.95	0.23
LM Arch test	0.86	0.96	0.85	0.78	0.99	0.86	0.96	0.96
Volatility	Very high	Very high	Very high	Very high	Low	Very high	Low	High

Note: * denotes significant at one per cent level, ** denotes significant at five per cent level, ***denotes significant at ten per cent level, figure in parenthesis indicate calculated z statistics

Table 4.40 Estimates of the fitted GARCH models for coffee prices (₹) in Hyderabad

Particulars	Indian markets							
	Arabica Plantation – Hyderabad				Robusta Cherry – Hyderabad			
	Overall	Period I	Period II	Period III	Overall	Period I	Period II	Period III
Constant	0.0094** (1.85)	0.0002 (2.65)	0.0056 (1.07)	0.0017*** (3.73)	0.0017* (0.96)	0.0032 (0.57)	0.0081 (4.23)	0.0007 (2.36)
Estimates of ARCH term (α)	0.01** (2.53)	0.01*** (3.89)	0.02*** (4.32)	0.01 (1.01)	0.86* (3.56)	0.18 (2.38)	0.01 (1.79)	0.42** (1.64)
Estimates of GARCH term (β)	0.87* (1.55)	0.90 (0.98)	0.81 (2.32)	0.64 (2.63)	0.10 (1.96)	0.55** (1.29)	0.81** (1.23)	0.25*** (4.69)
Log likelihood	338.64	42.14	168.97	148.82	404.29	55.55	148.57	209.71
α+β	0.88	0.91	0.83	0.65	0.96	0.74	0.82	0.67
Ljung-Box test	0.94	0.99	0.34	0.74	0.73	0.02	0.54	0.83
LM Arch test	0.99	0.99	0.38	0.81	0.96	0.16	0.99	0.81
Volatility	Very high	Very high	High	Medium	Very high	High	High	Medium

Note: * denotes significant at one per cent level, ** denotes significant at five per cent level, ***denotes significant at ten per cent level, figure in parenthesis indicate calculated z statistics

Table 4.41 Estimates of the fitted GARCH models for coffee prices (USD) in Hyderabad

Particulars	Indian markets							
	Arabica Plantation – Hyderabad				Robusta Cherry – Hyderabad			
	Overall	Period I	Period II	Period III	Overall	Period I	Period II	Period III
Constant	0.0097*** (4.11)	0.0019 (2.39)	0.0012 (1.11)	0.0018*** (3.89)	0.0018* (1.12)	0.0058** (2.86)	0.0032 (3.56)	0.0088 (2.31)
Estimates of ARCH term (α)	0.14*** (2.87)	0.03 (1.05)	0.06 (1.23)	0.02 (1.36)	0.86* (2.98)	0.31 (1.56)	0.86* (1.69)	0.18** (2.45)
Estimates of GARCH term (β)	0.77* (1.69)	0.83*** (3.01)	0.74** (2.67)	0.60 (2.46)	0.08*** (4.12)	0.26 (1.33)	0.01 (1.36)	0.79* (1.89)
Log likelihood	328.85	41.23	99.48	147.27	394.36	55.33	114.86	203.78
α+β	0.91	0.86	0.80	0.62	0.94	0.57	0.86	0.97
Ljung-Box test	0.83	0.97	0.89	0.66	0.81	0.97	0.77	0.81
LM Arch test	1.00	0.99	0.99	0.68	0.89	0.63	0.05	0.49
Volatility	Very high	Very high	High	Medium	Very high	Medium	Very high	Very high

Note: * denotes significant at one per cent level, ** denotes significant at five per cent level, ***denotes significant at ten per cent level, figure in parenthesis indicate calculated z statistics

Table 4.42 Estimates of the fitted GARCH models for coffee prices (₹) in international market

Particulars	International Coffee Organization market							
	ICO Indicator Price - Other Mild Arabicas				ICO Indicator Price – Robusta			
	Overall	Period I	Period II	Period III	Overall	Period I	Period II	Period III
Constant	0.0014* (2.56)	0.0027 (2.13)	0.0090 (2.86)	0.0025*** (3.65)	0.0019 (0.98)	0.0011 (1.58)	0.0029 (2.35)	0.0007 (2.01)
Estimates of ARCH term (α)	0.23* (1.86)	0.36 (1.23)	0.04* (1.57)	0.32 (1.66)	0.43* (0.54)	0.33 (2.61)	0.44* (2.22)	0.10** (1.89)
Estimates of GARCH term (β)	0.51* (1.63)	0.45*** (4.64)	0.72 (1.56)	0.01 (2.33)	0.22* (1.65)	0.56* (1.89)	0.06*** (4.34)	0.58 (2.14)
Log likelihood	381.67	59.35	161.18	168.28	408.35	74.11	147.61	196.17
α+β	0.74	0.81	0.76	0.33	0.64	0.89	0.50	0.68
Ljung-Box test	0.19	0.73	0.47	0.30	0.13	0.53	0.34	0.10
LM Arch test	0.85	0.57	0.85	0.99	0.18	0.95	0.06	0.98
Volatility	High	High	High	Low	Medium	Very high	Medium	Medium

Note: * denotes significant at one per cent level, ** denotes significant at five per cent level, ***denotes significant at ten per cent level, figure in parenthesis indicate calculated z statistics

Table 4.43 Estimates of the fitted GARCH models for coffee prices (USD) in international market

Particulars	International Coffee Organization market							
	ICO Indicator Price - Other Mild Arabicas				ICO Indicator Price – Robusta			
	Overall	Period I	Period II	Period III	Overall	Period I	Period II	Period III
Constant	0.0014* (2.34)	0.0024 (2.39)	0.0016*** (4.12)	0.0026 (1.96)	0.0014* (1.01)	0.0009 (1.96)	0.0017*** (4.89)	0.0005** (1.86)
Estimates of ARCH term (α)	0.22* (2.01)	0.38*** (3.21)	0.33*** (4.86)	0.25** (1.46)	0.45* (0.91)	0.29*** (3.01)	0.34** (2.09)	0.10 (1.92)
Estimates of GARCH term (β)	0.49* (1.56)	0.45* (1.88)	0.47* (1.65)	0.00 (2.43)	0.30*** (3.77)	0.60* (2.01)	0.43** (3.24)	0.66 (2.89)
Log likelihood	393.81	61.75	128.76	170.95	420.32	77.30	136.64	203.98
α+β	0.71	0.83	0.80	0.25	0.75	0.90	0.76	0.75
Ljung-Box test	0.06	0.71	0.43	0.12	0.07	0.69	0.32	0.58
LM Arch test	0.43	0.88	0.81	0.99	0.41	0.88	0.90	0.74
Volatility	High	High	High	Low	High	Very high	High	High

Note: * denotes significant at one per cent level, ** denotes significant at five per cent level, ***denotes significant at ten per cent level, figure in parenthesis indicate calculated z statistics

Table 4.44 Estimates of the fitted GARCH models for coffee prices (₹) in international market

Particulars	International Coffee Organization market			
	ICO composite indicator price			
	Overall	Period I	Period II	Period III
Constant	0.0013** (1.85)	0.0016 (1.32)	0.0019 (2.41)	0.0024 (2.23)
Estimates of ARCH term (α)	0.22* (1.56)	0.51** (2.36)	0.00 (4.54)	0.24*** (3.65)
Estimates of GARCH term (β)	0.52* (2.23)	0.42** (1.89)	0.95* (1.39)	0.10*** (4.10)
Log likelihood	400.73	67.81	164.90	174.63
α+β	0.74	0.93	0.95	0.34
Ljung-Box test	0.12	0.66	0.53	0.29
LM Arch test	0.93	0.97	0.96	0.98
Volatility	High	Very high	Very high	Low

Note: * denotes significant at one per cent level, ** denotes significant at five per cent level, ***denotes significant at ten per cent level figure in parenthesis indicate calculated z statistics

Table 4.45 Estimates of the fitted GARCH models for coffee prices (USD) in international market

Particulars	International Coffee Organization market			
	ICO composite indicator price			
	Overall	Period I	Period II	Period III
Constant	0.00110* (0.72)	0.0012** (1.56)	0.0013** (2.13)	0.0024 (2.49)
Estimates of ARCH term (α)	0.22* (1.89)	0.51** (2.98)	0.37** (3.33)	0.13** (2.43)
Estimates of GARCH term (β)	0.51* (1.98)	0.46* (2.02)	0.45* (1.96)	0.03 (2.01)
Log likelihood	414.36	70.94	138.64	179.76
α+β	0.73	0.97	0.82	0.16
Ljung-Box test	0.06	0.72	0.55	0.15
LM Arch test	0.90	0.93	0.91	0.97
Volatility	High	Very high	High	Low

Note: * denotes significant at one per cent level, ** denotes significant at five per cent level, ***denotes significant at ten per cent level, figure in parenthesis indicate calculated z statistics

Table 4.46 Estimates of the fitted GARCH models for coffee prices (₹) in international futures market

Particulars	Futures market							
	ICE (New York)				LIFFE (London)			
	Overall	Period I	Period II	Period III	Overall	Period I	Period II	Period III
Constant	0.0023** (1.23)	0.0025 (1.56)	0.0001 (1.89)	0.0036 (2.31)	0.0046 (1.96)	0.0006 (2.22)	0.0016** (3.25)	0.0089 (2.89)
Estimates of ARCH term (α)	0.19* (2.01)	0.33*** (2.36)	0.03 (1.89)	0.25*** (4.11)	0.17*** (4.75)	0.29 (2.65)	0.01 (1.96)	0.10 (3.47)
Estimates of GARCH term (β)	0.50* (1.98)	0.46* (1.77)	4.93*** (3.91)	0.01 (0.59)	0.74** (2.36)	0.66* (4.02)	0.70 (3.89)	4.56*** (3.46)
Log likelihood	352.99	57.59	149.62	150.56	394.03	71.21	141.81	183.13
α+β	0.68	0.79	0.96	0.26	0.91	0.95	0.71	0.66
Ljung-Box test	0.23	0.54	0.50	0.33	0.00	0.47	0.10	0.21
LM Arch test	0.89	0.71	0.86	0.98	0.53	0.95	0.70	0.95
Volatility	Medium	High	Very high	Low	Very high	Very high	High	Medium

Note: * denotes significant at one per cent level, ** denotes significant at five per cent level, ***denotes significant at ten per cent level, figure in parenthesis indicate calculated z statistics

Table 4.47 Estimates of the fitted GARCH models for coffee prices (USD) in international futures market

Particulars	Futures market							
	ICE (New York)				LIFFE (London)			
	Overall	Period I	Period II	Period III	Overall	Period I	Period II	Period III
Constant	0.0018** (1.43)	0.0026 (1.51)	0.0020*** (3.03)	0.0037 (2.54)	0.0005* (1.86)	0.00045 (1.96)	0.007* (2.89)	0.0066 (3.11)
Estimates of ARCH term (α)	0.17* (1.96)	0.36*** (3.05)	0.29* (1.11)	0.10* (0.98)	0.20* (3.16)	0.29** (3.68)	0.25* (2.01)	0.06 (3.58)
Estimates of GARCH term (β)	0.52* (2.13)	0.47* (1.11)	0.45* (1.56)	0.07 (1.1)	0.70* (2.45)	0.67 (3.33)	0.67* (2.98)	0.66** (2.36)
Log likelihood	363.94	59.77	120.94	153.84	405.23	74.67	131.31	188.73
α+β	0.69	0.83	0.74	0.17	0.90	0.96	0.92	0.72
Ljung-Box test	0.08	0.53	0.43	0.14	0.00	0.63	0.04	0.39
LM Arch test	0.84	0.82	0.91	0.90	0.53	0.86	0.78	0.84
Volatility	Medium	Medium	High	Low	Very high	Very high	Very high	High

Note: * denotes significant at one per cent level, ** denotes significant at five per cent level, ***denotes significant at ten per cent level, figure in parenthesis indicate calculated z statistics

The findings of the volatility analyses clearly point to the significant and persistently volatile nature of coffee prices in both Indian and international markets.

4.6 DETERMINANTS OF PRICE VOLATILITY

In order to find out the determinants or causes of price volatility in coffee prices, a linear regression model was fitted and step-wise regression was done due to the presence of large number of independent variables, which in turn could lead to low degrees of freedom. The price volatility in the average domestic wholesale price was hypothesized as a function of coffee production at the state and national levels, weather parameters in the study area, annual coffee exports, annual coffee imports, exchange rate of Indian rupee against US dollar and annual consumption of coffee at the national level.

A linear regression model was fitted and step-wise regression analysis was employed to understand the factors contributing to price volatility in Indian coffee markets. The specific combination of linear model was chosen based on leap plot results. The graphical representation of leap plot is presented in Figure 5.0. Based on the number of black-coloured bands on the leap plot, the specific significant linear combination with maximum adjusted R^2 was chosen as the fitted linear model. The fitted linear model is expressed as:

$$\mathrm{Y} = \mathrm{b}_0 + \mathrm{b}_1\mathrm{X}_{1\mathrm{t}} + \mathrm{b}_5\mathrm{X}_{5\mathrm{t}} + \mathrm{b}_6\mathrm{X}_{6\mathrm{t}} + \mathrm{b}_8\mathrm{X}_{8\mathrm{t}} + \mathrm{b}_{13}\mathrm{X}_{13\mathrm{t}} + \mathrm{b}_{15}\mathrm{X}_{15\mathrm{t}} + \mathrm{b}_{16}\mathrm{X}_{16\mathrm{t}} + \mathrm{b}_{17}\mathrm{X}_{17\mathrm{t}} + \mathrm{b}_{18}\mathrm{X}_{18\mathrm{t}}$$

$\mathrm{Y} = \text{Coefficient of Variation of coffee wholesale price}$

$\mathrm{b}_0 = \text{Intercept} \quad \mathrm{b}_1 \rightarrow \mathrm{b}_{18} = \text{Regression coefficients}$

$\mathrm{X}_{1\mathrm{t}} = \text{Coffee production in India during } \mathrm{t}^{\mathrm{th}} \text{ year}$

$\mathrm{X}_{5\mathrm{t}} = \text{Quantity of coffee consumed in India at } \mathrm{t}^{\mathrm{th}}\text{year}$

$\mathrm{X}_{6\mathrm{t}} = \text{Temperature in first quarter in the study area during } \mathrm{t}^{\mathrm{th}}\text{year}$

$\mathrm{X}_{8\mathrm{t}} = \text{Temperature in third quarter in the study area during } \mathrm{t}^{\mathrm{th}}\text{year}$

$X_{13t} =$ Rainfall in fourth quarter in the study area during t^{th}year

$X_{15t} =$ Humidity in second quarter in the study area during t^{th}year

$X_{16t} =$ Humidity in third quarter in the study area during t^{th}year

$X_{17t} =$ Humidity in fourth quarter in the study area during t^{th}year

$X_{18t} =$ Average exchange rate of Indian rupee against USD during t^{th}year

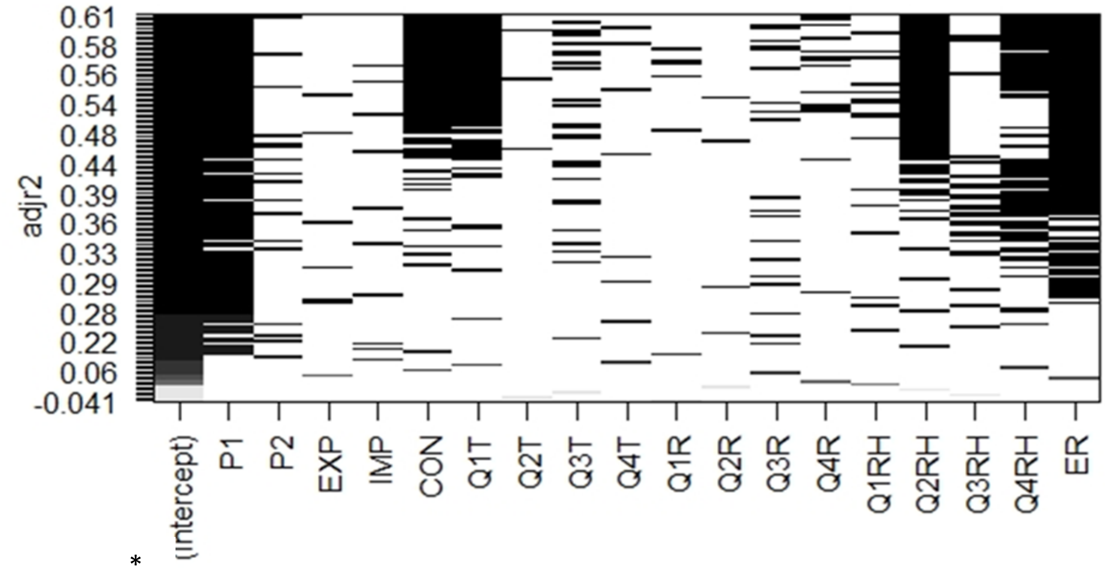
The estimates of the fitted linear model is presented in Table 4.48 and Figure 6. Among the 18 independent variables, eight independent variables were chosen for the fitted linear regression model after step-wise regression analysis. Among the eight variables, only six independent variables were found to be statistically significant in the results. The dependent variable, the coefficient of variation in monthly wholesale prices of coffee for each year was considered as the indicator of volatility in prices and the estimates from the fitted model indicate how these listed variables influence the volatility in wholesale coffee prices in India.

Table 4.48 Estimates of the fitted linear regression model for causes of price volatility in Indian domestic market

Particulars	**Estimates**	**Standard Error**	**P value**	**VIF**
Intercept	-56.21***	11.98	0.0002	
Production	3.56***	0.67	0.0001	3.69
Consumption	1.41***	0.47	0.0087	2.93
Q I Temperature	8.08**	3.27	0.0244	1.55
Q III Temperature	2.79	1.95	0.1713	1.36
Q IV Rainfall	-0.18	0.12	0.1657	1.31
Q II Relative humidity	-7.45***	2.03	0.0019	2.45
Q IV Relative humidity	1.92**	0.87	0.0416	1.33
Exchange rate	-2.42***	0.53	0.0003	4.66
R^2	0.74	-	-	-
Adjusted R^2	0.67	-	-	-
Shapiro-wilk normality test	0.97	-	-	-
Durbin-Watson statistics	1.98	-	-	-

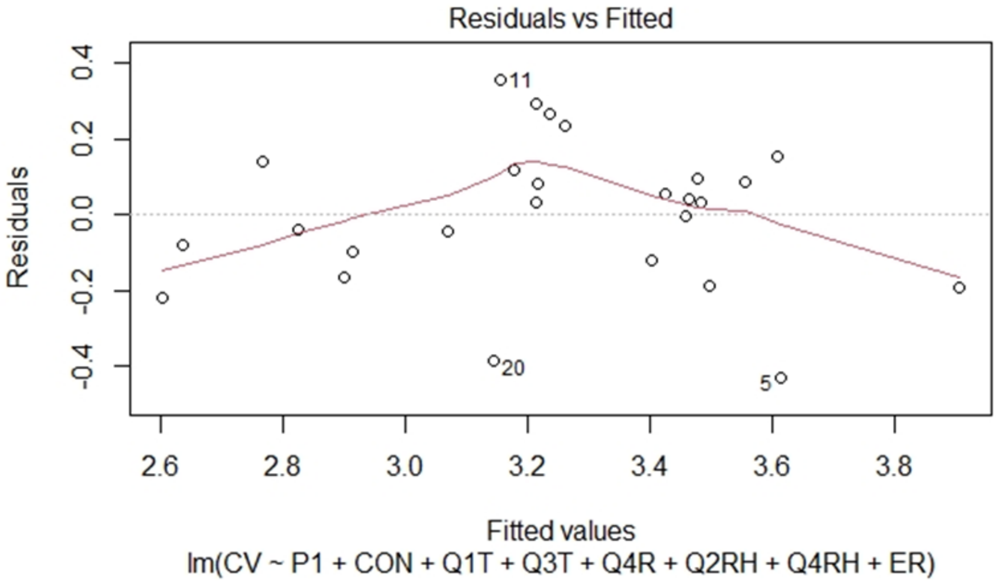
***denotes significant at one percent level, ** denotes significant at five per cent level

Figure 5. Step-wise regression- Leap's plot



*P1=X_{1t} , P2=X_{2t}, EXP=X_{3t}, IMP=X_{4t}, CON=X_{5t}, Q1T=X_{6t} Q2T=X_{7t}, Q3T=X_{8t}, Q4T=X_{9t} , Q1R=X_{10t} , Q2R=X_{11t} , Q3R=X_{12t} , Q4R=X_{13t} , Q1RH=X_{14t} , Q2RH= X_{15t}, Q3RH=X_{16t} , Q4RH=X_{17t} , ER= X_{18t}

Figure 6. Fitted linear regression model



From Table 4.48, it is clearly evident that 74 per cent of the variation in volatility in coffee prices in India could be attributed to the eight independent variables. The linear regression model was subjected to statistical validation tests to check the autocorrelation, multicollinearity and normality. The VIF values of less than five for all the independent variables and intercept indicated that the model had the acceptable level of multicollinearity. The DW statistics value of 1.98~2 indicated that it was free from auto correlation and the value of normality statistics also strongly recommended the validity and significance of the selected linear regression model.

The agricultural commodity prices vary with changes in production and consumption (Gilbert, 2010). The iterated regression estimates of the Indian production variable indicates that a one unit increase in production (one metric ton) from the mean level would result in 3.56 units (per cent) change in wholesale price volatility from the mean level. Shocks to production and consumption transmit into price variability (Gilbert and Morgan, 2010). The highly significantly estimate obtained for production in the linear model implies a significant relation between production of coffee in the country and price volatility. Similarly, a one unit (metric ton) increase in consumption from the mean level was found to increase the price volatility by 1.41 per cent. The present study, thus confirmed the direct implications of production and consumption changes on volatility of coffee prices in India and the direct transmission of volatility signals from these variables.

Weather shocks to agricultural yield is an inevitable factor causing price variability (Balcombe, 2009), In the present model, it was assumed that the effect of weather factors in the t-1th year would influence the production in the current year. The weather parameters such as rainfall, temperature and relative humidity in the study area in the tth year also were assumed to have a direct effect on price volatility. A one unit increase in temperature (^{o}C) in the first quarters was found to result in 8.08 per cent change in coffee price variability. The second and fourth quarter relative humidity (per cent) also were found to have significant implications on price volatility. A one unit increase in fourth quarter rainfall was found to decrease the price volatility. Similarly, the second quarter relative humidity also was found to cause a decline in price volatility by 7.45 per cent, whereas one percent increase in the fourth quarter relative humidity was found to result in a 1.92 per cent increase in price volatility. Other than market factors, climatic factors such as rainfall, temperature and snow had significant implications on price volatility of coffee (ITC, 2017). The volatility indices were found to be high during the years of deficient rainfall in the coffee growing areas (Kuruvila *et al.*,2012) and this finding was in accordance with the current observations.

The present analysis did not discuss about the direct impact of weather parameters on production, but the study discusses about its consequence as well as indirect implications on commodity prices. The study also gives some hints regarding the direct effect of climatic factors on price volatility in the study area. Demand shocks, income shocks and policy shocks such as changes in exchange rate also play an important role in price volatility (Christiaensen, 2009). The rupee-US dollar exchange rate in the specified model also was found to be having significant effect on volatility of prices. A unit increase in exchange rate (Value of Indian rupee against US dollar) was found to cause a 2.42 per cent decline in price volatility. In accordance with the findings of Gilbert, Morgan, Balcome, Kuruvila and Christiaensen, it could be concluded that the volatility in prices of Indian coffee is significantly dependent on various factors such as production, consumption, weather parameters and currency exchange rates.

4.7 BEHAVIOR, INTEGRATION AND TRANSMISSION OF COFFEE PRICES

The price of a commodity in a market is formed as a result of various economic, political, physical and social processes and this is called as price formation (Indira, 1988). The occurrence and movement of prices in the market system is explained by the study of price behaviour. The relationship of the price of a commodity in the market with other commodities or markets and the direction of movement of price signals is termed as price transmission and direction of price transmission. The formation or determination as well as the behavior of coffee prices and the extent as well as direction of price transmission between Indian and International markets of coffee prices were analysed.

4.7.1 Behavior of coffee prices

4.7.1.1 Behaviour of monthly coffee prices

The monthly prices of Arabica and Robusta coffee in different Indian and international markets are plotted in Figures 7 and 8. From Figure 7, it could be observed that all the Arabica price series moved closely after liberalization exhibiting a similar pattern and a significant divergence occurred only during 2009 and again followed a similar pattern with slight divergence in 2010. Thereafter, a slight divergence was observed between various Arabica coffee prices. After 2014, the divergence between coffee prices increased and by 2018 divergence reduced and the price series began to move closely. Throughout the study period, the ICO composite indicator price exhibited the lowest magnitude among coffee prices and Arabica coffee prices in Hyderabad had the highest price during the whole period. The international as well as domestic Arabica coffee prices moved together during the study period. While considering the sub-periods of the study, it could be observed that the price movements in different markets were very close during period I and II, whereas in period III, an increasing divergence between prices could be observed.

The prices of Robusta coffee in different domestic as well as international markets moved closely, especially during period I and II. In the case of Arabica prices, all the prices were above the ICO composite indicator price, whereas for Robusta coffee, all the price series were placed below the ICO composite indicator price. The ICO composite indicator price series formed a mean price series for all the Arabica and Robusta prices. Among the prices of Robusta coffee, a comparatively low magnitude was observed in London future market during most of the time. During period III, the relative divergence between the price series were found to be more than the previous time periods.

Figure 7 Plot of monthly Indian and international Arabica coffee prices in ₹/kg

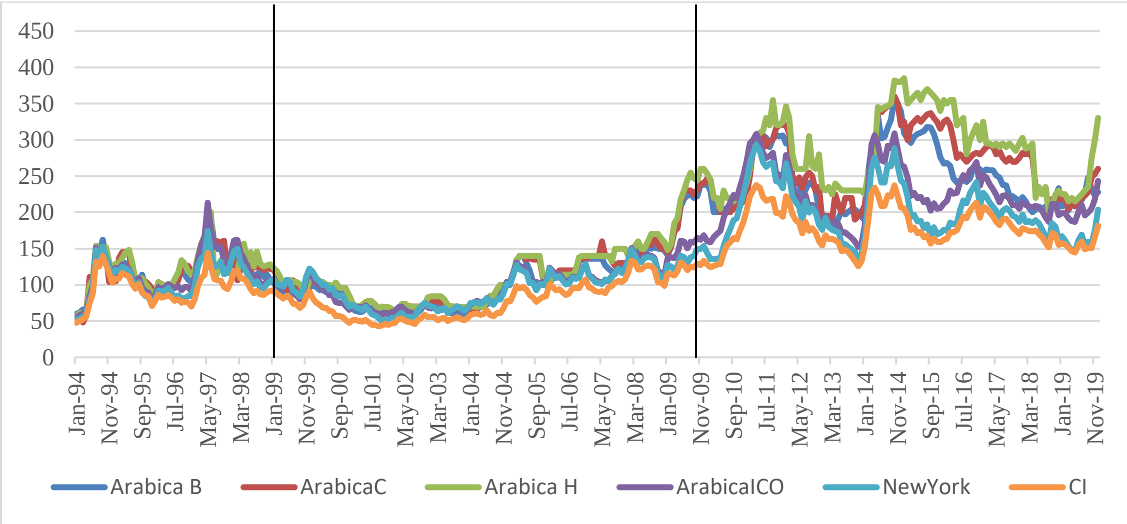
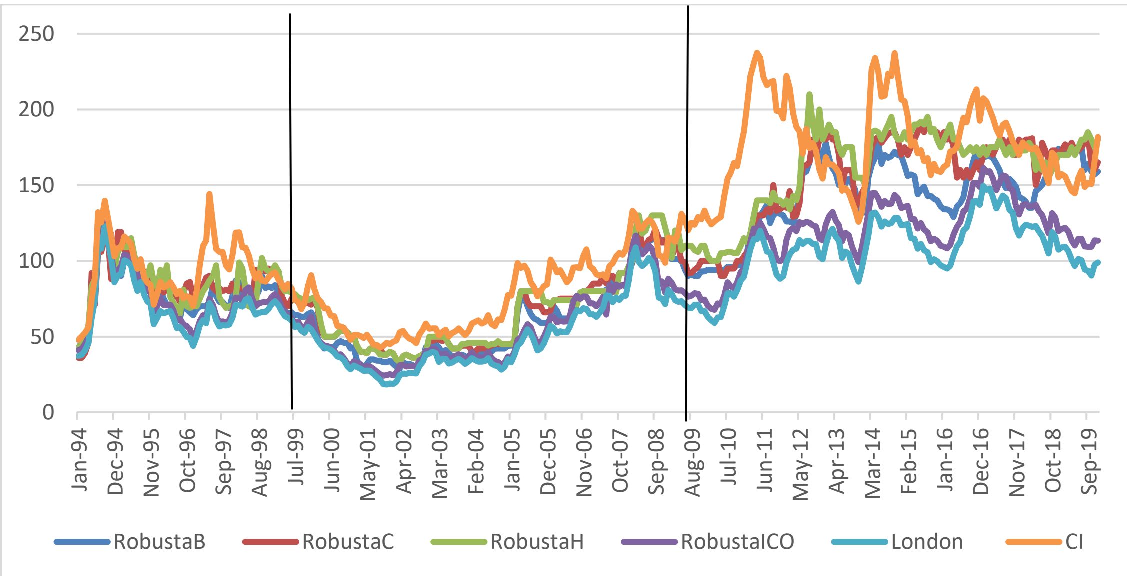


Figure 8 Plot of monthly Indian and international prices of Robusta coffee (₹/kg)



The plots for the prices of Arabica and Robusta coffee in Indian and international markets in US dollar are presented in Figure 9 and 10. Figure 9 indicates the monthly price movement of Arabica coffee in various domestic and international markets along with the international composite indicator price. As observed earlier, the highest price was observed for Arabica coffee price in Hyderabad, while the ICO composite indicator price was found to be the lowest. The price series in dollar moved as similar to the movement of prices in rupee throughout the study period. From the figures it is evident that the domestic as well as international market prices were moving closely and at times the international prices were found to be higher than the domestic prices

The Robusta coffee prices in US dollar also showed similar patterns as Robusta prices in rupees, with very few exceptional movements. The international prices such as London future market price and Robusta price in ICO market were found to be the lowest among the Robusta prices.

While comparing Robusta and Arabica prices, it could be observed that all the price series were moving in unison during the study period. The ICO composite indicator price act as an intermediary or mean price which demarcated Arabica and Robusta coffee price movements. While analyzing the behaviour of prices in different sub-periods, it could be concluded that, compared to period I and II, both Arabica and Robusta coffee prices have shown increasing divergence during the period III.

The highest price for Arabica coffee in rupee was observed in Hyderabad market (₹356/kg) in the year 2014 and for Robusta coffee also the highest price was observed in Hyderabad market (₹210/kg) during 2012. The highest price of 7.6 USD/kg for Arabica coffee was observed in 2011 and the lowest price of 4 USD/kg for Robusta coffee was found in 2012 in Hyderabad market.

Figure 9 Plot of monthly Arabica coffee prices (USD/kg)

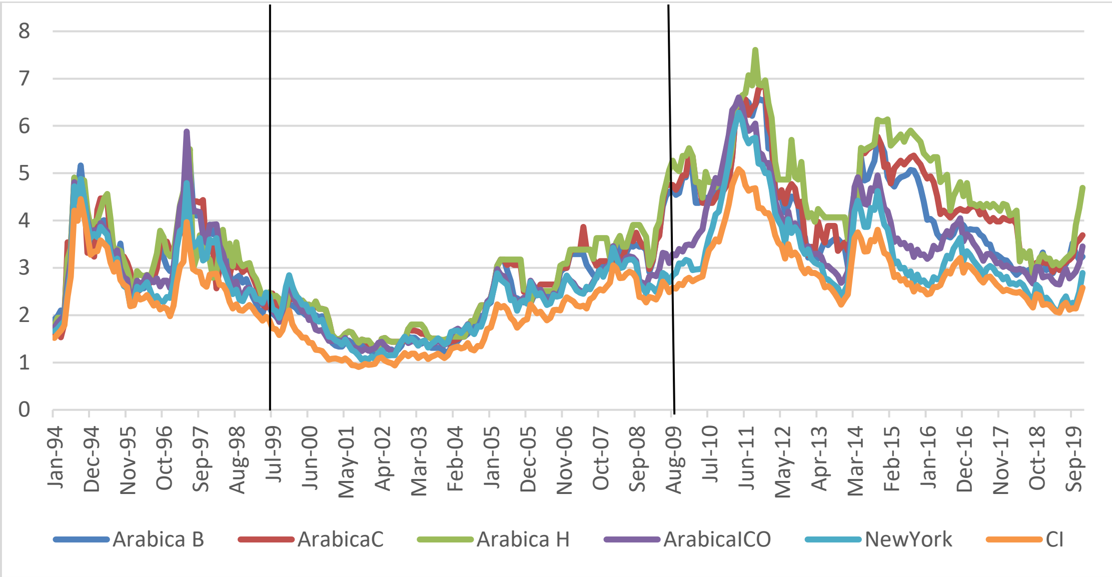
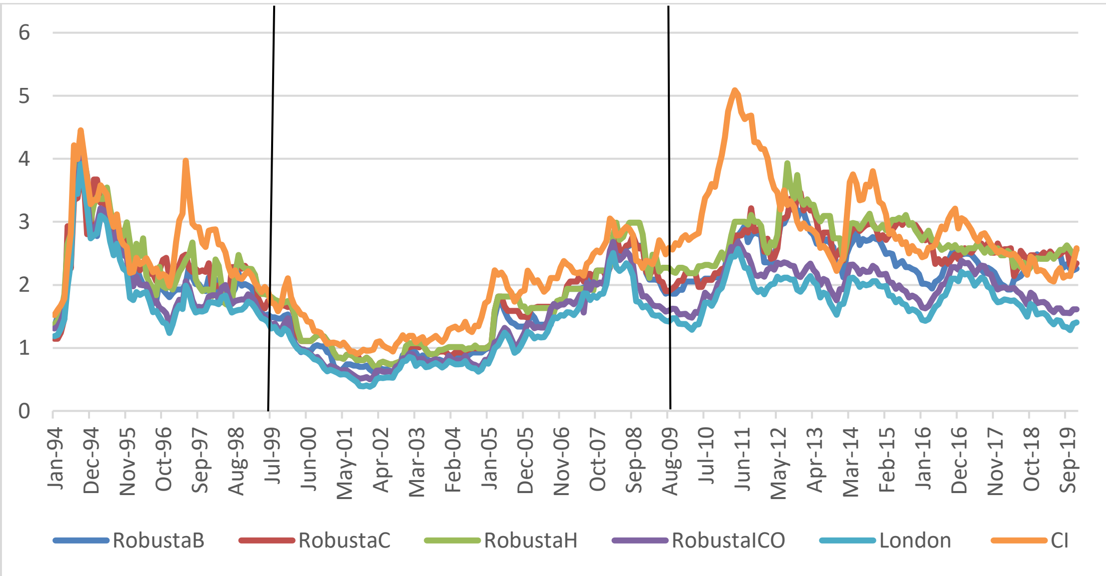


Figure 10 Plot of monthly Robusta coffee prices (USD/kg)



4.7.1.2 Seasonality in coffee prices

As any other agricultural commodity, coffee is also seasonal in production. The blossom showers and backing showers are essential for flowering and fruit setting. The blossom showers during the months from January to March will initiate flowering and backing showers in the months from March to May lead to fruit setting in Kerala. The harvest takes place in October- November and extends up to December. The seasonal indices for prices of Arabica and Robusta coffee in rupee and US dollar in different markets were estimated and the results are presented in Table 4.49 and Table 4.50 respectively.

It could be observed from the table that the prices of coffee exhibited considerable seasonality. The seasonality indices for prices of Arabica coffee in Bangalore starts increasing from the month of May, while that of Robusta starts increasing from July onwards. While considering the prices in Chennai market, it was observed that the seasonal indices of Arabica and Robusta exhibited a stable increase from July. The seasonal indices for Arabica and Robusta prices in Hyderabad market showed an increasing pattern from June. The international prices exhibited a decline in the seasonal index from June for Arabica and October for Robusta prices. The Composite indicator price also exhibited decline in seasonal index from June. The prices in New York and London futures markets also exhibited a generally declining trend in seasonal indices from June. These general trends are observed for prices in Rupees as well as US Dollar. Among the Arabica coffee markets, highest coefficient of variation in seasonal indices was observed in Chennai prices, while the lowest was observed in ICO market. The highest coefficient of variation in seasonal indices among Robusta market prices was observed in Chennai prices and it happened to be lowest in New York future market.

Table 4.49 Seasonal indices for coffee prices (₹/kg) in Indian and international markets (Per cent)

Month	Arabica B	Robusta B	Arabica C	Robusta C	Arabica H	Robusta H	Arabica ICO	Robusta ICO	CI ICO	New York	London
Jan	94.51	96.75	94.98	97.38	96.61	95.53	98.84	97.96	100.71	97.81	99.04
Feb	97.92	97.30	96.86	98.80	96.82	96.76	101.20	100.21	101.37	100.31	101.11
Mar	98.46	97.37	97.35	99.09	97.94	99.79	101.58	101.20	101.00	101.32	101.46
Apr	98.63	97.65	98.78	100.54	99.53	100.67	101.33	100.55	100.49	101.00	101.15
May	101.90	99.54	100.46	99.34	99.59	99.30	102.29	101.71	101.29	102.43	102.07
Jun	101.12	99.97	99.63	98.03	100.78	100.18	99.51	100.51	98.62	101.73	99.53
Jul	100.43	100.52	101.87	101.20	100.06	101.02	99.95	102.42	99.17	102.54	100.35
Aug	100.71	100.52	103.92	101.49	101.03	102.46	99.69	101.45	99.56	101.34	100.03
Sep	102.75	103.62	104.24	102.07	101.41	102.85	99.32	100.06	99.57	99.87	99.49
Oct	102.61	103.27	102.54	101.09	102.34	100.56	99.04	99.25	99.76	98.41	98.97
Nov	101.26	102.17	100.21	100.51	102.36	101.13	99.06	98.16	99.54	97.40	98.90
Dec	99.70	101.34	99.14	100.47	101.54	99.75	98.19	96.51	98.92	95.84	97.89
CV	2.35	2.36	2.83	1.46	1.99	2.10	1.29	1.74	0.94	2.16	1.25

Arabica B- Arabica Plantation – Bangalore, Robusta B- Robusta Cherry – Bangalore, Arabica C- Arabica Plantation – Chennai, Robusta C- Robusta Cherry – Chennai, Arabica H- Arabica Plantation- Hyderabad, Robusta H- Robusta Cherry – Hyderabad, Arabica ICO- ICO Indicator Price - Other Mild Arabicas, Robusta ICO- ICO Indicator Price – Robusta, CI ICO- ICO Composite Indicator Price, New York- ICE (New York), London- LIFFE (London)

Table 4.50 Seasonal indices for coffee prices (USD/kg) in Indian and international markets (Per cent)

Month	Arabica B	Robusta B	Arabica C	Robusta C	Arabica H	Robusta H	Arabica ICO	Robusta ICO	CI ICO	New York	London
Jan	93.81	95.81	93.63	96.63	95.05	94.62	98.03	96.88	98.10	99.82	96.63
Feb	97.33	96.51	95.96	98.05	96.04	96.28	100.75	99.33	100.49	100.99	99.31
Mar	98.25	96.81	96.74	98.22	97.56	99.12	101.25	100.53	101.01	100.73	100.58
Apr	98.52	97.13	98.36	99.96	99.31	100.39	101.05	100.03	100.76	100.23	100.45
May	102.21	99.51	100.92	100.03	100.31	99.49	102.94	101.99	102.55	101.82	102.77
Jun	101.52	100.07	99.62	97.60	101.56	100.10	99.81	100.60	99.78	98.85	102.02
Jul	101.00	100.87	102.65	101.56	100.35	101.47	100.42	103.02	100.88	99.61	103.20
Aug	100.97	101.10	104.37	101.80	101.58	102.65	100.24	102.29	100.68	100.10	102.21
Sep	103.45	104.58	105.12	102.66	102.53	103.55	99.86	101.11	100.21	100.18	101.07
Oct	102.65	103.78	103.40	102.10	102.82	101.08	98.81	99.53	98.97	99.48	98.68
Nov	101.09	102.54	100.08	100.85	101.99	101.60	98.78	98.39	98.81	99.30	97.58
Dec	99.19	101.30	99.14	100.54	100.88	99.65	98.05	96.31	97.77	98.91	95.51
CV	2.71	2.92	3.51	1.96	2.54	2.52	1.44	2.06	1.37	0.87	2.49

Arabica B- Arabica Plantation – Bangalore, Robusta B- Robusta Cherry – Bangalore, Arabica C- Arabica Plantation – Chennai, Robusta C- Robusta Cherry – Chennai, Arabica H- Arabica Plantation- Hyderabad, Robusta H- Robusta Cherry – Hyderabad, Arabica ICO- ICO Indicator Price - Other Mild Arabicas, Robusta ICO- ICO Indicator Price – Robusta, CI ICO- ICO Composite Indicator Price, New York- ICE (New York), London- LIFFE (London)

Figure 11 Seasonal indices for Arabica coffee prices (₹)

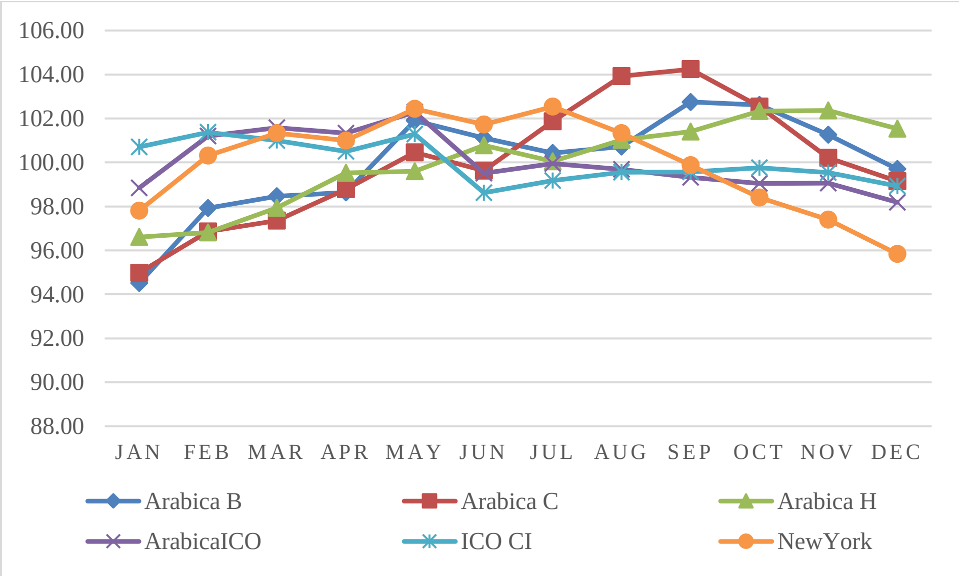


Figure 12 Seasonal indices for Robusta coffee prices (₹)

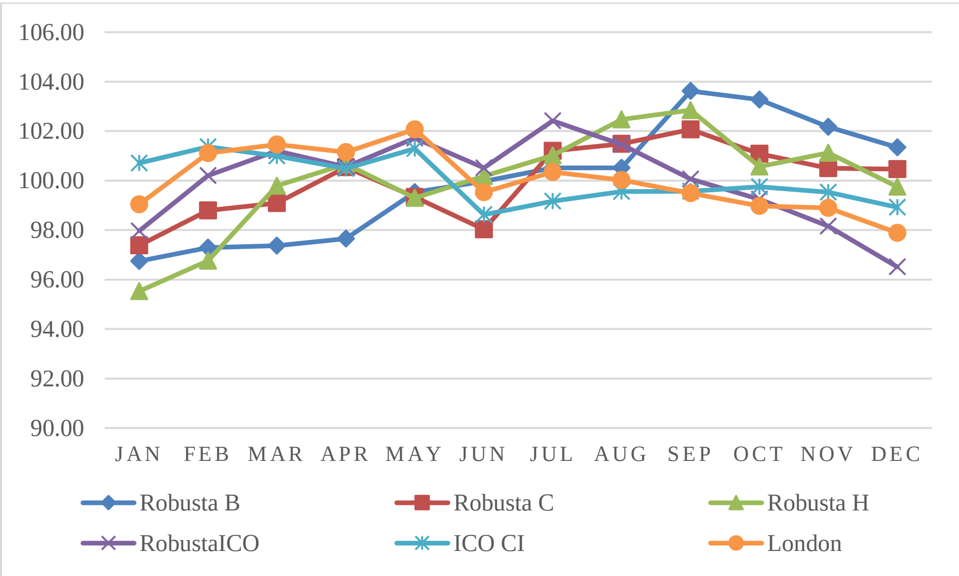


Figure 13 Seasonal indices for Arabica coffee prices (USD)

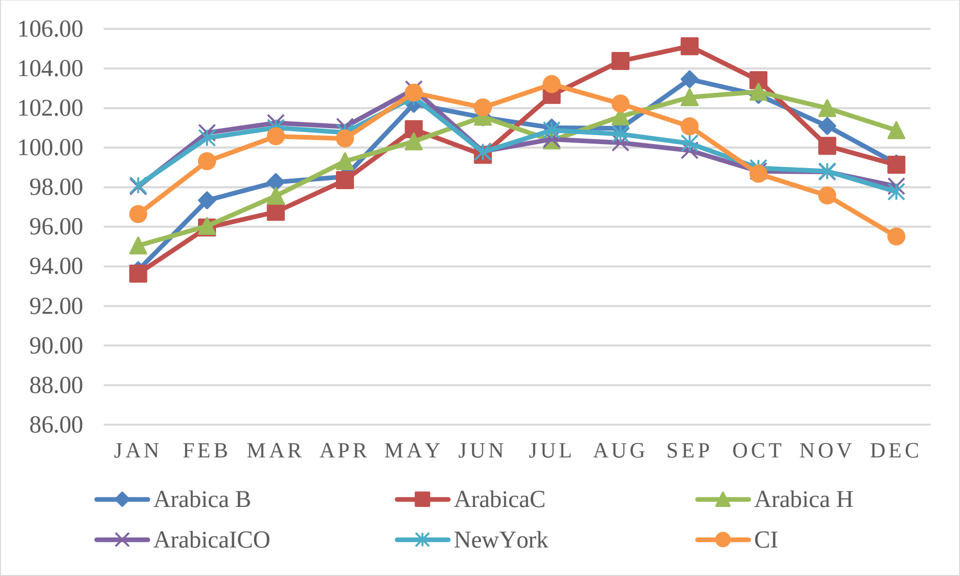
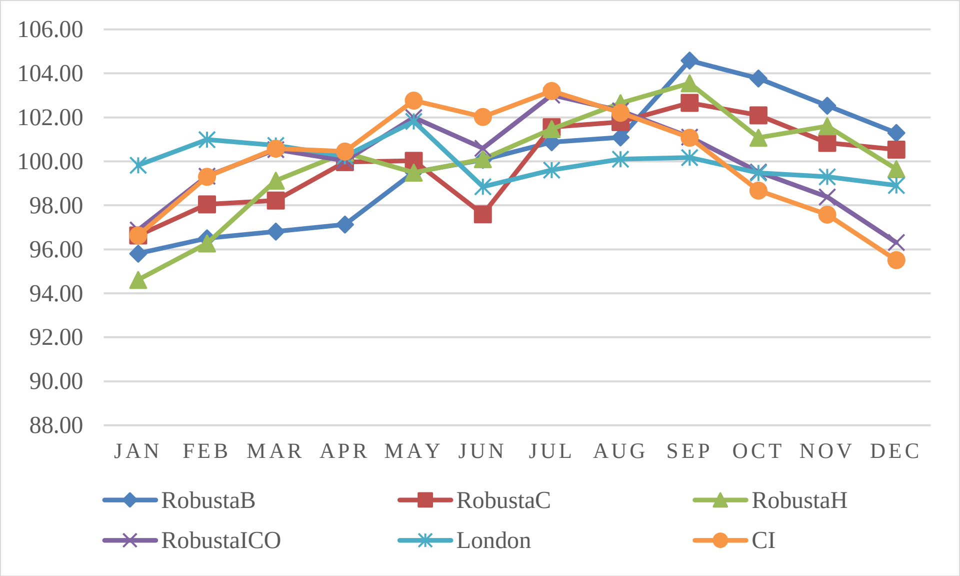


Figure 14 Seasonal indices for Robusta coffee prices (USD)



Seasonality indices for coffee prices in different markets are plotted from Figure 11 to Figure 14. From the plots, it could be observed that a general pattern of increase in seasonality index in domestic markets coincided with a decreasing trend of the seasonality indices in the international market and this trend coincided with the winter season in Brazil and monsoon season in Kerala. The seasonal consumption trends like coffee consumption peaks during colder, winter months and dips during summer month (ITC, 2017) also had significant implications on pattern of seasonality in coffee prices.

4.7.1.3 Cyclicality in coffee prices

The price cycles represent deviations in price levels from the average trend due to business sequences of booms and recessions that appear in an economy. Cyclical movements are of longer duration, usually extending to a few years and are of different periodicity. The cyclical pattern of coffee prices could be observed from Figure 15 to Figure 18.

The cyclical pattern of coffee prices in the international and Indian domestic markets were clearly demonstrated with ICO composite indicator prices of Arabica as well as Robusta coffee, both in rupees and US dollar. It could be observed that a price cycle started with the lowest point in 1996 and reached its peak in 1997 and declined and completed the first cycle with lowest point in 2002. The second cycle started in 2002, reached the peak in 2011 and completed the cycle in 2013. The third cycle started in 2013 reached its peak in 2014 and completed the cycle with the lowest point in 2019. These cyclical patterns were found to be similar in prices of both Arabica and Robusta coffee, whether the prices were in rupees or US dollars. In all the three cycles identified, abrupt fluctuations were also observed several times. In the first and third cycle, peak of the cycle was reached quickly after initiation, while a longer time was taken to reach its lowest point and for the completion of the cycle. Contrary to this, the second cycle took nine years to reach its peak and completed the cycle quickly after reaching the peak.

Figure 15 Plot for annual Arabica coffee prices (₹/kg)

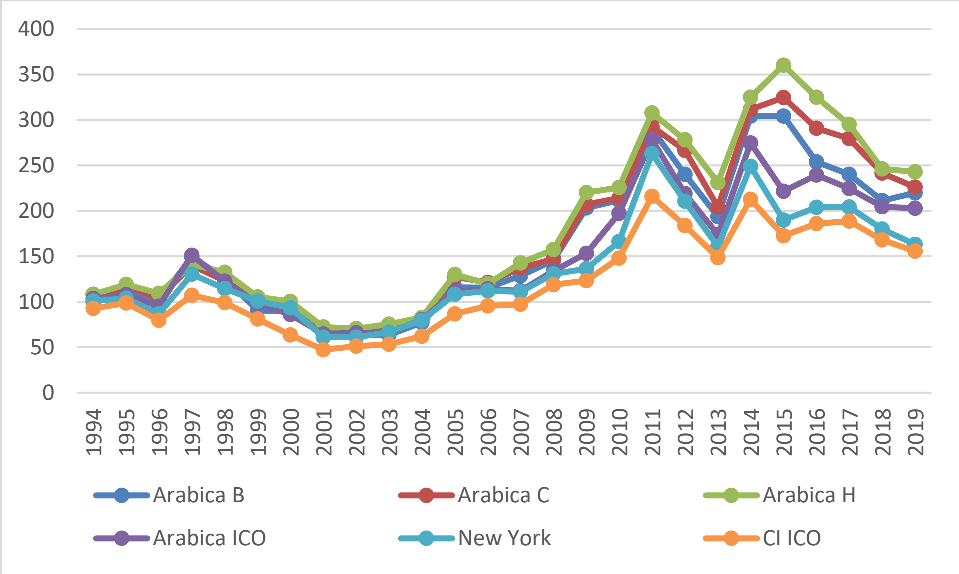


Figure 16 Plot for annual Robusta coffee prices (₹/kg)

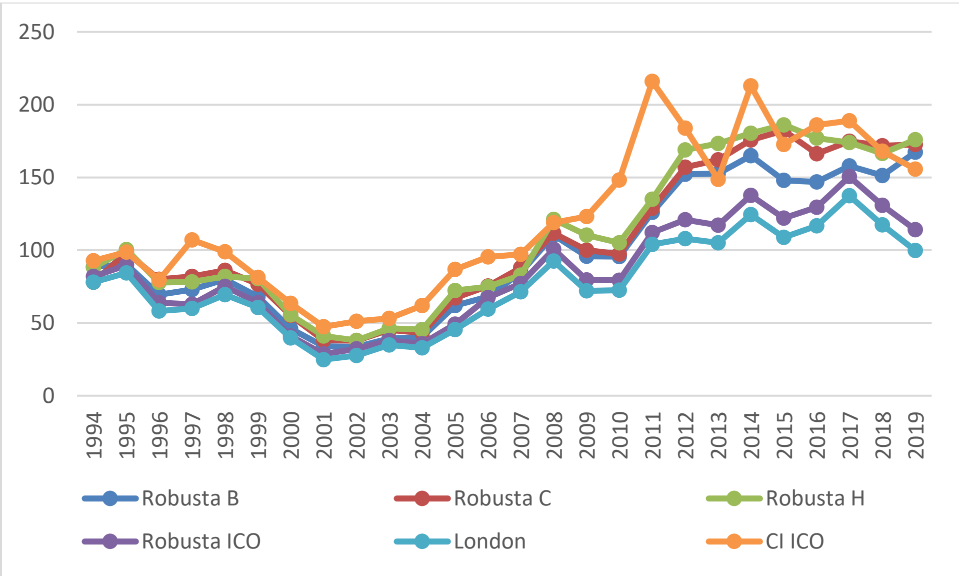


Figure 17 Plot for annual Arabica coffee prices (USD/kg)

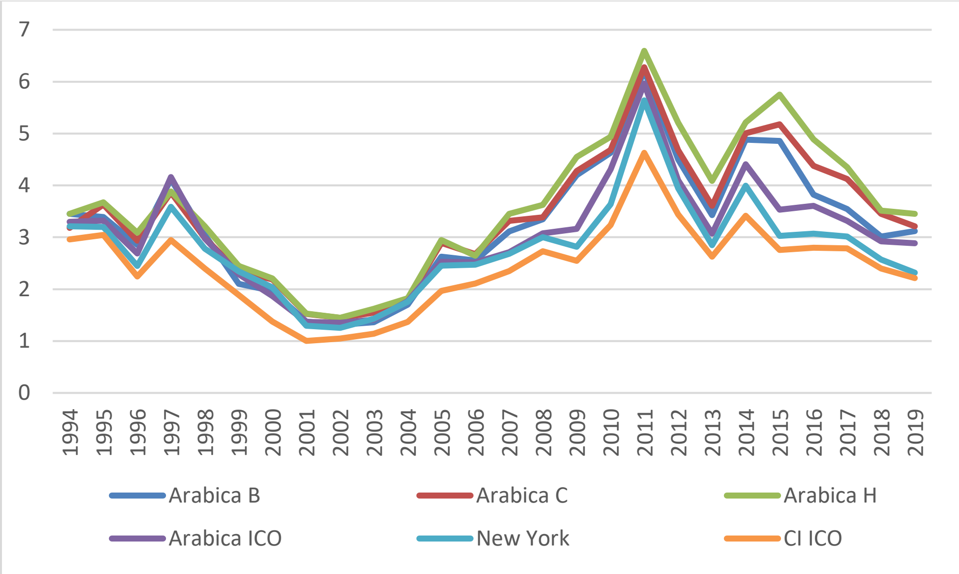
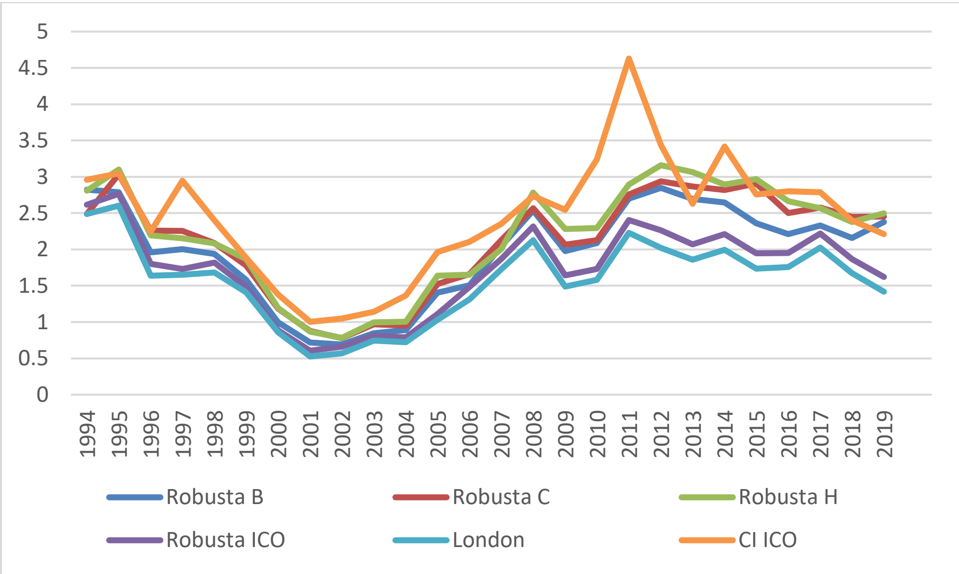


Figure 18 Plot for annual Robusta coffee prices (USD/kg)



As similar to the cyclical movement of ICO composite indicator prices, the domestic market prices of coffee also exhibited a similar cyclical movement up to 2013 for Arabica as well as Robusta prices, both in Rupees and US Dollar. The third cycle of domestic Arabica as well as Robusta coffee prices reached its peak in 2015 and completed the cycle with the lowest point in 2019. Coffee markets fluctuates with certain regularities and these fluctuations show cyclical behaviour. These findings were in accordance with the findings of Deaton (1999).

4.7.2 Formation, integration and transmission of coffee prices

The Johansen cointegration approach, Error correction model (ECM) and Granger causality tests were employed to analyze the price formation, integration and transmission of coffee prices between Indian and International markets. The domestic market prices of Arabica and Robusta coffee in Bangalore, Chennai and Hyderabad and, the prices in international markets such as ICO markets and New York and London future markets were considered for the analyses. The study employed monthly price series from 1994 to 2019, which were divided into different periods *viz*., Period I (1994-1999), Period II (2000-2009), Period III (2010-2019) and overall period (1994-2019) for the disaggregated analysis.

4.7.2.1 Tests of stationarity

Stationarity indicates the property of a time series that the mean, variance and autocorrelation do not change over time. In the current study, the price series in rupees and US dollar for different periods were tested for stationarity using Augmented Dickey Fuller test at levels and first differences, before proceeding to cointegration analysis. The results of stationarity tests are presented from Table 4.51 to Table 4.53.

Table 4.51 Results of stationarity tests for monthly price of coffee for overall period (1994-95 to 2019-20)

Market/Price series		**Price in Rupees**			**Price in US Dollar**		
		Level	**First difference**	**Critical value**	**Level**	**First difference**	**Critical value**
India	Arabica Plantation – Bangalore	-1.26 (0.644)	-9.37* (0.000)	-3.45	-1.72 (0.417)	-9.39* (0.000)	-3.45
	Robusta Cherry – Bangalore	-1.41 (0.576)	-13.83* (0.000)		-1.70 (0.422)	-13.98* (0.000)	
	Arabica Plantation – Chennai	-1.18 (0.683)	-11.20* (0.000)		-1.68 (0.436)	-10.94* (0.000)	
	Robusta Cherry – Chennai	-1.11 (0.646)	-11.22* (0.000)		-1.60 (0.481)	-10.93* (0.000)	
	Arabica Plantation- Hyderabad	-1.76 (0.395)	-17.31* (0.000)		-2.01 (0.282)	-17.26* (0.000)	
	Robusta Cherry – Hyderabad	-0.92 (0.778)	-8.48* (0.000)		-1.85 (0.355)	-15.15* (0.000)	
International	ICO Composite Indicator Price	-2.09 (0.282)	-14.17* (0.000)		-2.22 (0.199)	-13.95* (0.000)	
	ICO Indicator Price - Other Mild Arabicas	-1.66 (0.449)	-14.23* (0.000)		-1.72 (0.416)	-14.17* (0.000)	
	ICO Indicator Price – Robusta	-1.89 (0.337)	-14.08* (0.000)		-1.90 (0.328)	-8.60* (0.000)	
	ICE (New York)	-2.31 (0.169)	-14.71* (0.000)		-2.45 (0.129)	-14.51* (0.000)	
	LIFFE (London)	-1.89 (0.336)	-12.78* (0.000)		-2.04 (0.267)	-8.31* (0.000)	

Note: 1. * Denotes significant at one per cent level, **denotes significant at five per cent level

2. Figures in parentheses indicate probability value (p value)

Table 4.52 Results of the stationarity tests for monthly price of coffee for Period I (1994-95 to 1999-2000)

Market/Price series		Price in Rupees			Price in US Dollar		
		Level	**First difference**	**Critical value**	**Level**	**First difference**	**Critical value**
India	Arabica Plantation – Bangalore	-2.75 (0.069)	-7.73* (0.000)	-3.53	-1.97 (0.298)	-7.77* (0.000)	-3.53
	Robusta Cherry – Bangalore	-3.11 (0.029)	-4.09* (0.000)		-1.76 (0.395)	-7.08* (0.000)	
	Arabica Plantation – Chennai	-1.82 (0.366)	-3.49** (0.014)	-2.90	-3.12 (0.029)	-9.01* (0.000)	
	Robusta Cherry – Chennai	-2.58 (0.483)	-5.42* (0.000)	-3.53	-2.92 (0.047)	-9.35* (0.000)	
	Arabica Plantation- Hyderabad	-3.65* (0.006)			-2.91 (0.048)	-8.36* (0.000)	
	Robusta Cherry – Hyderabad	-3.49 (0.040)	-5.35* (0.000)		-2.28 (0.180)	-7.49* (0.000)	
International	ICO Composite Indicator Price	-3.26 (0.020)	-6.42* (0.000)		-2.66 (0.084)	-6.37* (0.000)	
	ICO Indicator Price - Other Mild Arabicas	-2.53 (0.112)	-6.08* (0.000)		-1.51 (0.519)	-5.93* (0.000)	
	ICO Indicator Price – Robusta	-3.61* (0.007)			-2.18 (0.213)	-6.27* (0.000)	
	IE (New York)	-3.51 (0.012)	-6.55* (0.000)		-2.51 (0.112)	-6.56* (0.000)	
	LIFFE (London)	-2.48 (0.123)	-6.12* (0.000)		-1.47 (0.538)	-5.94* (0.000)	

Note:1. * denotes significant at one per cent level, **denotes significant at five per cent level

2.Figures in parenthesis indicate probability value (p value)

Table 4.53 Results of the stationarity tests for monthly prices of coffee for Period II (2000-01 to 2009-10)

Market/Price series		Price in Rupees			Price in US Dollar		
		Level	**First difference**	**Critical value**	**Level**	**First difference**	**Critical value**
India	Arabica Plantation – Bangalore	0.05 (0.956)	-6.95* (0.000)	-3.48	0.26 (0.92)	-7.18* (0.000)	-3.48
	Robusta Cherry – Bangalore	0.89 (0.781)	-8.21* (0.000)		-0.67 (0.84)	-9.64* (0.000)	
	Arabica Plantation – Chennai	0.59 (0.989)	-9.51* (0.000)		0.22 (0.972)	-9.46* (0.000)	
	Robusta Cherry – Chennai	-1.78 (0.387)	-10.06* (0.000)		-1.74 (0.406)	-10.02* (0.000)	
	Arabica Plantation- Hyderabad	0.14 (0.96)	-8.25* (0.000)		0.18 (0.935)	-8.35* (0.000)	
	Robusta Cherry – Hyderabad	0.83 (0.806)	-8.28* (0.000)		-0.99 (0.755)	-7.88* (0.000)	
International	ICO Composite Indicator Price	0.33 (0.915)	-9.72* (0.000)		-0.37 (0.908)	-9.39* (0.000)	
	ICO Indicator Price - Other Mild Arabicas	0.67 (0.848)	-9.88* (0.000)		-0.67 (0.847)	-9.64* (0.000)	
	ICO Indicator Price – Robusta	0.23 (0.930)	-9.67* (0.000)		-0.28 (0.923)	-9.25* (0.000)	
	ICE (New York)	0.76 (0.820)	-10.50* (0.000)		-0.77 (0.823)	-10.10* (0.000)	
	LIFFE (London)	-1.05 (0.731)	-7.83* (0.000)		-1.05 (0.734)	-7.58* (0.000)	

Note: 1. * Denotes significant at one per cent level, **denotes significant at five per cent level,
2. Figures in parenthesis indicate probability value (p value)

The results reveled that for the overall period, all the price series in rupees and US dollars were non-stationary at levels and stationary at first difference. In period I, with the exceptions of Arabica coffee price in Hyderabad and ICO indictor price for Robusta coffee in the international market in rupees, all other price series were non-stationary at levels and became stationary after first differencing. Those price series which were already stationary at levels were not considered for subsequent analysis. All the price series considered were found to be non-stationary at levels and stationary at first difference in period II. During period III, except for ICO composite indicator price in rupees, all other price series were non-stationary at levels and became stationery after first differencing. If a price series is non-stationary at levels, it indicates the time dependent statistical properties of the time series that may be stochastic or deterministic, while stationarity of the price series after first differencing shows that there is no systemic variation of the series with time and it had the tendency to return to its mean value and had a constant finite covariance structure. All the price series that were considered for cointegration analysis satisfied these criteria (non-stationary at levels and stationary at first difference).

4.7.2.2 Cointegration analysis

Cointegration analysis identify the scenarios in which two or more non-stationary time series are integrated together in a way that they cannot deviate from equilibrium in the long run. The cointegration analyses between different price series of coffee were done for price series which were of the same order of integration using the Johansen cointegration method. As the conclusion of the trace statistics and maximum eigen value statistics were the same, the result of trace statistics alone is presented from Table 4.56 to Table 4.63. Two summary tables indicating the results of the cointegration analyses between different price series are presented as Table 4.64 and 4.65. The test for cointegration between different price series in domestic and international markets were attempted for the price series which were of the same order of integration.

Table 4.54 Details of codes assigned to different price combinations of Indian and international prices of coffee for pair-wise cointegration analysis

Indian and International market price combinations	Code
Arabica Plantation-Bangalore and ICO Indicator Price-Other Mild Arabicas	A
Arabica Plantation-Bangalore and ICO Composite Indicator Price	B
Arabica Plantation-Bangalore and ICE (New York)	C
Robusta Cherry-Bangalore and ICO Indicator Price–Robusta	D
Robusta Cherry-Bangalore and ICO Composite Indicator Price	E
Robusta Cherry-Bangalore and LIFFE (London)	F
Arabica Plantation-Chennai and ICO Indicator Price-Other Mild Arabicas	G
Arabica Plantation-Chennai and ICO Composite Indicator Price	H
Arabica Plantation-Chennai and ICE (New York)	I
Robusta Cherry-Chennai and ICO Indicator Price – Robusta	J
Robusta Cherry-Chennai and ICO Composite Indicator Price	K
Robusta Cherry-Chennai and LIFFE (London)	L
Arabica Plantation-Hyderabad and ICO Indicator Price - Other Mild Arabicas	M
Arabica Plantation-Hyderabad and ICO Composite Indicator Price	N
Arabica Plantation-Hyderabad and ICE (New York)	O
Robusta Cherry-Hyderabad and ICO Indicator Price–Robusta	P
Robusta Cherry-Hyderabad and ICO Composite Indicator Price	Q
Robusta Cherry-Hyderabad and LIFFE (London)	R

Table 4.55 Details of codes assigned to different price combinations of Indian prices of coffee for pair-wise cointegration analysis

Combination of different coffee prices in Indian market	Code
Arabica Plantation-Bangalore and Arabica Plantation-Chennai	S
Arabica Plantation-Bangalore and Arabica Plantation-Hyderabad	T
Robusta Cherry-Bangalore and Robusta Cherry-Chennai	U
Robusta Cherry-Bangalore and Robusta Cherry-Hyderabad	V
Arabica Plantation-Chennai and Arabica Plantation-Hyderabad	W
Robusta Cherry-Chennai and Robusta Cherry-Hyderabad	X

Table 4.56 Results of pair-wise cointegration tests between Indian and International prices of coffee during overall period (1994-95 to 2019-20)

Market/ Price series	**Price in Rupees**				**Price in US Dollar**			
	Null	**Eigen value**	**Trace statistic**	**Critical value**	**Null**	**Eigen value**	**Trace statistic**	**Critical value**
Arabica Plantation - Bangalore and ICO Indicator Price - Other Mild Arabicas	r=0	0.09	30.96	20.26	r=0	0.08	29.88	20.26
	r<=1	0.01	1.68	9.16	r<=1	0.01	2.81	9.16
Arabica Plantation - Bangalore and ICO Composite Indicator Price	r=0	0.06	19.15	12.32	r=0	0.06	20.97	20.26
	r<=1	0.00	0.22	4.12	r<=1	0.01	2.83	9.16
Arabica Plantation - Bangalore and ICE (New York)	r=0	0.08	27.18	20.26	r=0	0.07	23.71	20.26
	r<=1	0.01	1.56	9.16	r<=1	0.01	2.82	9.16
Robusta Cherry – Bangalore and ICO Composite Indicator Price	r=0	0.06	23.17	20.26	r=0	0.06	23.36	20.26
	r<=1	0.01	3.08	9.16	r<=1	0.01	2.83	9.16
Robusta Cherry – Bangalore and LIFFE (London)	r=0	0.10	37.01	25.87	r=0	0.07	30.12	25.87
	r<=1	0.02	5.26	12.51	r<=1	0.02	6.23	12.51
Arabica Plantation - Chennai and ICO Indicator Price - Other Mild Arabicas	r=0	0.13	45.55	25.87	r=0	0.12	44.55	25.87
	r<=1	0.01	4.48	12.51	r<=1	0.01	4.21	12.51
Arabica Plantation - Chennai and ICO Composite Indicator Price	r=0	0.08	26.66	12.32	r=0	0.10	35.13	25.87
	r<=1	0.00	0.41	4.12	r<=1	0.01	4.05	12.51
Arabica Plantation - Chennai and ICE (New York)	r=0	0.11	40.81	25.87	r=0	0.11	39.54	25.87
	r<=1	0.02	4.76	12.51	r<=1	0.01	4.42	12.51
	r<=1	0.00	0.17	4.12	r<=1	0.02	5.33	12.51

Note:(-) excluded from cointegration analysis due to the stationarity of any one of the price series at its levels

…cont. Table 4.56 Results of pair-wise cointegration tests between Indian and International prices of coffee during overall period (1994-95 to 2019-20)

Market/ Price series	Price in Rupees				Price in US Dollar			
	Null	Eigen value	Trace statistic	Critical value	Null	Eigen value	Trace statistic	Critical value
Robusta Cherry – Chennai and ICO Composite Indicator Price	r=0	0.07	25.80	20.26	r=0	0.07	25.37	20.26
	r<=1	0.01	2.12	9.16	r<=1	0.01	3.27	9.16
Robusta Cherry – Chennai and LIFFE (London)	r=0	0.12	44.55	25.87	r=0	0.12	45.05	25.87
	r<=1	0.02	5.08	12.51	r<=1	0.02	5.11	12.51
Arabica Plantation - Hyderabad and ICO Indicator Price - Other Mild Arabicas	r=0	0.07	25.75	20.26	r=0	0.06	19.41	12.32
	r<=1	0.01	1.89	9.16	r<=1	0.00	0.11	4.12
Arabica Plantation - Hyderabad and ICO Composite Indicator Price	r=0	0.05	17.24	12.32	r=0	0.07	25.43	25.87
	r<=1	0.00	0.43	4.12	r<=1	0.02	4.70	12.51
Arabica Plantation - Hyderabad and ICE (New York)	r=0	0.07	23.46	20.26	r=0	0.07	27.07	25.87
	r<=1	0.01	1.77	9.16	r<=1	0.02	5.38	12.51
Robusta Cherry – Hyderabad and ICO Indicator Price – Robusta	r=0	0.05	16.81	12.32	r=0	0.06	25.15	25.87
	r<=1	0.00	0.12	4.12	r<=1	0.02	5.04	12.51
Robusta Cherry – Hyderabad and ICO Composite Indicator Price	r=0	0.07	23.67	20.26	r=0	0.06	21.27	20.26
	r<=1	0.01	1.61	9.16	r<=1	0.01	2.81	9.16
Robusta Cherry – Hyderabad and LIFFE (London)	r=0	0.05	15.43	12.32	r=0	0.06	24.55	25.87
	r<=1	0.00	0.17	4.12	r<=1	0.02	5.33	12.51

Note:(-) excluded from cointegration analysis due to the stationarity of any one of the price series at its levels

Table 4.57 Results of pair-wise cointegration tests between different coffee prices in Indian market during overall period (1994-95 to 2019-20)

Market/ Price series	Price in Rupees				Price in US Dollar			
	Null	**Eigen value**	**Trace statistic**	**Critical value**	**Null**	**Eigen value**	**Trace statistic**	**Critical value**
Arabica Plantation - Bangalore and Arabica Plantation – Chennai	r=0	0.15	54.33	25.87	r=0	0.15	55.39	25.87
	r<=1	0.02	5.26	12.51	r<=1	0.01	4.61	12.51
Arabica Plantation - Bangalore and Arabica Plantation – Hyderabad	r=0	0.12	46.65	25.87	r=0	0.10	36.33	25.87
	r<=1	0.02	6.51	12.51	r<=1	0.02	4.85	12.51
Robusta Cherry – Bangalore and Robusta Cherry – Chennai	r=0	0.17	56.85	12.32	r=0	0.17	59.13	20.26
	r<=1	0.00	0.12	4.12	r<=1	0.01	2.86	9.16
Robusta Cherry – Bangalore and Robusta Cherry – Hyderabad	r=0	0.08	25.65	12.32	r=0	0.09	30.20	20.26
	r<=1	0.00	0.16	4.12	r<=1	0.01	2.85	9.16
Arabica Plantation - Chennai and Arabica Plantation- Hyderabad	r=0	0.16	54.45	20.26	r=0	0.15	51.84	12.32
	r<=1	0.01	1.71	9.16	r<=1	0.00	0.16	4.12
Robusta Cherry – Chennai and Robusta Cherry – Hyderabad	r=0	0.15	50.21	12.32	r=0	0.15	53.86	20.26
	r<=1	0.00	0.33	4.12	r<=1	0.01	2.43	9.16

Note:(-) excluded from cointegration analysis due to the stationarity of any one of the price series at its levels

Table 4.58 Results of the Pair-wise cointegration tests between Indian and International prices of coffee during Period I (1994-95 to 1999-20)

Market/ Price series	Price in Rupees				Price in US Dollar			
	Null	Eigen value	Trace statistic	Critical value	Null	Eigen value	Trace statistic	Critical value
Arabica Plantation - Bangalore and ICO Indicator Price - Other Mild Arabicas	r=0	0.21	22.28	20.26	r=0	0.19	19.33	20.26
	r<=1	0.09	6.32	9.16	r<=1	0.07	5.12	9.16
Arabica Plantation - Bangalore and ICO Composite Indicator Price	r=0	0.25	23.14	20.26	r=0	0.28	25.48	25.87
	r<=1	0.04	2.87	9.16	r<=1	0.04	2.82	12.51
Arabica Plantation - Bangalore and ICE (New York)	r=0	0.24	22.09	20.26	r=0	0.20	18.47	20.26
	r<=1	0.05	3.26	9.16	r<=1	0.04	2.98	9.16
Robusta Cherry – Bangalore and ICO Indicator Price – Robusta	r=0	-	-	-	r=0	0.29	39.05	18.39
	r<=1	-	-	-	r<=1	0.20	2.26	3.84
Robusta Cherry – Bangalore and ICO Composite Indicator Price	r=0	0.28	30.54	25.87	r=0	0.30	32.12	25.87
	r<=1	0.11	8.10	12.51	r<=1	0.11	7.95	12.51
Robusta Cherry – Bangalore and LIFFE (London)	r=0	0.28	39.71	25.87	r=0	0.29	40.78	18.39
	r<=1	0.22	11.38	12.51	r<=1	0.22	2.92	3.84
Arabica Plantation - Chennai and ICO Indicator Price - Other Mild Arabicas	r=0	0.31	37.63	20.26	r=0	0.30	35.87	18.39
	r<=1	0.16	2.03	9.16	r<=1	0.15	11.37	3.84
Arabica Plantation - Chennai and ICO Composite Indicator Price	r=0	0.27	34.28	15.49	r=0	0.28	36.03	25.87
	r<=1	0.16	2.18	3.84	r<=1	0.17	11.70	12.51
Arabica Plantation - Chennai and ICE (New York)	r=0	0.28	34.60	15.49	r=0	0.28	35.00	25.87
	r<=1	0.16	2.34	3.84	r<=1	0.16	12.14	12.51

Note:(-) excluded from cointegration analysis due to the stationarity of any one of the price series at its levels

…Cont. Table 4.58 Results of the Pair-wise cointegration tests between Indian and International prices of coffee during Period I(1994-95 to 1999-20)

Market/ Price series	Price in Rupees				Price in US Dollar			
	Null	**Eigen value**	**Trace statistic**	**Critical value**	**Null**	**Eigen value**	**Trace statistic**	**Critical value**
Robusta Cherry – Chennai and ICO Indicator Price – Robusta	r=0	-	-	-	r=0	0.40	43.87	25.87
	r<=1	-	-	-	r<=1	0.12	8.52	12.51
Robusta Cherry – Chennai and ICO Composite Indicator Price	r=0	0.39	43.71	25.87	r=0	0.40	44.25	25.87
	r<=1	0.13	9.78	12.51	r<=1	0.13	9.32	12.51
Robusta Cherry – Chennai and LIFFE (London)	r=0	0.38	41.01	20.26	r=0	0.40	44.69	25.87
	r<=1	0.11	8.19	9.16	r<=1	0.12	9.14	12.51
Arabica Plantation - Hyderabad and ICO Indicator Price - Other Mild Arabicas	r=0	-	-	-	r=0	0.24	28.93	18.39
	r<=1				r<=1	0.14	1.02	3.84
Arabica Plantation - Hyderabad and ICO Composite Indicator Price	r=0	-	-	-	r=0	0.26	31.32	25.87
	r<=1	-	-	-	r<=1	0.14	10.73	12.51
Arabica Plantation - Hyderabad and ICE (New York)	r=0	-	-	-	r=0	0.24	31.06	25.87
	r<=1				r<=1	0.16	12.02	12.51
Robusta Cherry – Hyderabad and ICO Indicator Price – Robusta	r=0	-	-	-	r=0	0.37	43.37	25.87
	r<=1	-	-	-	r<=1	0.16	11.63	12.51
Robusta Cherry – Hyderabad and ICO Composite Indicator Price	r=0	0.35	35.25	25.87	r=0	0.36	35.46	25.87
	r<=1	0.07	5.01	12.51	r<=1	0.07	5.02	12.51
Robusta Cherry – Hyderabad and LIFFE (London)	r=0	0.37	40.78	20.26	r=0	0.37	44.92	25.87
	r<=1	0.12	8.52	9.16	r<=1	0.17	12.57	12.51

Note:(-) excluded from cointegration analysis due to the stationarity of any one of the price series at its levels

Table 4.59 Results of pair-wise cointegration tests between different coffee prices in Indian market during Period I (1994-95 to 1999-20)

Market/ Price series	Price in Rupees				Price in US Dollar			
	Null	**Eigen value**	**Trace statistic**	**Critical value**	**Null**	**Eigen value**	**Trace statistic**	**Critical value**
Arabica Plantation - Bangalore and Arabica Plantation – Chennai	r=0	0.35	38.56	20.26	r=0	0.31	32.18	20.26
	r<=1	0.11	8.38	9.16	r<=1	0.09	6.19	9.16
Arabica Plantation - Bangalore and Arabica Plantation – Hyderabad	r=0	-	-	-	r=0	0.25	27.86	25.87
	r<=1	-	-	-	r<=1	0.11	7.78	12.50
Robusta Cherry – Bangalore and Robusta Cherry – Chennai	r=0	0.39	43.42	20.26	r=0	0.38	44.38	18.39
	r<=1	0.12	8.97	9.16	r<=1	0.15	1.28	3.84
Robusta Cherry – Bangalore and Robusta Cherry – Hyderabad	r=0	0.33	39.60	18.39	r=0	0.32	40.81	18.39
	r<=1	0.17	2.46	3.84	r<=1	0.18	3.81	3.84
Arabica Plantation - Chennai and Arabica Plantation- Hyderabad	r=0	-	-	-	r=0	0.28	22.31	12.32
	r<=1				r<=1	0.00	0.12	4.12
Robusta Cherry – Chennai and Robusta Cherry – Hyderabad	r=0	0.38	49.33	25.87	r=0	0.39	49.63	25.87
	r<=1	0.20	6.11	12.51	r<=1	0.20	11.60	12.50

Note:(-) excluded from cointegration analysis due to the stationarity of any one of the price series at its levels

Table 4.60 Results of the Pair-wise cointegration tests between Indian and International prices of coffee during Period II (2000-01 to 2009-10)

Market/ Price series	Price in Rupees				Price in US Dollar			
	Null	**Eigen value**	**Trace statistic**	**Critical value**	**Null**	**Eigen value**	**Trace statistic**	**Critical value**
Arabica Plantation - Bangalore and ICO Indicator Price - Other Mild Arabicas	r=0	0.15	22.76	18.39	r=0	0.22	17.38	12.51
	r<=1	0.04	3.68	3.84	r<=1	0.39	3.42	20.26
Arabica Plantation - Bangalore and ICO Composite Indicator Price	r=0	0.16	26.81	25.80	r=0	0.12	8.97	9.16
	r<=1	0.04	4.90	12.51	r<=1	0.24	22.09	20.26
Arabica Plantation - Bangalore and ICE (New York)	r=0	0.07	18.26	15.49	r=0	0.05	3.26	9.16
	r<=1	0.00	0.34	3.80	r<=1	0.00	0.27	3.84
Robusta Cherry – Bangalore and ICO Indicator Price – Robusta	r=0	0.09	20.74	15.49	r=0	0.11	8.19	9.16
	r<=1	0.00	0.32	3.84	r<=1	0.38	49.33	25.87
Robusta Cherry – Bangalore and ICO Composite Indicator Price	r=0	0.12	24.65	15.49	r=0	0.01	0.60	3.84
	r<=1	0.00	0.03	3.84	r<=1	0.18	22.86	15.49
Robusta Cherry – Bangalore and LIFFE (London)	r=0	0.09	21.39	15.49	r=0	0.00	0.08	3.84
	r<=1	0.00	0.30	3.84	r<=1	0.19	25.26	15.49
Arabica Plantation - Chennai and ICO Indicator Price - Other Mild Arabicas	r=0	0.14	17.93	15.49	r=0	0.20	18.47	20.26
	r<=1	0.00	0.30	3.84	r<=1	0.04	2.98	9.16
Arabica Plantation - Chennai and ICO Composite Indicator Price	r=0	0.07	18.21	15.49	r=0	0.31	32.18	20.26
	r<=1	0.00	0.18	3.84	r<=1	0.09	6.19	9.16
Arabica Plantation - Chennai and ICE (New York)	r=0	0.09	21.67	15.49	r=0	0.20	15.60	12.50
	r<=1	0.00	0.24	3.84	r<=1	0.24	8.93	18.39

Note:(-) excluded from cointegration analysis due to the stationarity of any one of the price series at its levels

…Cont. Table 4.60 Results of the Pair-wise cointegration tests between Indian and International prices of coffee during Period II (2000-01 to 2009-10)

Market/ Price series	Price in Rupees				Price in US Dollar			
	Null	**Eigen value**	**Trace statistic**	**Critical value**	**Null**	**Eigen value**	**Trace statistic**	**Critical value**
Robusta Cherry – Chennai and ICO Indicator Price – Robusta	r=0	0.18	22.89	15.49	r=0	0.18	22.86	15.49
	r<=1	0.01	0.60	3.84	r<=1	0.00	0.08	3.84
Robusta Cherry – Chennai and ICO Composite Indicator Price	r=0	0.18	22.86	15.49	r=0	0.19	25.26	15.49
	r<=1	0.00	0.08	3.84	r<=1	0.01	0.71	3.84
Robusta Cherry – Chennai and LIFFE (London)	r=0	0.19	25.26	15.49	r=0	0.26	31.32	25.87
	r<=1	0.01	0.71	3.84	r<=1	0.14	10.73	12.51
Arabica Plantation - Hyderabad and ICO Indicator Price - Other Mild Arabicas	r=0	0.13	16.22	15.49	r=0	0.37	43.37	25.87
	r<=1	0.00	0.23	3.84	r<=1	0.17	2.46	3.84
Arabica Plantation - Hyderabad and ICO Composite Indicator Price	r=0	0.06	17.35	15.49	r=0	0.31	37.63	20.26
	r<=1	0.00	0.16	3.84	r<=1	0.16	9.03	9.16
Arabica Plantation - Hyderabad and ICE (New York)	r=0	0.09	20.87	15.49	r=0	0.27	34.28	15.49
	r<=1	0.00	0.20	0.38	r<=1	0.13	9.78	12.51
Robusta Cherry – Hyderabad and ICO Indicator Price – Robusta	r=0	0.06	17.79	15.49	r=0	0.15	11.28	3.84
	r<=1	0.01	0.82	3.84	r<=1	0.32	10.81	18.39
Robusta Cherry – Hyderabad and ICO Composite Indicator Price	r=0	0.16	19.59	15.49	r=0	0.18	13.89	3.84
	r<=1	0.00	0.07	3.84	r<=1	0.30	15.87	18.39
Robusta Cherry – Hyderabad and LIFFE (London)	r=0	0.05	16.63	12.32	r=0	0.15	11.37	3.84
	r<=1	0.00	0.45	4.12	r<=1	0.28	16.03	25.87

Note:(-) excluded from cointegration analysis due to the stationarity of any one of the price series at its levels

Table 4.61 Results of pair-wise cointegration tests between different coffee prices in Indian market during Period II (2000-01 to 2009-10)

Market/ Price series	Price in Rupees				Price in US Dollar			
	Null	**Eigen value**	**Trace statistic**	**Critical value**	**Null**	**Eigen value**	**Trace statistic**	**Critical value**
Arabica Plantation - Bangalore and Arabica Plantation – Chennai	r=0	0.28	37.92	15.49	r=0	0.11	13.96	15.49
	r<=1	0.00	0.50	3.84	r<=1	0.00	0.42	3.84
Arabica Plantation - Bangalore and Arabica Plantation – Hyderabad	r=0	0.23	31.03	15.49	r=0	0.13	9.78	12.51
	r<=1	0.00	0.26	3.84	r<=1	0.38	41.01	20.26
Robusta Cherry – Bangalore and Robusta Cherry – Chennai	r=0	0.23	30.40	15.49	r=0	0.18	13.89	3.84
	r<=1	0.00	0.27	3.84	r<=1	0.30	15.87	18.39
Robusta Cherry – Bangalore and Robusta Cherry – Hyderabad	r=0	0.11	23.96	15.49	r=0	0.15	11.37	3.84
	r<=1	0.00	0.42	3.84	r<=1	0.28	16.03	25.87
Arabica Plantation - Chennai and Arabica Plantation- Hyderabad	r=0	0.01	23.02	15.49	r=0	0.14	10.02	3.84
	r<=1	0.00	0.05	3.84	r<=1	0.26	11.32	25.87
Robusta Cherry – Chennai and Robusta Cherry – Hyderabad	r=0	0.19	24.01	15.49	r=0	0.24	31.06	25.87
	r<=1	0.00	0.42	3.84	r<=1	0.16	12.02	12.51

Note:(-) excluded from cointegration analysis due to the stationarity of any one of the price series at its levels

Table 4.62 Results of the Pair-wise cointegration tests between Indian and International prices of coffee during Period III (2010-11 to 2019-20)

Market/ Price series	**Price in Rupees**				**Price in US Dollar**			
	Null	**Eigen value**	**Trace statistic**	**Critical value**	**Null**	**Eigen value**	**Trace statistic**	**Critical value**
Arabica Plantation - Bangalore and ICO Indicator Price - Other Mild Arabicas	r=0	0.04	14.90	12.51	r=0	0.04	2.87	9.16
	r<=1	0.07	12.26	15.49	r<=1	0.24	22.09	20.26
Arabica Plantation - Bangalore and ICO Composite Indicator Price	r=0	-	-	-	r=0	0.05	3.26	9.16
	r<=1	-	-	-	r<=1	0.35	38.56	20.26
Arabica Plantation - Bangalore and ICE (New York)	r=0	0.00	0.50	3.84	r=0	0.01	0.71	3.84
	r<=1	0.50	3.84	0.47	r<=1	0.19	24.01	15.49
Robusta Cherry – Bangalore and ICO Indicator Price – Robusta	r=0	0.16	12.03	9.16	r=0	0.18	22.86	15.49
	r<=1	0.28	19.71	25.87	r<=1	0.00	0.08	3.84
Robusta Cherry – Bangalore and ICO Composite Indicator Price	r=0	-	-	-	r=0	0.19	25.26	15.49
	r<=1	-	-	-	r<=1	0.18	3.79	3.84
Robusta Cherry – Bangalore and LIFFE (London)	r=0	0.12	8.97	9.16	r=0	0.30	35.87	18.39
	r<=1	0.00	0.18	3.84	r<=1	0.15	1.37	3.84
Arabica Plantation - Chennai and ICO Indicator Price - Other Mild Arabicas	r=0	0.18	22.89	15.49	r=0	0.13	9.78	12.51
	r<=1	0.37	13.37	25.87	r<=1	0.38	41.01	20.26
Arabica Plantation - Chennai and ICO Composite Indicator Price	r=0	-	-	-	r=0	0.11	8.19	9.16
	r<=1	-	-	-	r<=1	0.38	49.33	25.87
Arabica Plantation - Chennai and ICE (New York)	r=0	0.07	5.02	12.51	r=0	0.07	18.21	15.49
	r<=1	0.37	44.92	25.87	r<=1	0.00	0.18	3.84

Note:(-) excluded from cointegration analysis due to the stationarity of any one of the price series at its levels

…Cont. Table 4.62 Results of the Pair-wise cointegration tests between Indian and International prices of coffee during Period III (2010-11 to 2019-20)

Market/ Price series	Price in Rupees				Price in US Dollar			
	Null	**Eigen value**	**Trace statistic**	**Critical value**	**Null**	**Eigen value**	**Trace statistic**	**Critical value**
Arabica Plantation - Bangalore and ICO Indicator Price - Other Mild Arabicas	r=0	0.04	14.90	12.51	r=0	0.04	2.87	9.16
	r<=1	0.07	12.26	15.49	r<=1	0.24	22.09	20.26
Arabica Plantation - Bangalore and ICO Composite Indicator Price	r=0	-	-	-	r=0	0.05	3.26	9.16
	r<=1	-	-	-	r<=1	0.35	38.56	20.26
Arabica Plantation - Bangalore and ICE (New York)	r=0	0.00	0.50	3.84	r=0	0.01	0.71	3.84
	r<=1	0.50	3.84	0.47	r<=1	0.19	24.01	15.49
Robusta Cherry – Bangalore and ICO Indicator Price – Robusta	r=0	0.16	12.03	9.16	r=0	0.18	22.86	15.49
	r<=1	0.28	19.71	25.87	r<=1	0.00	0.08	3.84
Robusta Cherry – Bangalore and ICO Composite Indicator Price	r=0	-	-	-	r=0	0.19	25.26	15.49
	r<=1	-	-	-	r<=1	0.18	3.79	3.84
Robusta Cherry – Bangalore and LIFFE (London)	r=0	0.12	8.97	9.16	r=0	0.30	35.87	18.39
	r<=1	0.00	0.18	3.84	r<=1	0.15	1.37	3.84
Arabica Plantation - Chennai and ICO Indicator Price - Other Mild Arabicas	r=0	0.18	22.89	15.49	r=0	0.13	9.78	12.51
	r<=1	0.37	13.37	25.87	r<=1	0.38	41.01	20.26
Arabica Plantation - Chennai and ICO Composite Indicator Price	r=0	-	-	-	r=0	0.11	8.19	9.16
	r<=1	-	-	-	r<=1	0.38	49.33	25.87
Arabica Plantation - Chennai and ICE (New York)	r=0	0.07	5.02	12.51	r=0	0.07	18.21	15.49
	r<=1	0.37	44.92	25.87	r<=1	0.00	0.18	3.84

Note:(-) excluded from cointegration analysis due to the stationarity of any one of the price series at its levels

Table 4.63 Results of pair-wise cointegration tests between different coffee prices in Indian market during Period III (2010-11 to 2019-20)

Market/ Price series	Price in Rupees				Price in US Dollar			
	Null	**Eigen value**	**Trace statistic**	**Critical value**	**Null**	**Eigen value**	**Trace statistic**	**Critical value**
Arabica Plantation - Bangalore and Arabica Plantation – Chennai	r=0	0.12	8.97	9.16	r=0	0.00	0.42	3.84
	r<=1	0.33	39.60	18.39	r<=1	0.13	16.22	15.49
Arabica Plantation - Bangalore and Arabica Plantation – Hyderabad	r=0	0.17	12.46	3.84	r=0	0.00	0.23	3.84
	r<=1	0.31	17.63	20.26	r<=1	0.06	17.35	15.49
Robusta Cherry – Bangalore and Robusta Cherry – Chennai	r=0	0.09	21.67	15.49	r=0	0.22	17.38	12.51
	r<=1	0.00	0.24	3.84	r<=1	0.39	13.42	20.26
Robusta Cherry – Bangalore and Robusta Cherry – Hyderabad	r=0	0.01	23.02	15.49	r=0	0.12	8.97	9.16
	r<=1	0.00	0.05	3.84	r<=1	0.33	39.60	18.39
Arabica Plantation - Chennai and Arabica Plantation- Hyderabad	r=0	0.00	0.23	3.84	r=0	0.09	21.67	15.49
	r<=1	0.06	17.35	15.49	r<=1	0.00	0.24	3.84
Robusta Cherry – Chennai and Robusta Cherry – Hyderabad	r=0	0.38	44.38	18.39	r=0	0.17	12.46	3.84
	r<=1	0.15	1.28	3.84	r<=1	0.31	17.63	20.26

Note:(-) excluded from cointegration analysis due to the stationarity of any one of the price series at its levels

Table 4.64 Summary of the results of pair-wise cointegration tests between Indian and International prices of coffee

Market/ Price series	Price in Rupees				Price in US Dollar			
	Overall Period	**Period I**	**Period II**	**Period III**	**Overall Period**	**Period I**	**Period II**	**Period III**
Arabica Plantation - Bangalore and ICO Indicator Price - Other Mild Arabicas	C	C	C	C	C	X	C	X
Arabica Plantation - Bangalore and ICO Composite Indicator Price	C	C	C	_	C	X	X	X
Arabica Plantation - Bangalore and ICE (New York)	C	C	C	X	C	X	X	X
Robusta Cherry - Bangalore and ICO Indicator Price – Robusta	C	_	C	C	C	C	X	C
Robusta Cherry - Bangalore and ICO Composite Indicator Price	C	C	C	_	C	C	X	C
Robusta Cherry - Bangalore and LIFFE (London)	C	C	C	X	C	C	X	C
Arabica Plantation - Chennai and ICO Indicator Price - Other Mild Arabicas	C	C	C	C	C	C	X	X
Arabica Plantation - Chennai and ICO Composite Indicator Price	C	C	C	_	C	C	C	X
Arabica Plantation - Chennai and ICE (New York)	C	C	C	X	C	C	C	C
Robusta Cherry - Chennai and ICO Indicator Price – Robusta	C	_	C	X	C	C	C	C
Robusta Cherry - Chennai and ICO Composite Indicator Price	C	C	C	_	C	C	C	C
Robusta Cherry - Chennai and LIFFE (London)	C	C	C	C	C	C	C	C
Arabica Plantation - Hyderabad and ICO Indicator Price - Other Mild Arabicas	C	_	C	C	C	C	C	C
Arabica Plantation - Hyderabad and ICO Composite Indicator Price	C	_	C	_	C	C	C	C
Arabica Plantation - Hyderabad and ICE (New York)	C	_	C	C	C	C	C	C
Robusta Cherry - Hyderabad and ICO Indicator Price – Robusta	C	_	C	C	C	C	C	C
Robusta Cherry - Hyderabad and ICO Composite Indicator Price	C	C	C	_	C	C	C	C
Robusta Cherry - Hyderabad and LIFFE (London)	C	C	C	X	X	C	C	C

Note: C denotes presence of co-integration, X denotes absence of co-integration, _ denotes price series is stationary at levels

Table 4.65 Summary of the results of pair-wise cointegration tests between different coffee prices in Indian market

Market/ Price series	Price in rupees				Price in US dollar			
	Overall	Period I	Period II	Period III	Overall	Period I	Period II	Period III
Arabica Plantation - Bangalore and Arabica Plantation – Chennai	C	C	C	X	C	C	X	X
Arabica Plantation - Bangalore and Arabica Plantation – Hyderabad	C	_	C	C	C	C	X	X
Robusta Cherry - Bangalore and Robusta Cherry – Chennai	C	C	C	C	C	C	C	C
Robusta Cherry - Bangalore and Robusta Cherry – Hyderabad	C	C	C	C	C	C	C	X
Arabica Plantation - Chennai and Arabica Plantation- Hyderabad	C	_	C	X	C	C	C	C
Robusta Cherry - Chennai and Robusta Cherry – Hyderabad	C	C	C	C	C	C	C	C

Note: C denotes presence of co-integration, X denotes absence of co-integration, _ denotes price series is stationary at levels

Table 4.66 Details of codes assigned to different price combinations for multiple cointegration analysis

I	ICO Composite Indicator Price, Arabica Plantation-Bangalore, Arabica Plantation - Chennai, Arabica Plantation- Hyderabad, Robusta Cherry – Bangalore, Robusta Cherry – Chennai, Robusta Cherry – Hyderabad
II	ICO Indicator Price - Other Mild Arabicas, Arabica Plantation - Bangalore, Arabica Plantation - Chennai, Arabica Plantation-Hyderabad
III	ICO Indicator Price – Robusta, Robusta Cherry – Bangalore, Robusta Cherry – Chennai, Robusta Cherry – Hyderabad
IV	ICE (New York), Arabica Plantation - Bangalore, Arabica Plantation - Chennai, Arabica Plantation- Hyderabad
V	LIFFE (London), Robusta Cherry – Bangalore, Robusta Cherry – Chennai, Robusta Cherry – Hyderabad
VI	Arabica Plantation - Bangalore, Arabica Plantation - Chennai, Arabica Plantation- Hyderabad
VII	Robusta Cherry – Bangalore, Robusta Cherry – Chennai, Robusta Cherry – Hyderabad

Table 4.67 Results of the Multiple cointegration tests between Indian and International prices of coffee (Overall period: 1994-95 to 2019-2020)

Markets/Price series	Price in Rupees				Price in US Dollar			
	Null	**Eigen value**	**Trace statistic**	**Critical value**	**Null**	**Eigen value**	**Trance statistic**	**Critical value**
I	r=0	0.27	281.93	150.06	r=0	0.27	282.88	150.55
	r<=1	0.18	184.23	117.70	r<=1	0.18	184.74	117.70
	r<=2	0.13	123.39	88.80	r<=2	0.14	124.58	88.80
	r<=3	0.11	79.72	63.87	r<=3	0.11	79.43	63.88
	r<=4	0.08	45.10	42.91	r<=4	0.08	43.91	42.91
	r<=5	0.04	19.06	25.80	r<=5	0.05	19.38	25.87
	r<=6	0.02	5.30	12.51	r<=6	0.02	4.98	12.51
II	r=0	0.22	140.29	63.87	r=0	0.22	141.21	63.87
	r<=1	0.11	65.08	42.91	r<=1	0.11	65.89	42.91
	r<=2	0.08	30.13	25.87	r<=2	0.07	29.17	25.87
	r<=3	0.02	5.87	12.51	r<=3	0.02	5.25	12.51
III	r=0	0.18	109.86	54.07	r=0	0.17	107.78	54.07
	r<=1	0.10	49.72	35.19	r<=1	0.10	48.97	35.19
	r<=2	0.05	15.87	20.26	r<=2	0.04	15.43	20.26
	r<=3	0.00	1.11	9.16	r<=3	0.01	3.31	9.16

IV	r=0	0.22	136.19	63.87	r=0	0.17	107.78	54.07
	r<=1	0.11	61.28	42.91	r<=1	0.10	48.97	35.19
	r<=2	0.06	26.61	25.87	r<=2	0.04	15.43	20.26
	r<=3	0.02	6.34	12.51	r<=3	0.01	3.31	9.16
V	r=0	0.18	105.61	40.17	r=0	0.17	107.78	54.07
	r<=1	0.10	44.94	24.27	r<=1	0.10	48.97	35.19
	r<=2	0.04	13.47	12.32	r<=2	0.04	15.43	20.26
	r<=3	0.00	0.19	4.12	r<=3	0.01	3.31	9.16
VI	r=0	0.20	105.36	42.91	r=0	0.20	106.38	42.91
	r<=1	0.10	37.20	25.87	r<=1	0.10	36.90	25.87
	r<=2	0.02	5.66	12.51	r<=2	0.02	4.91	12.51
VII	r=0	0.18	85.41	24.27	r=0	0.17	89.22	35.19
	r<=1	0.08	25.87	12.32	r<=1	0.09	30.67	20.26
	r<=2	0.00	0.18	4.12	r<=2	0.01	2.74	9.16

Note: I- ICO Composite Indicator Price, Arabica Plantation - Bangalore, Arabica Plantation - Chennai, Arabica Plantation- Hyderabad, Robusta Cherry – Bangalore, Robusta Cherry – Chennai, Robusta Cherry – Hyderabad, II- ICO Indicator Price - Other Mild Arabicas, Arabica Plantation - Bangalore, Arabica Plantation - Chennai, Arabica Plantation- Hyderabad, III- ICO Indicator Price – Robusta, Robusta Cherry – Bangalore, Robusta Cherry – Chennai, Robusta Cherry – Hyderabad IV- ICE (New York), Arabica Plantation - Bangalore, Arabica Plantation - Chennai, Arabica Plantation- Hyderabad, V- LIFFE (London), Robusta Cherry – Bangalore, Robusta Cherry – Chennai, Robusta Cherry – Hyderabad, VI- Arabica Plantation - Bangalore, Arabica Plantation - Chennai, Arabica Plantation- Hyderabad, VII- Robusta Cherry – Bangalore, Robusta Cherry – Chennai, Robusta Cherry – Hyderabad

Note:(-) excluded from cointegration analysis due to the stationarity of any one of the price series at its levels

Table 4.68 Results of the Multiple cointegration test between Indian and International prices of coffee (Period I: 1994-95 to 1999-2000)

Markets/Price series	**Price in Rupees**				**Price in US Dollar**			
	Null	**Eigen value**	**Trace statistic**	**Critical value**	**Null**	**Eigen value**	**Trance statistic**	**Critical value**
I	r=0	0.52	145.47	103.84	r=0	0.55	162.78	134.67
	r<=1	0.42	95.16	76.97	r<=1	0.43	107.65	103.84
	r<=2	0.36	57.71	54.07	r<=2	0.33	69.21	76.97
	r<=3	0.18	27.01	35.19	r<=3	0.24	41.43	54.07
	r<=4	0.14	13.44	20.26	r<=4	0.16	22.92	35.19
	r<=5	0.05	3.34	9.16	r<=5	0.11	10.54	20.26
	r<=6	-	-	-	r<=6	0.04	2.84	9.16
II	r=0	0.38	54.37	35.19	r=0	0.38	70.23	54.07
	r<=1	0.19	21.46	20.26	r<=1	0.24	37.27	35.19
	r<=2	0.10	7.28	9.16	r<=2	0.16	18.05	20.26
	r<=3	-	-	-	r<=3	0.08	5.64	9.16
III	r=0	0.42	81.84	54.07	r=0	0.42	84.50	63.87
	r<=1	0.29	44.82	35.19	r<=1	0.28	47.12	42.91
	r<=2	0.18	21.40	20.26	r<=2	0.19	24.18	25.87
	r<=3	0.11	7.99	9.16	r<=3	0.13	9.83	12.51

IV	r=0	0.39	52.92	35.19	r=0	0.38	67.16	54.07
	r<=1	0.19	18.34	20.26	r<=1	0.23	34.22	35.19
	r<=2	0.05	3.89	9.16	r<=2	0.17	15.98	20.26
	r<=3	-	-	-	r<=3	0.05	3.45	9.16
V	r=0	0.42	85.25	54.07	r=0	0.43	88.19	63.87
	r<=1	0.31	47.68	35.19	r<=1	0.30	49.84	42.91
	r<=2	0.19	22.44	20.26	r<=2	0.20	24.96	25.87
	r<=3	0.11	7.96	9.16	r<=3	0.13	9.96	12.51
VI	r=0	0.35	38.56	20.26	r=0	0.33	49.19	35.19
	r<=1	0.11	8.38	9.16	r<=1	0.20	21.22	20.26
	r<=2	-	-	-	r<=2	0.08	5.60	9.16
VII	r=0	0.41	60.83	35.19	r=0	0.40	63.68	42.91
	r<=1	0.22	24.84	20.26	r<=1	0.21	27.96	25.87
	r<=2	0.11	7.88	9.16	r<=2	0.15	11.33	12.51

Note: I- ICO Composite Indicator Price, Arabica Plantation - Bangalore, Arabica Plantation - Chennai, Arabica Plantation- Hyderabad, Robusta Cherry – Bangalore, Robusta Cherry – Chennai, Robusta Cherry – Hyderabad, II- ICO Indicator Price - Other Mild Arabicas, Arabica Plantation - Bangalore, Arabica Plantation - Chennai, Arabica Plantation- Hyderabad, III- ICO Indicator Price – Robusta, Robusta Cherry – Bangalore, Robusta Cherry – Chennai, Robusta Cherry – Hyderabad IV- ICE (New York), Arabica Plantation - Bangalore, Arabica Plantation - Chennai, Arabica Plantation- Hyderabad, V- LIFFE (London), Robusta Cherry – Bangalore, Robusta Cherry – Chennai, Robusta Cherry – Hyderabad, VI- Arabica Plantation - Bangalore, Arabica Plantation - Chennai, Arabica Plantation- Hyderabad, VII- Robusta Cherry – Bangalore, Robusta Cherry – Chennai, Robusta Cherry – Hyderabad

Note:(-) excluded from cointegration analysis due to the stationarity of any one of the price series at its levels

Table 4.69 Results of the Multiple cointegration test between Indian and International prices of coffee (Period II: 2000-01 to 2009-10)

Markets/Price series	**Price in Rupees**				**Price in US Dollar**			
	Null	**Eigen value**	**Trace statistic**	**Critical value**	**Null**	**Eigen value**	**Trance statistic**	**Critical value**
I	r=0	0.41	185.18	134.67	r=0	0.04	178.01	134.67
	r<=1	0.35	124.65	103.84	r<=1	0.33	118.85	103.84
	r<=2	0.24	74.66	76.97	r<=2	0.24	73.64	76.97
	r<=3	0.16	42.35	54.07	r<=3	0.17	41.79	54.07
	r<=4	0.13	21.70	35.19	r<=4	0.13	20.35	35.19
	r<=5	0.04	5.83	20.26	r<=5	0.03	4.92	20.26
	r<=6	0.01	0.80	9.16	r<=6	0.01	0.87	9.16
II	r=0	0.32	79.08	54.07	r=0	0.32	75.10	54.07
	r<=1	0.16	35.04	35.19	r<=1	0.15	30.21	35.19
	r<=2	0.11	14.88	20.26	r<=2	0.08	11.09	20.26
	r<=3	0.02	2.12	9.16	r<=3	0.01	1.27	9.16
III	r=0	0.25	61.39	54.07	r=0	0.25	60.42	54.07
	r<=1	0.15	27.84	35.19	r<=1	0.15	27.46	35.19
	r<=2	0.06	8.51	20.26	r<=2	0.06	8.66	20.26
	r<=3	0.01	1.04	9.16	r<=3	0.01	1.11	9.16
IV	r=0	0.33	75.04	54.07	r=0	0.34	74.39	54.07

	r<=1	0.15	29.56	35.19	r<=1	0.15	26.66	35.19
	r<=2	0.07	10.90	20.26	r<=2	0.06	8.13	20.26
	r<=3	0.02	2.41	9.16	r<=3	0.01	1.57	9.16
V	r=0	0.29	70.53	54.07	r=0	0.29	69.78	54.07
	r<=1	0.18	30.99	35.19	r<=1	0.17	30.26	35.19
	r<=2	0.06	8.14	20.26	r<=2	0.06	8.37	20.26
	r<=3	0.01	1.04	9.16	r<=3	0.01	1.10	9.16
VI	r=0	0.31	57.35	35.19	r=0	0.31	69.71	42.91
	r<=1	0.11	14.84	20.26	r<=1	0.15	26.48	25.87
	r<=2	0.02	2.05	9.16	r<=2	0.07	7.85	12.51
VII	r=0	0.22	38.81	24.27	r=0	0.23	45.28	35.19
	r<=1	0.08	9.92	12.32	r<=1	0.11	14.59	20.26
	r<=2	0.00	0.54	4.12	r<=2	0.01	0.99	9.16

Note: I- ICO Composite Indicator Price, Arabica Plantation - Bangalore, Arabica Plantation - Chennai, Arabica Plantation- Hyderabad, Robusta Cherry – Bangalore, Robusta Cherry – Chennai, Robusta Cherry – Hyderabad, II- ICO Indicator Price - Other Mild Arabicas, Arabica Plantation - Bangalore, Arabica Plantation - Chennai, Arabica Plantation- Hyderabad, III- ICO Indicator Price – Robusta, Robusta Cherry – Bangalore, Robusta Cherry – Chennai, Robusta Cherry – Hyderabad IV- ICE (New York), Arabica Plantation - Bangalore, Arabica Plantation - Chennai, Arabica Plantation- Hyderabad, V- LIFFE (London), Robusta Cherry – Bangalore, Robusta Cherry – Chennai, Robusta Cherry – Hyderabad, VI- Arabica Plantation - Bangalore, Arabica Plantation - Chennai, Arabica Plantation- Hyderabad, VII- Robusta Cherry – Bangalore, Robusta Cherry – Chennai, Robusta Cherry – Hyderabad

Note:(-) excluded from cointegration analysis due to the stationarity of any one of the price series at its levels

Table 4.70 Results of the Multiple cointegration test between Indian and International prices of coffee (Period III: 2010-11 to 2019-20)

Markets/Price series	Price in Rupees				Price in US Dollar			
	Null	**Eigen value**	**Trace statistic**	**Critical value**	**Null**	**Eigen value**	**Trance statistic**	**Critical value**
I	r=0	-	-	-	r=0	0.41	161.47	134.67
	r<=1	-	-	-	r<=1	0.30	101.35	103.84
	r<=2	-	-	-	r<=2	0.19	59.62	76.97
	r<=3	-	-	-	r<=3	0.12	35.11	54.07
	r<=4	-	-	-	r<=4	0.08	19.87	35.19
	r<=5	-	-	-	r<=5	0.05	9.91	20.26
	r<=6	-	-	-	r<=6	0.03	3.51	9.16
II	r=0	0.23	51.24	40.17	r=0	0.25	59.97	54.07
	r<=1	0.11	21.22	24.27	r<=1	0.13	27.14	35.19
	r<=2	0.07	8.05	12.32	r<=2	0.07	11.68	20.26
	r<=3	0.00	0.01	4.12	r<=3	0.03	3.76	9.16
III	r=0	0.16	40.18	40.17	r=0	0.21	55.51	54.07
	r<=1	0.09	19.59	24.27	r<=1	0.09	24.03	35.19
	r<=2	0.06	8.59	12.32	r<=2	0.07	12.58	20.26
	r<=3	0.01	1.18	4.12	r<=3	0.03	3.95	9.16

IV	r=0	0.28	70.75	63.87	r=0	0.25	60.04	54.07
	r<=1	0.14	32.37	42.91	r<=1	0.13	26.88	35.19
	r<=2	0.08	15.59	25.87	r<=2	0.06	10.20	20.26
	r<=3	0.05	5.85	12.51	r<=3	0.03	3.37	9.16
V	r=0	0.17	53.12	54.07	r=0	0.22	51.95	54.07
	r<=1	0.13	31.25	35.19	r<=1	0.09	24.05	35.19
	r<=2	0.09	15.17	20.26	r<=2	0.08	12.75	20.26
	r<=3	0.03	4.09	9.16	r<=3	0.03	3.67	9.16
VI	r=0	0.19	42.93	35.19	r=0	0.22	42.99	35.19
	r<=1	0.10	18.10	20.26	r<=1	0.10	14.31	20.26
	r<=2	0.05	6.06	9.16	r<=2	0.02	2.82	9.16
VII	r=0	0.11	24.53	24.27	r=0	0.13	30.94	35.19
	r<=1	0.09	11.70	12.30	r<=1	0.08	14.91	20.26
	r<=2	0.01	1.07	4.12	r<=2	0.04	4.73	9.16

Note: I- ICO Composite Indicator Price, Arabica Plantation - Bangalore, Arabica Plantation - Chennai, Arabica Plantation- Hyderabad, Robusta Cherry – Bangalore, Robusta Cherry – Chennai, Robusta Cherry – Hyderabad, II- ICO Indicator Price - Other Mild Arabicas, Arabica Plantation - Bangalore, Arabica Plantation - Chennai, Arabica Plantation- Hyderabad, III- ICO Indicator Price – Robusta, Robusta Cherry – Bangalore, Robusta Cherry – Chennai, Robusta Cherry – Hyderabad IV- ICE (New York), Arabica Plantation - Bangalore, Arabica Plantation - Chennai, Arabica Plantation- Hyderabad, V- LIFFE (London), Robusta Cherry – Bangalore, Robusta Cherry – Chennai, Robusta Cherry – Hyderabad, VI- Arabica Plantation - Bangalore, Arabica Plantation - Chennai, Arabica Plantation- Hyderabad, VII- Robusta Cherry – Bangalore, Robusta Cherry – Chennai, Robusta Cherry – Hyderabad

Note:(-) excluded from cointegration analysis due to the stationarity of any one of the price series at its levels

Table 4.71 Summary of the results of multiple cointegration tests between Indian and International prices of coffee in different time-periods

Market/Price series	**Accepted H0**				**Accepted H0**			
	Price in rupees				**Price in dollars**			
	Overall period	**Period I**	**Period II**	**Period III**	**Overall period**	**Period I**	**Period II**	**Period III**
I	r<=5	r<=3	r<=2	-	r<=5	r<=2	r<=2	r<=1
II	r<=3	r<=2	r<=1	r<=1	r<=3	r<=2	r<=1	r<=1
III	r<=2	r<=3	r<=1	r<=1	r<=2	r<=2	r<=1	r<=1
IV	r<=3	r<=2	r<=1	r<=1	r<=2	r<=2	r<=1	r<=1
V	r<=3	r<=3	r<=1	r<=0	r<=2	r<=2	r<=1	r<=0
VI	r<=2	r<=1	r<=1	r<=1	r<=2	r<=2	r<=2	r<=1
VII	r<=2	r<=2	r<=1	r<=0	r<=2	r<=2	r<=1	r<=0

Note: I- ICO Composite Indicator Price, Arabica Plantation - Bangalore, Arabica Plantation - Chennai, Arabica Plantation- Hyderabad, Robusta Cherry – Bangalore, Robusta Cherry – Chennai, Robusta Cherry – Hyderabad, II- ICO Indicator Price - Other Mild Arabicas, Arabica Plantation - Bangalore, Arabica Plantation - Chennai, Arabica Plantation- Hyderabad, III- ICO Indicator Price – Robusta, Robusta Cherry – Bangalore, Robusta Cherry – Chennai, Robusta Cherry – Hyderabad IV- ICE (New York), Arabica Plantation - Bangalore, Arabica Plantation - Chennai, Arabica Plantation- Hyderabad, V- LIFFE (London), Robusta Cherry – Bangalore, Robusta Cherry – Chennai, Robusta Cherry – Hyderabad, VI- Arabica Plantation - Bangalore, Arabica Plantation - Chennai, Arabica Plantation- Hyderabad, VII- Robusta Cherry – Bangalore, Robusta Cherry – Chennai, Robusta Cherry – Hyderabad

Note:(-) excluded from multiple cointegration analysis, Accepted H_0 indicates presence of cointegration was confirmed

: If any one of the price series shown stationary at levels, cointegration analysis done with other price series

The pair-wise cointegration were done between price series and the price series combinations were denoted by alphabets from A to X for the convenience of the discussion. The results presented in Table 4.64 and Table 4.65 confirmed the co-integration or co-movement of all the coffee price combinations in domestic as well as international market, with the exception of the combination of Robusta cherry price in Hyderabad market with London future market prices during the overall period. In period I, all the Indian market price combinations have exhibited cointegration for prices in Rupees as well as US Dollars.

The results of pair-wise cointegration tests between Indian and international prices in period III indicated that except for price combinations such as C, F, I, J and R in Rupees, and A, B, C, G and H in Dollars, all other price/market combinations have exhibited cointegration relationships during the period. All the price combinations except S and W pairs of prices in Rupees and S, T and V price combinations in US Dollar in domestic market exhibited cointegration.

In general, almost all the coffee markets in India were cointegrated or move together with international markets. The study also confirmed the existence of strong co-movement of prices between the markets of coffee within the country. The findings indicate that the liberalization reforms, subsequent measures and technological revolution have led to effective and spontaneous transmission of price signals between international and domestic market and between the domestic markets, resulting in high integration of the coffee markets (Joseph, 2004)

The transmission of price signals between Indian and international markets were also confirmed for period I, II and III. Thus, the price of coffee in one market was found to be having considerable influence on the prices prevailing in the other market. Markets which were integrated with same order were subjected to multiple cointegration analysis using the Maximum Likelihood Estimation procedure (Johansen and Juselius, 1990). For the convenience of discussion grouped price series were represented by Roman numerals from I-VII.

Multiple cointegration analysis of all the combinations of market prices in Dollars as well as Rupees in all the time periods, except combination I in period III have exhibited at least one co-movement among prices. The transmission of price signals and integration of markets depend on various factors such as presence of tariff barriers, degree of protection and border and domestic policies after liberalization and Free Sale Quota (FSQ). Reduction in these trade barriers as well as policy changes have led to better integration and transmission of prices between the markets in the post-WTO period. In-spite of the general movement of prices between Indian and international markets, the prices converged quickly in absolute terms. This could possibly be due to several factors such as non-tariff barriers, transportation and transaction costs, extent of market power, scale of economies, and extent of exchange rate pass through on output prices (IGIDR, 2011). The price series of coffee in different markets were moving together in almost all the periods considered. Even though there is price variation among different varieties of coffee, the overall demand for the commodity in the domestic market is irrespective of its quality and variety, which in turn could be the reason for the co-movement of prices in different markets of coffee.

4.7.2.3 Correction of short run disequilibrium -Vector Error Correction Model

The confirmation of cointegration between two price series indicates the existence of a long run relationship between them. The Error Correction Model (ECM) was applied for the subsequent analysis. The ECM focuses on the strength of interrelationships or the speed and magnitude of the reactions of one price over another while the system is shocked (Schroeder and Goodwin,1990), and thus combining the long run relationship with the short run dynamics of the model. The ECM works based on the behavioral assumption of the attainment of an equilibrium that determines both long run and short run behavior.

The error correction term was measured for the cointegrated price series for which the optimum lag was selected based on five criteria *viz*., sequential modified Likelihood Ratio test statistics (LR), Final Prediction Error (FPE), Akaike Information Criterion (AIC), Schwarz Information Criterion (SIC) and Hannan-

Table 4.72 Estimates of Error Correction Model for cointegrated Indian and international coffee markets.

Market combinations	ECM Price in rupees				ECM Price in US dollar			
	Overall period	Period I	Period II	Period III	Overall period	Period I	Period II	Period III
D(ARB)	-0.06***	-0.523***	-0.0662***	-0.0845**	-0.67***	-	-0.078*	-
D(ARICO)	0.11**	0.061**	0.069	0.029	0.097**	-	0.126*	-
Correction time (months)	2	2	2		2	-	2	-
D(ARB)	-0.059***	0.023***	-0.055***	-	-0.049***	-	-	-
D(CIICO)	0.066***	0.11***	0.063***	-	0.036***	-	-	-
Correction time (months)	2	1	2		2	-	-	-
D(RCB)	-0.081***	-	-0.11***	-0.031**	-0.105***	-0.069***	-	-0.042***
D(RCICO)	0.098**	-	0.14	0.0020**	0.0633***	0.016**	-	0.006***
Correction time (months)	2	-	1	2	2	2	-	2
D(RCB)	-0.052**	-0.0965***	-0.048***	-	-0.0662**	-0.117**	-	-0.0015***
D(CIICO)	0.049***	0.100***	0.0019	-	0.069***	0.118**	-	0.22**
Correction time (months)	2	2	1	-	2	1	-	2
D(RCB)	-0.055***	-0.117**	-0.015**	-	-0.075***	-0.164***	-	-0.017***
D(LON)	0.094	0.056***	0.153**	-	0.064***	0.044***	-	0.044***
Correction time (months)	2	2	2	-	2	2	-	2
D(ARH)	-0.107***	-	-0.021***	-0.233***	-0.107***	-0.15***	-0.0612**	-0.10***
D(ARICO)	0.084***	-	0.0045***	0.170***	0.084***	0.234***	0.00308***	0.45***
Correction time (months)	2	-	2	2	2	1	2	2
D(ARH)	-0.117***	-	-0.230***	-	-0.245***	-0.030**	-0.058*	-0.052***
D(CIICO)	0.056	-	0.165***	-	0.038**	0.0021***	0.0021***	0.094**
Correction time (months)	2	-	2	-	2	2	2	2
D(ARH)	-0.054***	-	-0.00494***	-0.00494**	-0.032***	-0.030***	-0.38***	-0.058***
D(NEW)	0.097***	-	0.0019***	0.0019***	0.088	0.301***	0.38***	0.301***
Correction time (months)	2	-	2	2	2	2	2	2
D(RCH)	-0.112***	-	-0.133**	-0.118**	-0.002**	-0.048***	-0.55***	-0.048**
D(RCICO)	0.053**	-	0.152	0.140***	0.047***	0.0019**	0.002***	0.0013***
Correction time (months)	2	-	2	1	2	2	2	2

Note: 1: ***denotes significant at 1 per cent level, ** denotes significant at 5 per cent, * denotes significant at 10 per cent level

…Cont. Table 4.72 Estimates of Error Correction Model for cointegrated Indian and international markets.

Market combinations	ECM				ECM			
	Price in rupees				Price in US dollar			
	Overall period	Period I	Period II	Period III	Overall period	Period I	Period II	Period III
D(ARC)	-0.17**	-0.054***	-0.117***	-0.10***	-0.37***	-0.017***	-	-
D(ARICO)	0.085***	0.097***	0.056***	0.126***	0.105***	0.044	-	-
Correction time (months)	2	2	2	2	2	1	-	-
D(ARC)	-0.150***	-0.043***	-0.0280**	-	-0.230***	-0.112***	-0.015***	-
D(CIICO)	0.052	0.165**	0.14***	-	0.042***	0.047***	0.153***	-
Correction time (months)	2		1	-	2	2	2	-
D(ARC)	-0.0965***	-0.0817***	-0.043***	-	-0.0845***	-0.107***	-0.084***	-0.126**
D(NEW)	0.100***	0.043***	0.165**	-	0.029***	0.070	0.044***	0.0160**
Correction time (months)	2	2	2	-	2	1	2	2
D(ARC)	-0.360***	-	-0.002***	-	-0.180***	-0.100**	-0.164**	-0.164*
D(ARH)	0.20***	-	0.33***	-	0.10	0.070**	0.044***	0.024***
Correction time (months)	1	-	1	-	1	1	1	1
D(RCC)	-0.54**	-	-0.021***	-	-0.87***	-0.030***	-0.315**	-0.0476***
D(RCICO)	0.030***	-	0.189***	-	0.011**	0.0015***	0.208***	0.00118**
Correction time (months)	1	-	1	-	1	2	1	1
D(RCC)	-0.289***	-0.105***	-0.0038***	-	-0.116***	-0.100***	-0.15***	-0.012***
D(CIICO)	0.0258***	0.0325***	0.160***	-	0.0568***	0.062**	0.234**	0.0101***
Correction time (months)	2	2	2		2	2	2	2
D(RCC)	-0.410***	-0.069***	-0.094***	-0.133***	-0.523***	-0.066***	-0.058***	-0.028**
D(LON)	0.054***	0.002***	0.0010***	0.152***	0.061***	0.0046***	0.0021***	0.0486***
Correction time (months)	2		2	2	2	2	3	2
D(RCH)	-0.081***	-0.12***	-0.233***	-	-0.126***	-0.021***	-0.235***	-0.0038**
D(CIICO)	0.040	0.149**	0.170***	-	0.029***	0.189***	0.160**	0.160***
Correction time (months)	1	1	1	-	1	1	2	1
D(RCH)	-0.0817***	-0.017**	-0.00106***	-	-	-0.095**	-0.056***	-0.092***
D(LON)	0.0606***	0.044***	0.0021**	-	-	0.239***	0.186***	0.260**
Correction time (months)	2	2	2		-	2	2	2

Note: 1: ***denotes significant at 1 per cent level, ** denotes significant at 5 per cent, *** denotes significant at 10 per cent level

Table 4.73 Estimates of Error Correction Model for cointegrated Indian markets

Market combinations	ECM Price in rupees				ECM Price in US dollar			
	Overall period	**Period I**	**Period II**	**Period III**	**Overall period**	**Period I**	**Period II**	**Period III**
D(ARB)	0.0422***	0.023**	-0.058***	-	0.043**	-0.426***	-	-
D(ARC)	0.375***	0.11**	0.0021	-	0.10	0.0015***	-	-
Correction time (months)	2	2	1	2	2	2	-	-
D(ARB)	-0.021**	-	-0.052**	-0.21***	-0.0038***	-0.025**	-	-
D(ARH)	0.235**	-	0.094***	0.24**	0.234***	0.065***	-	-
Correction time (months)	2	-	2	2	2	1		-
D(RCB)	-0.039***	-0.56***	-0.410***	-0.012***	-0.038***	-0.005***	-0.0160***	-0.016***
D(RCC)	0.77**	0.066***	0.054***	0.00052	0.76***	0.243***	0.265***	0.635***
Correction time (months)	4	2	3	2	4	3	3	2
D(RCB)	-0.021***	-0.105***	-0.117***	-0.12***	0.023***	-0.028***	-0.036***	-
D(RCH)	0.25***	0.0633**	0.056***	0.155***	0.11**	0.084**	0.0056***	-
Correction time (months)	2	2	2	2	2	2	2	-
D(RCC)	-0.79***	-0.021***	-0.180**	-0.00106***	-0.56***	-0.80***	-0.315***	-0.12***
D(RCH)	0.054***	0.0045***	0.134***	0.0021***	0.066**	0.019**	0.208***	0.55***
Correction time (months)	1	1	1	1	1	1	1	1

Note: 1: ***denotes significant at 1 per cent level, ** denotes significant at 5 per cent, * denotes significant at 10 per cent level

Quinn Information Criterion (HQIC) by fitting an unrestricted VAR model. The coefficients of the error correction terms denote the percentage of disequilibrium being adjusted and the speed of convergence to the long-run path as a consequence of shock on its own prices (Barret, 2001). The estimates of VECM are presented in Table 4.72 and 4.73.

While discussing ECM for Arabica coffee prices in Bangalore market and the Arabica coffee price in international ICO market, the information flow was more in the international market during the overall period, whereas a strong information flow was observed in the Bangalore Arabica coffee market during period II for prices in Dollars. This indicates the dynamic price adjustment mechanism that is occurring in the system. The short run disequilibrium in the domestic price got corrected within two months by changes in its own price and the international market price, while the deviation in the ICO prices got corrected within two months by change in its own price. A coefficient with less than 0.5 value indicates the slow pace of adjustment towards the equilibrium path. The ICO Arabica price in all the periods have less than 0.5 value for coefficients and hence there will only be a slow pace of adjustment towards the equilibrium path. A similar kind of findings were observed by Mohan *et al*., (2014) while studying the welfare gain from eliminating the coffee price volatility in consideration with the Indian producer prices in the international market.

The ECM for Arabica price in Bangalore and ICO composite indicator price in international market indicates that the information flow was more in ICO market for prices in rupees during the overall period, whereas for prices US Dollar, information flow was more in Bangalore market during the same period. Both ICO and Bangalore market prices were found to be corrected within two months in the overall period.

When the ECM for Arabica prices in Bangalore and New York future market were analysed, the coefficients indicated that more information flow was observed in New York market during the overall period, whereas in period I and II the information flow was found to be more in domestic market for prices in Rupees.

Both the prices were found to correct their disequilibrium within a period of two months.

The domestic Arabica markets (Bangalore and Chennai) were subjected to VECM and the results indicated that among the domestic markets, information flow was more in Chennai market than the Bangalore market in the overall period for prices in Rupee as well as US Dollars, and the disequilibrium in both market prices were corrected within a period of two months. The third domestic market (Hyderabad) also showed cointegration with Bangalore market and the VECM for this combination indicates a strong information flow from Hyderabad market to Bangalore market in the overall period as well as during all the other three periods.

The Robusta coffee prices in Bangalore market was cointegrated with Robusta prices in ICO market. Except for the period I and II (prices in Rupees), the information flow was more in Bangalore market. In the overall period, the price series corrected their disequilibrium within a period of two months.

The ECM for Robusta coffee prices in Bangalore market and ICO composite indicator price in international market indicates that the Bangalore market price in Rupees exhibited more information flow and quick adjustment in overall period, whereas for prices in US dollars, more information flow was observed in the ICO market. With the exception of period II, for prices in Rupees, all other periods have shown more information flow in ICO market. The ICO market price and domestic prices regained equilibrium within a period of two months, but in period II, for prices in Rupees and period I for prices in Dollars, disequilibrium was corrected the within a period of one month.

The ECM of Robusta price series in Bangalore and London future market indicates that strong information flow occurred in London market for prices in Rupees and Bangalore market for prices in Dollars. The disequilibrium in the overall period for both the prices was corrected within a period of two months.

The ECM for domestic Robusta markets such as Bangalore and Chennai were analysed. The estimates indicated that in all the time periods except period II and III for prices in Rupees, the information flow was more in Chennai market. This indicated the quick disequilibrium adjustment in Chennai market. The disequilibrium was corrected quickly for Chennai market prices within a period of four months during the overall period. The ECM for Robusta price in Bangalore and Hyderabad markets indicates the information flow was more in Hyderabad market for prices in both Rupees as well as Dollar terms and the disequilibrium in the short run was corrected quickly in Hyderabad market within a period of two months.

The ECM model for Arabica coffee price in the Chennai and ICO market indicates that the information flow was more in Arabica coffee price in Chennai market compared to ICO market in the overall period for prices both in Rupees and Dollar terms and the disequilibrium was corrected with in a period of two months in both the markets. Among the markets, quick correction was observed in Chennai market.

The Arabica coffee in Chennai and composite indicator price in ICO market were integrated and the ECM estimates indicated that the information flow was more in Chennai market for both prices in rupees as well as dollar during the overall period. The quick correction of disequilibrium was observed with Chennai market and the disequilibrium was corrected within a period of two months in the overall period.

The ECM for Arabica coffee prices in Chennai and New York markets indicates that the information flow was more in New York market for prices in Rupees and for prices in Dollar, it was more in Chennai market and the disequilibrium was corrected within two months in both the markets. The domestic Arabica coffee prices in Chennai and Hyderabad markets were integrated and ECM indicates more information flow in Chennai market in both rupees and dollar terms. The quick adjustment of disequilibrium was seen in Chennai market, which got corrected within one month.

The ECM for Robusta coffee in Chennai and ICO markets indicates that the information flow was more in Chennai market in the overall period and the disequilibrium was corrected within a period of one month in both the price series. While analysing the ECM model for Robusta prices in Chennai and ICO composite indicator price, it was found that Chennai market exhibited a higher information flow with a quick disequilibrium correction period of two months. The ECM model for Robusta coffee prices in Chennai and London markets indicates that the Chennai market exhibited the higher information flow in overall period for prices both in Rupees and Dollar terms. The disequilibrium was corrected within a period of two months for both the prices.

While considering the integration between Robusta coffee prices in Chennai and Hyderabad markets, it was found that the information flow was more in the Chennai market during overall period as well as in all the decades. The short-run disequilibrium in Chennai as well as Hyderabad markets were adjusted within one month by changes in its own price and the speed of adjustment was considerably high in the overall period and low in other disaggregated periods.

The estimates of VECM for integrated price series of Arabica coffee price in Hyderabad and ICO markets revealed that the speed of adjustment was comparatively high in Hyderabad market than ICO market in the overall period. The short-run equilibrium in the market prices were corrected within two months in the overall period.

With regard to the integration between Arabica coffee prices in Hyderabad and composite indicator price in ICO market, the speed of adjustment was quick in Hyderabad market than ICO market and the correction of short-run disequilibrium took two months in the overall period. Similar trends were observed for prices in both Rupees and US dollars. The Arabica coffee price in Hyderabad and New York markets were integrated and more information flow was observed in New York market, with quick short-run adjustment of disequilibrium within a period of two months.

Considering the market integration of Robusta coffee in Hyderabad market with ICO Robusta coffee prices, the information flow was more in Hyderabad market for prices in rupees as well as dollars. The short-run disequilibrium was corrected within a period of two months in all the markets, except for integration with ICO composite indicator prices, in which the disequilibrium was corrected within one month.

The Error Correction models confirmed the presence of short-run disequilibrium in different price series of coffee and the statistically significant coefficients in all the cases implied that the series were once in disequilibrium and the system tries to come back to its equilibrium state with varying speed of adjustments in different time periods. As higher value of error correction term indicates higher rate of adjustment towards equilibrium, the speed of convergence for short-run price movements to become stable along the long-run equilibrium path was found to be increasing during the overall period. This could be attributed to the outward market orientation of coffee and trade liberalization has also considerably influenced the market integration in coffee (Bhalla,2014). In most of the cases of integration with international prices, the international markets exhibited better information flow and quick adjustment of short-run disequilibrium than the domestic markets. The international price integration and quick adjustment of equilibrium also observed by Struthers (2014). Among the domestic markets, coffee prices in Chennai market exhibited better information transmission and quick adjustments during the overall study period. The study revealed that there were effective transmissions of coffee price signals between international and domestic market, and in between domestic markets resulting in high integration of the markets. These findings were in accordance with the findings of Joseph (2010).

4.7.2.4 Granger causality

The cointegration analysis proved that the prices moved together and there is transmission of price signals between domestic and international markets and between domestic markets and there is causality in at least one direction. The strength of information flow from one market to the other and the short-run disequilibrium correction in the market prices were discussed with the VECM. In addition, to understand more about the transmission of price signals between markets and the direction of causation, granger causality test was employed and results are presented in Table 4.74 and 4.75 (prices in Rupees), and 4.76 and 4.78 (prices in US Dollars). The Granger causality test provides additional evidence as to whether and in which direction, the price transmission occurs between two price series. The tests were carried out on monthly prices of coffee in both rupees and dollars.

The results of the Granger causality tests for integrated coffee price series in Rupees are summarized in Table 4.74 and Table 4.75. All the price series of coffee in Rupees exhibited cointegration relationship during the overall period and hence the discussion is confined to the overall study period. The Arabica coffee price in Bangalore and ICO market exhibited bi-directional causality with statistical significance. The Arabica coffee price in Bangalore and composite indicator price in ICO market were integrated, in which a significant one-way causation was observed between them and price transmission from ICO composite price to Bangalore Arabica market price was observed. While discussing Arabica price in Bangalore and New York future markets, a bi-directional causality was observed with high statistical significance, thus confirming price transmission in both directions. The bi-directional causality of Indian coffee prices with international coffee prices was observed by Girippa (1995). The Arabica coffee prices in Bangalore market was integrated with Arabica prices in Chennai as well as Hyderabad markets. Arabica coffee price in Bangalore granger caused Arabica prices in Chennai as well as Hyderabad markets. A unidirectional price transmission from Bangalore to other domestic markets was also reported. This unidirectional movement was in consideration with the ICA auction taking place in Bangalore market and the consequent information flow. This unidirectional information flow was observed by Jena (2016) in his study on commodity market integration and price transmission and the results are in line with the present study.

Table 4.74 Results of the Granger causality tests for integrated Indian and international prices of coffee in Rupees

Null hypothesis	Price in rupees							
	Overall		Period I		Period II		Period III	
	F-Stat	Probability	F-Stat	Probability	F-Stat	Probability	F-Stat	Probability
ARB does not Granger cause ARICO	3.710**	0.025	2.038	0.138	1.090	0.337	0.557	0.574
ARICO does not Granger cause ARB	32.050***	0.000	10.600***	0.000	18.060***	0.000	13.001***	0.000
ARB does not Granger cause CIIICO	2.450	0.888	1.950	0.149	0.387	0.670	-	-
CIICO does not Granger cause ARB	28.480***	0.000	12.47***	0.000	14.880***	0.000	-	-
ARB does not Granger cause NEW	4.930***	0.007	1.990	0.140	1.680	0.189	-	-
NEW does not Granger cause ARB	26.940***	0.000	9.360***	0.000	12.990***	0.000	-	-
RCB does not Granger cause RCICO	3.260**	0.040	-	-	1.420	0.310	0.658	0.650
RCICO does not Granger cause RCB	22.055***	0.000	-	-	6.450***	0.000	8.120***	0.000
RCB does not Granger cause CIICO	1.580	0.207	0.325	0.723	0.560	0.234	-	-
CIICO does not Granger cause RCB	17.160***	0.000	4.530**	0.014	6.340***	0.000	-	-
RCB does not Granger cause LON	4.320**	0.014	1.380	0.250	1.560	0.120	-	-
LON does not Granger cause RCB	19.960***	0.000	7.070***	0.002	9.320***	0.000	-	-
ARC does not Granger cause ARCICO	2.609***	0.075	1.650	0.560	1.890	0.650	1.790	0.489
ARCICO does not Granger cause ARC	22.460***	0.000	6.530***	0.001	9.650***	0.000	11.360***	0.000
ARC does not Granger cause CIICO	1.450	0.235	1.460	0.415	0.568	0.260	-	-
CIICO does not Granger cause ARC	20.197***	0.000	11.360***	0.000	13.520***	0.000	-	-
ARC does not Granger cause NEW	4.420**	0.012	2.410	0.514	1.780*	0.090	-	-
NEW does not Granger cause ARC	17.080***	0.000	8.340***	0.000	9.650***	0.000	-	-
RCC does not Granger cause RCICO	0.965	0.380	-	-	1.120	0.640	-	-
RCICO does not Granger cause RCC	34.580***	0.000	-	-	13.650***	0.000	-	-
RCC does not Granger cause CIICO	0.270	0.760	1.260	0.560	1.650	0.560	-	-
CIICO does not Granger cause RCC	20.440***	0.000	5.670***	0.000	4.330***	0.000	-	-
RCC does not Granger cause LON	3.520**	0.030	1.730	0.470	1.250	0.990	1.350	0.640
LON does not Granger cause RCC	26.790***	0.000	13.450***	0.000	9.650***	0.000	11.230***	0.000

Note: *** denotes significant at one per cent level, ** denotes significant at five per cent level, * denotes significant at 10 per cent level

…Cont. Table 4.74 Results of the Granger causality tests for integrated Indian and international prices of coffee in Rupees

Null hypothesis	Price in rupees							
	Overall		Period I		Period II		Period III	
	F-Stat	Probability	F-Stat	Probability	F-Stat	Probability	F-Stat	Probability
ARH does not Granger cause ARICO	3.980**	0.019	-	-	1.590	0.960	1.320	0.990
ARICO does not Granger cause ARH	27.730***	0.000	-	-	14.360***	0.000	15.320***	0.000
ARH does not Granger cause CIICO	2.360	0.195	-	-	2.120	0.746	-	-
CIICO does not Granger cause ARH	25.290***	0.000	-	-	11.265***	0.000	-	-
ARH does not Granger cause NEW	4.800	0.008	-	-	2.960	0.650	1.960	0.870
NEW does not Granger cause ARH	22.600***	0.000	-	-	8.430***	0.001	11.360***	0.000
RCH does not Granger cause RCICO	1.290	0.275	-	-	1.690	0.965	2.310	0.990
RCICO does not Granger cause RCH	22.260***	0.000	-	-	5.750***	0.000	9.630***	0.000
RCH does not Granger cause CIICO	1.050	0.349	1.005	0.265	1.360	0.950	-	-
CIICO does not Granger cause RCH	16.550***	0.000	8.360***	0.005	6.660***	0.000	-	-
RCH does not Granger cause LON	1.730	0.178	1.120***	0.002	1.460	0.025	-	-
LON does not Granger cause RCH	19.580***	0.000	6.250***	0.000	8.630***	0.000	-	-

Note: *** denotes significant at one per cent level, ** denotes significant at five per cent level, * denotes significant at 10 per cent level

Table 4.75 Results of the Granger causality tests for integrated coffee prices in Indian market in Rupees

Null hypothesis	Price in rupees							
	Overall		Period I		Period II		Period III	
	F-Stat	Probability	F-Stat	Probability	F-Stat	Probability	F-Stat	Probability
ARB does not Granger cause ARC	35.002***	0.000	6.600***	0.003	8.300***	0.000	-	-
ARC does not Granger cause ARB	1.240	0.289	0.940	0.393	0.456	0.365	-	-
ARB does not Granger cause ARH	21.260***	0.000	-	-	21.070***	0.000	11.140***	0.000
ARH does not Granger cause ARB	0.425	0.653	-	-	0.060	0.930	0.425	0.653
RCB does not Granger cause RCC	0.349	0.705	2.890***	0.002	0.218	0.230	5.670***	0.005
RCC does not Granger cause RCB	55.930***	0.000	3.710***	0.004	6.960***	0.001	2.390*	0.091
RCB does not Granger cause RCH	33.450***	0.000	16.520***	0.000	9.430***	0.000	8.650***	0.000
RCH does not Granger cause RCB	0.775	0.461	1.230	0.236	1.140	0.321	1.260	0.560
ARC does not Granger cause ARH	4.970***	0.008	-	-	3.120	0.910	-	-
ARH does not Granger cause ARC	13.710***	0.000	-	-	11.690***	0.000	-	-
RCC does not Granger cause RCH	1.325	0.260	1.120	0.562	0.896***	0.089	1.240	0.870
RCH does not Granger cause RCC	46.770***	0.000	17.350***	0.000	11.360***	0.000	13.650***	0.005

Note: *** denotes significant at one per cent level, ** denotes significant at five per cent level, * denotes significant at 10 per cent level

A two-way causation was observed between Robusta cherry price in Bangalore market with Robusta coffee price in ICO market. While considering the Robusta coffee price in Bangalore market and Indicator price in ICO market, a significant unidirectional price transmission was observed from ICO market to Bangalore market. At the same time, a bi-directional price transmission was observed between Robusta cherry price in Bangalore and London future market. In the domestic coffee markets, it was found that the Bangalore Robusta cherry prices granger caused Robusta cherry prices in Hyderabad, whereas Robusta cherry price in Chennai market granger caused Robusta cherry price in Bangalore market. It indicates price signal transmission from Chennai to Bangalore and from Bangalore to Hyderabad.

From the table it is clearly evident that ICO composite price of Arabica coffee granger caused Arabica coffee price in Chennai market and a significant price transmission was observed from ICO price to Chennai market. In a similar way, composite indicator price in ICO market also exhibited a unidirectional causation in Chennai market, whereas a bi-directional flow of price information was observed between Arabica price in Chennai and New York future markets. In the case of domestic markets, transmission of price signals in both directions was confirmed between Arabica coffee prices in Chennai and Hyderabad. As similar to the previous cases, ICO market price for Robusta coffee as well as ICO composite indicator price granger caused Robusta cherry price in Chennai and a significant bi-directional price signal transmission had occurred between London and Chennai markets.

The ICO Robusta, Arabica and indicator prices and, futures prices in New York and London exhibited similar one-way causation from international market to Arabica and Robusta price in Hyderabad market during the overall study period. In almost all the markets, a general trend of price signal transmission from international market to domestic market was visible and a greater integration between domestic markets were also observed.

Table 4.76 Results of the Granger causality tests for integrated Indian and international prices of coffee in Dollars

Null hypothesis	Price in US dollar							
	Overall		Period I		Period II		Period III	
	F-Stat	Probability	F-Stat	Probability	F-Stat	Probability	F-Stat	Probability
ARB does not Granger cause ARICO	2.948*	0.053	-	-	0.456*	0.094	-	-
ARICO does not Granger cause ARB	31.560***	0.000	-	-	12.650***	0.000	-	-
ARB does not Granger cause CIIICO	1.790	0.160	-	-	-	-	-	-
CIICO does not Granger cause ARB	27.900***	0.000	-	-	-	-	-	-
ARB does not Granger cause NEW	3.160**	0.044	-	-	-	-	-	-
NEW does not Granger cause ARB	25.960***	0.000	-	-	-	-	-	-
RCB does not Granger cause RCICO	1.610	0.200	0.598	0.356	-	-	0.423	0.256
RCICO does not Granger cause RCB	25.950***	0.000	12.630***	0.000	-	-	9.650***	0.000
RCB does not Granger cause CIICO	1.180	0.308	1.360	0.456	-	-	0.698	0.789
CIICO does not Granger cause RCB	21.680***	0.000	8.960***	0.000	-	-	6.560***	0.000
RCB does not Granger cause LON	2.890	0.610	1.860	0.235	-	-	2.130	0.136
LON does not Granger cause RCB	24.320***	0.000	12.360***	0.002	-	-	11.360***	0.000
ARC does not Granger cause ARCICO	3.160	0.640	1.880	0.540	-	-	-	-
ARCICO does not Granger cause ARC	21.650***	0.000	5.740***	0.000	-	-	-	-
ARC does not Granger cause CIICO	1.630	0.360	1.360	0.680	0.960	0.650	-	-
CIICO does not Granger cause ARC	19.360***	0.000	12.650***	0.000	6.340***	0.001	-	-
ARC does not Granger cause NEW	5.630*	0.090	1.650	0.760	1.160	0.650	2.350	0.980
NEW does not Granger cause ARC	19.320***	0.000	9.650***	0.000	10.340***	0.000	11.960***	0.000
ARC does not Granger cause ARH	5.160	0.680	1.860	0.980	1.140	0.870	0.880	0.612
ARH does not Granger cause ARC	11.260***	0.000	6.520***	0.000	5.680***	0.001	7.350***	0.000
RCC does not Granger cause RCICO	1.160	0.180	1.111	0.630	1.640	0.690	2.140	0.560
RCICO does not Granger cause RCC	36.980***	0.000	16.320***	0.000	13.250***	0.000	11.360***	0.000
RCC does not Granger cause CIICO	1.170	0.698	1.650	0.064	2.330	0.650	1.960	0.932
CIICO does not Granger cause RCC	22.360***	0.000	8.640***	0.000	9.650***	0.000	8.650***	0.000

Note: *** denotes significant at one per cent level, ** denotes significant at five per cent level, * denotes significant at 10 per cent level

…Cont. Table 4.76 Results of the Granger causality tests for integrated Indian and international prices of coffee in Dollars

Null hypothesis	Price in US dollars							
	Overall		Period I		Period II		Period III	
	F-Stat	Probability	F-Stat	Probability	F-Stat	Probability	F-Stat	Probability
RCC does not Granger cause LON	5.610	0.780	1.520	0.460	1.340	0.780	1.520	0.590
LON does not Granger cause RCC	29.360***	0.000	13.260***	0.000	12.650***	0.000	11.630***	0.000
ARH does not Granger cause ARICO	7.630	0.350	1.650	0.963	1.130	0.900	1.560	0.870
ARICO does not Granger cause ARH	29.360***	0.000	11.410***	0.000	11.960***	0.000	13.430***	0.000
ARH does not Granger cause CIICO	3.340	0.960	1.650	0.850	0.658	0.635	1.120	0.570
CIICO does not Granger cause ARH	28.690***	0.000	12.960***	0.000	10.960***	0.000	11.480***	0.000
ARH does not Granger cause NEW	3.520	0.230	1.580	0.212	1.025	0.732	1.065	0.632
NEW does not Granger cause ARH	26.350***	0.000	6.540***	0.003	7.350***	0.000	9.360***	0.000
RCH does not Granger cause RCICO	1.850	0.510	0.654	0.760	0.990	0.963	1.123	0.530
RCICO does not Granger cause RCH	22.160***	0.000	6.850***	0.000	5.980***	0.000	9.360***	0.000
RCH does not Granger cause CIICO	1.006	0.948	1.000	0.600	0.945	0.560	1.120	0.736
CIICO does not Granger cause RCH	19.360***	0.000	5.420***	0.000	6.660***	0.000	7.254***	0.000
RCH does not Granger cause LON	-	-	0.315	0.730	1.120	0.890	1.154	0.630
LON does not Granger cause RCH	-	-	6.680***	0.002	9.630***	0.000	8.880***	0.000

Note: *** denotes significant at one per cent level, ** denotes significant at five per cent level, * denotes significant at 10 per cent level

Table 4.77 Results of the Granger causality test for integrated coffee prices in Indian market in Dollars

Null hypothesis	Price in US dollar							
	Overall		Period I		Period II		Period III	
	F-Stat	Probability	F-Stat	Probability	F-Stat	Probability	F-Stat	Probability
ARB does not Granger cause ARC	37.160***	0.000	8.490***	0.000	-	-	-	-
ARC does not Granger cause ARB	1.470	0.230	0.768	0.468	-	-	-	-
ARB does not Granger cause ARH	20.260***	0.000	9.650***	0.000	-	-	-	-
ARH does not Granger cause ARB	0.925	0.397	0.656	0.268	-	-	-	-
RCB does not Granger cause RCC	55.970***	0.000	8.720***	0.000	27.410***	0.000	6.580***	0.000
RCC does not Granger cause RCB	0.350	0.702	0.642	0.520	0.140	0.860	2.070	0.130
RCB does not Granger cause RCH	34.530***	0.000	15.430***	0.000	11.630***	0.000	-	-
RCH does not Granger cause RCB	1.120	0.250	1.740	0.630	1.950	0.960	-	-
RCC does not Granger cause RCH	2.650	0.740	1.980	0.090	1.410	0.960	1.660	0.490
RCH does not Granger cause RCC	43.260***	0.000	12.540***	0.000	11.390***	0.000	12.630***	0.000

Note: *** denotes significant at one per cent level, ** denotes significant at five per cent level, * denotes significant at 10 per cent level

Tables 4.76 and 4.77 summarise the results of Granger causality tests for integrated coffee prices in US dollars. All the price series were found to be integrated with the same order except, Robusta coffee price in Hyderabad market and London future market price during the overall period.

The results of Granger causality tests for prices in US Dollar indicated that Arabica coffee price and composite indicator price in ICO market significantly granger caused Arabica coffee price in all the three domestic markets. A significant price signal transmission from ICO market to domestic market was observed. A bi-directional causation was also observed between New York future market with Bangalore and Chennai Arabica coffee markets, whereas the Hyderabad Arabica coffee prices were found to be unidirectionally granger caused by New York future market prices. The Arabica coffee price in Bangalore market granger caused Arabica coffee price in Chennai as well as Hyderabad markets, whereas the Arabica coffee price in Chennai market was also granger caused by Arabica coffee price in Hyderabad market.

The causality in Robusta coffee price was found to be similar to that in Arabica coffee prices. ICO prices and London future market prices granger caused domestic Robusta coffee prices in Bangalore, Chennai and Hyderabad markets in a unidirectional way and therefore, the price signal transmission was observed from international market to domestic market during the overall study period. In the domestic markets, Bangalore Robusta coffee price significantly granger caused Robusta coffee price in Chennai as well as Hyderabad markets. In addition, a unidirectional causation was observed between Hyderabad and Chennai markets.

The Hyderabad Robusta coffee price granger caused Chennai Robusta coffee price during the overall study period. A general trend of price signal transmission from international market to domestic market was observed for coffee prices in Rupees as well as US Dollars. In very few cases, the study found a bi-directional price transmission, possibly due to the comparative dominance of India in the international coffee market. India, the fifth largest producer of coffee in the world (ICO, 2020), could influence the international coffee prices through its export and import decisions. But the severe competition from traditional as well as emerging coffee growers and traders (Coffee Board, 2018), dominance of Brazilian coffee (UPASI, 2020), high price of Indian coffee in the international market (World Bank, 2008) and less motivated exporters have constrained the performance of Indian coffee in the international market (Bhalla, 2004). These factors could possibly explain the inefficiency of India in transferring price signals from domestic market to the international market.

4.8 EXPORT PERFORMANCE AND COMPETITIVENESS

The export performance indicates the relative trade performance of a nation in the international market for a specific commodity or a sector or in the overall trade, whereas competitiveness indicates the comparative performance of the country with other competing countries in the international market. The export performance and competitiveness of Indian coffee were analysed with the help of growth and instability models, diversification indices, decomposition models, Markov chain analysis and Nominal Protection Coefficient (NPC). The analyses were done by dividing the study period into sub-periods *viz*., pre-WTO period from 1980-81 to 1994-95, post-WTO period from 1995-96 to 2019-20, over-all period from 1980-81 to 2019-20 and different decades *viz*., Decade I from 1980-81 to 1989-90, Decade II from 1990-91 to 1999-20, Decade III from 2000-01 to 2009-10, and Decade IV from 2010-11 to 2019-20.

4.8.1 Growth of coffee exports

An exponential growth function was used to evaluate the performance of Indian coffee exports. The CAGRs in quantity, value and unit value of coffee exports from India over the last forty years is presented in Table 4.78. The CAGRs of quantity exported and export value were 4.42 and 10.37 per cent respectively. It could be observed that the growth in value of coffee exports from India was contributed mainly by growth in unit value rather than quantity in the overall period. The Indian coffee exporters achieved a growth of 4.67 per cent in quantity, 8.39 per cent in value (₹) and 3.55 per cent in Unit value (₹/kg) during the pre-WTO period,

Table 4.78 Growth in export of Indian coffee (CAGR in Per cent per annum)

Period	Quantity (kg)			Value (Rs)			Value (US$)			Unit value (Rs/kg)			Unit value (US$/kg)		
	CAGR	SE	Sig	CAGR	SE	Sig	CAGR	SE	Sig	CAGR	SE	Sig	CAGR	SE	Sig
Overall	4.42	0.50	8.77***	10.37	1.20	8.66***	10.95	1.71	6.38***	5.69	0.99	5.75	6.25	1.43	4.36***
Pre-WTO	4.67	1.73	2.69**	8.39	4.30	1.95	17.45	4.85	3.59***	3.55	3.76	0.94	12.22	4.38	2.78***
Post-WTO	3.03	0.86	3.52***	7.61	2.07	3.66***	5.00	2.11	2.37**	4.44	1.98	2.24	1.91	2.10	0.91
Decade-1	4.52	3.59	1.25	2.54	1.76	1.44	12.48	2.22	5.62***	-1.89	3.51	-0.53	7.61	4.95	1.53
Decade-2	9.29	2.14	4.34***	27.91	8.98	3.10***	29.05	14.27	2.03**	17.03	7.91	2.15	18.07	12.66	1.42
Decade-3	-1.93	1.97	-0.98	8.97	4.42	2.02**	8.74	5.51	1.58	11.11	3.49	3.18	10.88	4.32	2.52**
Decade-4	2.52	1.86	1.35	4.62	2.65	1.74	0.86	3.31	0.26	2.04	2.22	0.91	-1.62	2.57	-0.63

Note: 1. Pre-WTO period implies 1980-81 to 1994-95, post-WTO period - 1995-96 to 2019-20, over-all period – 1980-81 to 2019-20, Decade I – 1980-81 to 1989-90, Decade II - 1990-91 to 1999-20, Decade III - 2000-01 to 2009-10, and Decade IV - 2010-11 to 2019-20.

2. CAGR implies Compound Annual Growth Rate, SE – Standard Error of CAGR and Sig – significance of CAGR

3. *** denotes significant at one per cent level, ** indicates significant at five per cent level

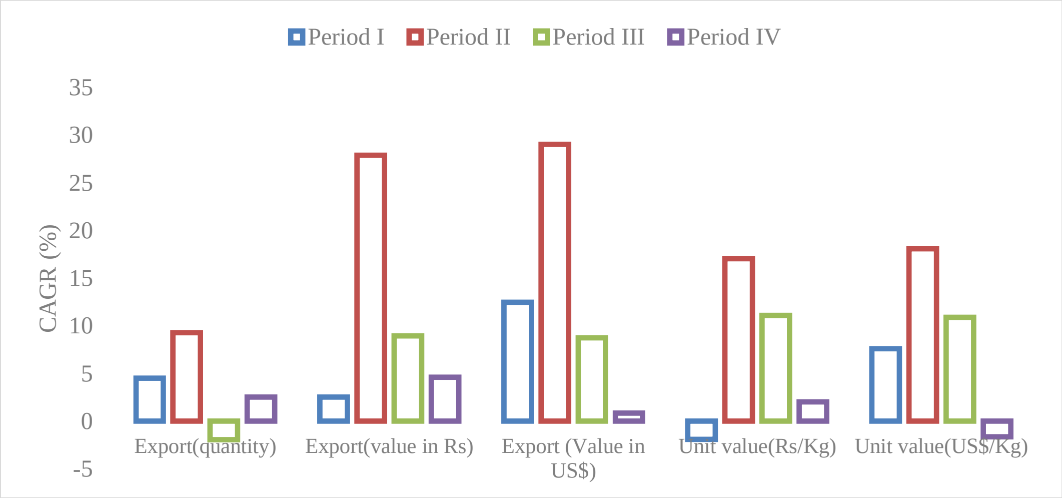
where as in the post-WTO period, the exports exhibited a comparatively lower growth.

While considering the decadal growth of exports (Figure 19), it could be observed that the second decade including the liberalization period showed the highest growth in export quantity, value as well as the unit values. Among the four decades, the third decade exhibited a significant negative growth in quantity exported as this period was severely affected by climatic fluctuations like inadequate rainfall in coffee belts and frequent droughts, ultimately reflecting as retarded growth in production as well as export of coffee (Joy,2004).

In addition, competitions from high quality coffee produced in Brazil and Colombia and cheap quality coffee from Vietnam and Indonesia in the world market, induced retardation of 1.93 per cent in third decade (Adhikari *et al*., 2020). Even with heavy competition from Nepal and Vietnam in the EU market, the fourth decade was hopeful for Indian coffee exporters, and the coffee exports achieved a growth of 2.52 per cent in export quantity and 4.62 per cent in export value. The growth in unit value of coffee exports in Indian Rupee was 5.69, while in US Dollar it was 6.25 per cent during the forty-year period from 1980-81 to 2019-20. In line with the export quantity and value, the unit values reached the peaks in the third decadal period.

The trade liberalization has opened wide opportunities to the Indian coffee farmers and exporters, but due to climatic aberrations (droughts, inadequate rainfall/blossom showers, rise in temperature), bottlenecks in export business including quality issues, and heavy competition from traditional as well as emerging coffee growers and traders in the international market, overall growth of Indian coffee sector was adversely affected. Even with all these constraints, India still stands as the major coffee producer and exporter in the international market.

Figure 19 Growth in Export of Indian coffee in different decades



4.8.2 Instability in export of coffee

The instability in the export of coffee from India in terms of quantity (kg), value (Rs and US dollars), and unit value (₹/kg, US dollar/kg) were estimated using Coppock's instability index and the results are presented in Table 4.79. It could be observed from the table that in all the study periods, including pre-WTO and post-WTO periods, exports of coffee from India exhibited similar levels of instabilities.

While comparing the different periods, it could be observed that the export value and unit value exhibited high instabilities in the pre-WTO period, whereas the quantity exported exhibited a constant lower instability in both pre-WTO and post-WTO periods. A reduction in the instabilities of the export values in the post-WTO period could be attributed to the decline in the unit value instabilities in the same period.

The instability in quantity exported could be because of the policy shifts including the changes in the policy of interference by Coffee Board in export activities, while the instability in value and unit value could be due to increased competition in trade and volatility in exchange rate of Indian Rupee against US dollar.

Table 4.79 Instability in export of coffee from India (Coppock's Instability Index)

Periods	Quantity (kg)	Value (₹)	Value (US$)	Unit value (₹/kg)	Unit value (US$/kg)
Overall	15.36	20.84	26.49	21.20	25.22
Pre-WTO	15.18	23.14	26.22	24.00	29.81
Post-WTO	15.62	18.41	23.87	18.36	19.78
Period I	18.12	10.85	19.65	18.45	26.96
Period II	13.23	26.45	38.18	29.60	36.74
Period III	11.12	16.32	26.21	12.21	20.54
Period IV	8.77	12.61	18.78	8.32	13.41

Note: Pre-WTO period implies from 1980-81 to 1994-95, Post-WTO period from 1995-96 to 2019-20, Over-all period from 1980-81 to 2019-20, Period I from 1980-81 to 1989-90, Period II from 1990-91 to 1999-20, Period III from 2000-01 to 2009-10, and Period IV from 2010-11 to 2019-20.

Figure 20 Instability in export of Indian coffee in pre & post-WTO periods

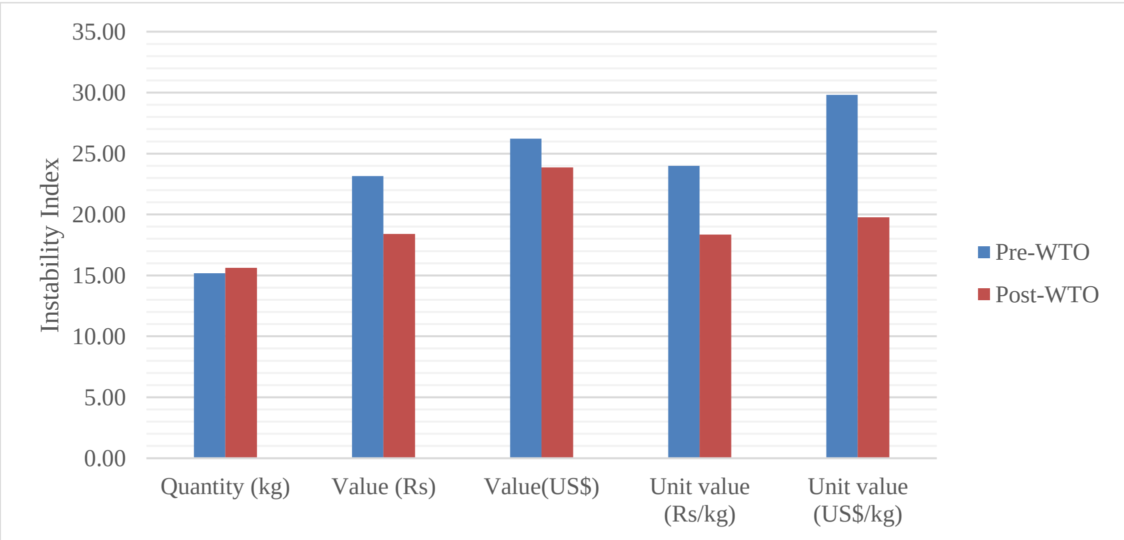
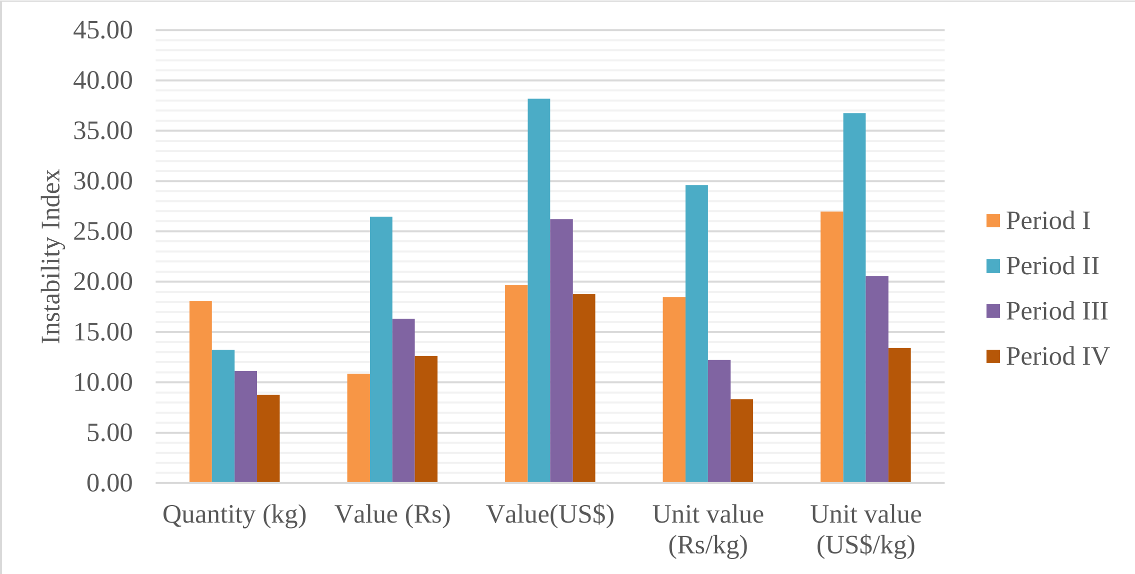


Figure 21 Instability in Export of Indian coffee in different decades



While considering the four decadal periods of the study, it could be observed from Figure 21 that the highest instability in quantum of coffee exports was found in period I, while it was the lowest in period IV. The highest and lowest instabilities in export value in Rupees were observed in period II and period I respectively. With regard to the export unit value, while a higher instability was observed in period II, it was found to be lowest in period IV. It could be observed from the table that the instabilities in coffee export were high during period I and II and it subsequently declined in period III and IV. From Figure 20, it is clearly evident that all the export components with an exception of export quantity, exhibited higher instabilities during the pre-WTO period. An interesting fact found in period II was that, when all the export components except export quantity exhibited increased instability in period II, whereas export quantity exhibited a decline in instability. The policy changes due to trade liberalization and the permission of Free Sale Quota initiated by GOI in 1993-94 could have caused higher instability in coffee exports during period II. These finding were in accordance with the findings of Shailza *et al.* (2015).

4.8.3 Decomposition of sources of growth in export value of coffee

The change in average value of exports of coffee from India between two years or periods could be attributed to the changes in mean export unit value and export quantity, their interaction and the changes in quantity-unit value covariance.

Table 4.80 Decomposition of components of change in average export value of Indian coffee

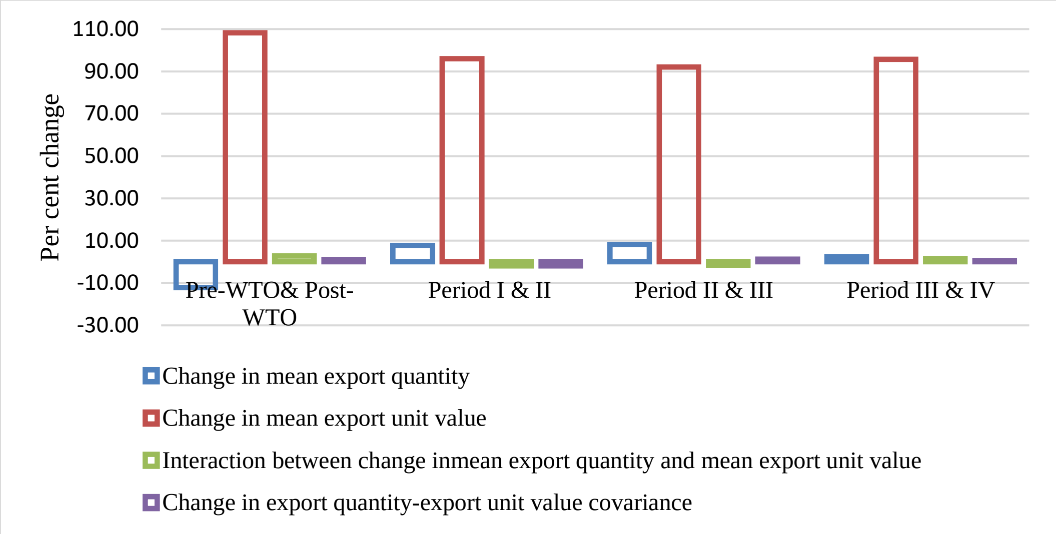
Period	Change in mean export quantity	Change in mean export unit value	Interaction between change in mean export quantity and mean export unit value	Change in export quantity-export unit value covariance
Pre-WTO& Post-WTO	-12.10	108.20	2.80	1.10
Period I & II	7.73	96.00	-1.90	-1.83
Period II & III	8.20	92.10	-1.63	1.33
Period III & IV	2.36	95.64	1.50	0.50

Hazell's decomposition model was employed to study the contribution of each component of change to the change in export value and the results are presented in Table 4.80.

It could be observed from the table that the increase in mean export value of coffee in the post-WTO period as compared to the pre-WTO period was mainly due to the changes in mean export unit value and it occurred even when there was a negative change or decline in mean export quantity. While comparing with the change in mean export unit value, other sources of growth such as change in export quantity, interaction between change in mean export quantity and mean export unit value and change in export unit value covariance were negligible.

While considering different decades, it could be observed that the change in mean export unit value played a major role in causing changes in the mean export value of coffee from India in all the decades and these results were clearly evident in Figure 18. In all the periods, change in mean export unit value contributed the lion share of changes in mean export value.

Figure 22 Decomposition of source of growth in Indian coffee export value



Between periods I and II and, periods II and III, changes in mean export quantity contributed relatively lower shares in the changes in export value. The changes in covariance and interaction components were relatively negligible in all the decades.

4.8.3.1 Sources of variance in export value of coffee

The stability in the export value of coffee was assumed to be affected by ten components of changes as shown in Table 4.81. From the table it is clearly evident that 83 per cent of increase in the variance of export value in the post-WTO period in comparison with pre-WTO period was attributed to the changes in variability of export unit value, followed by a significant contribution of 24 per cent change in the covariance between export quantity and export unit value. In all the segmented study periods, changes in variance of export value were significantly contributed by change in variance of export unit value.

The changes in the variance of export unit value could be considered as the major factor causing change in variance of export value between period I and II, whereas between period II & III and III & IV the same component contributed the lion share of change in variance of export value by 67 and 76 per cent respectively.

Table 4.81 Components of change in variance of export value of coffee from India
(Per cent)

Components of change in export value	Pre-WTO& Post-WTO	Period I & II	Period II & III	Period III & IV
Change in mean export unit value (EUV)	0.055	3.400	-1.330	0.005
Change in mean export quantity (EQ)	-0.005	0.386	-1.010	0.610
Change in export unit value variance	83.320	96.960	66.900	76.360
Change in export quantity variance	-7.500	-12.360	17.790	9.480
Interaction between changes in mean EUV and mean EQ	0.004	-2.720	2.120	0.000
Change in export quantity - export unit value covariance	24.205	5.850	14.690	13.380
Interaction between changes in mean EQ and EUV variance	-0.004	6.036	0.027	0.330
Interaction between changes in mean EUV and EQ variance	0.015	2.699	0.000	0.000
Interaction between changes in mean EQ and EUV and changes in EQ-EUV covariance	-0.004	0.473	0.630	-0.400
Change in residual	-0.013	-0.260	0.063	0.007

Note: Pre-WTO period from 1980-81 to 1994-95, Post-WTO period from 1995-96 to 2019-20, Over-all period from 1980-81 to 2019-20, Period I from 1980-81 to 1989-90, Period II from 1990-91 to 1999-20, Period III from 2000-01 to 2009-10, and Period IV from 2010-11 to 2019-20.

Considering other components attributing change in variance of export value, the change in variance of export quantity contributed a reduction in variance by 7.5 per cent in pre-WTO and post-WTO period, which indicates that the change in variance of export quantity had a stabilizing effect in the value of coffee exports.

4.8.4 Geographic concentration of coffee exports

The ‘Hirschman Index’, was employed to estimate the geographical concentration in coffee exports from India. The value of the geographical concentration index ranges between zero and 100. An estimated value of index closes to 100 indicates that the country’s exports were concentrated in very few foreign markets, whereas an index close to zero indicates the greatest diversification of export markets. The geographical concentration in the export of coffee from India was measured and the results are presented in Table 4.82 and 483.

A significant difference was observed between the geographic concentration indices of coffee exports from India during the pre-WTO and post-WTO periods and the values of the index in the whole period from 1980 to 2019 ranged from 25 to 66. The pre-WTO period was found to be having an average Hirschman Index value of 59.24, which indicates that the Indian coffee exports were highly dependent on few importing countries or few international markets, which in turn increased the risk and instability in the income earned from exports. After liberalization, the diversity of markets as well as the market access significantly improved, and it could be observed that the mean HI values reduced to 31.10. The lower HI values indicate that coffee exports from India were getting increasingly diversified after liberalization and were in a relatively better position than in the pre-WTO period.

The decadal estimates of HI give more information about the diversification of Indian coffee in the international market. The period I is from 1980-81 to 1989-90. This period formed part of the pre-WTO period in which Indian exports were concentrated in few markets and it was confirmed by the high HI value of 65.64.

Table 4.82 Geographic concentration of Indian coffee exports

Year	**HI**	**Year**	**HI**	**Year**	**HI**	**Year**	**HI**
1980	72.48	1990	70.28	2000	35.54	2010	32.64
1981	68.56	1991	57.91	2001	38.27	2011	29.65
1982	70.40	1992	34.94	2002	37.03	2012	29.69
1983	66.94	1993	34.77	2003	32.20	2013	28.38
1984	65.15	1994	34.27	2004	31.99	2014	26.83
1985	61.92	1995	35.63	2005	32.44	2015	28.15
1986	63.47	1996	37.38	2006	30.53	2016	27.73
1987	63.03	1997	34.57	2007	30.29	2017	25.34
1988	63.41	1998	30.88	2008	30.36	2018	26.02
1989	61.01	1999	30.43	2009	30.24	2019	25.32

Note: Period I from 1980-81 to 1989-90, Period II from 1990-91 to 1999-20, Period III from 2000-01 to 2009-10, and Period IV from 2010-11 to 2019-20.

Exports of coffee from India was the full responsibility and function of Coffee Board before liberalization, especially before 1992. Then, a partial pooling system was introduced in the place of total pooling in 1992-93 (Coffee Board, 2020).

Table 4.83 Geographic concentration of Indian coffee exports in different periods

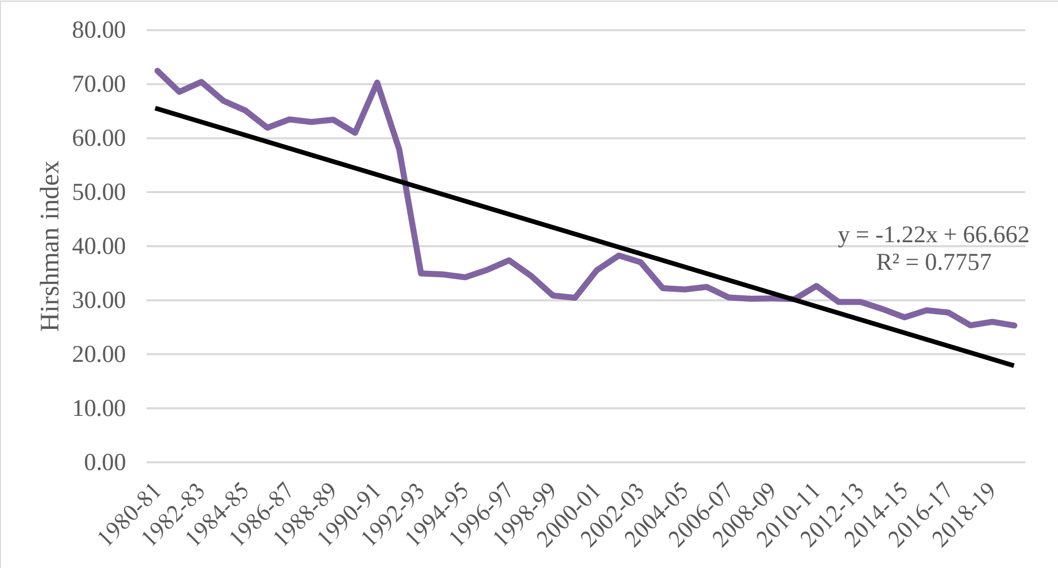
Periods	**Hirschman Index**
Pre -WTO period	59.24
Post- WTO period	31.10
Period I	65.64
Period II	40.11
Period III	32.89
Period IV	27.98

Note: pre-WTO period from 1980-81 to 1994-95, post-WTO period from 1995-96 to 2019-20, Over-all period from 1980-81 to 2019-20, Period I from 1980-81 to 1989-90, Period II from 1990-91 to 1999-20, Period III from 2000-01 to 2009-10, and Period IV from 2010-11 to 2019-20.

Under partial pooling, a system of internal sales quota was introduced according to which growers were allowed to sell 30 percent of their produce in the open market. As the Internal Sale Quota (ISQ) proved to be a success; a Free Sale Quota (FSQ) system was introduced as part of the complete liberalization in coffee during 1994-95 (Joy, 2004).

These trade liberalization policies opened up wider opportunities for exports from the country. The period II is from 1990-91 to 1999-20 and half of the total decade was in pre-WTO period, while the second half was in the post-WTO period. The policy changes (Free Sale Quota and liberalization policies) which were initiated in coffee trade have reflected in the HI values. The Indian coffee exporters diversified their trade during this period and the sudden shift and diversification are clearly depicted in Figure 18. From an average HI value of 65, a sudden drop with intensive diversification of markets was observed in 1992-94 period and all these factors resulted in the decrease in average HI value to 40.11 in period II.

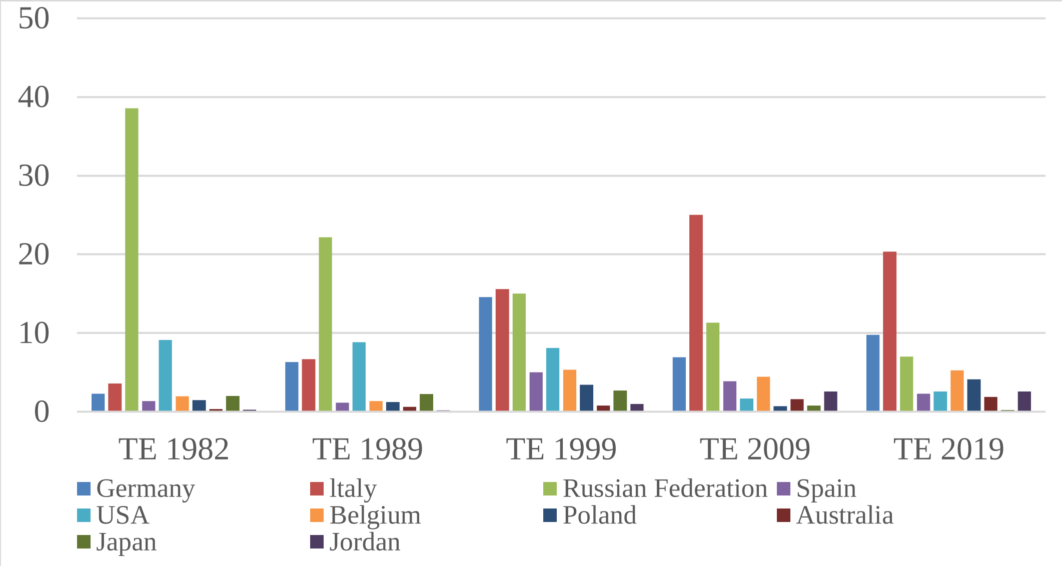
Figure 23 Geographic diversification of Indian coffee exports (1980-81 to 2019-20)



A gradual decline in HI values was observed from period I to IV. In period III and IV, the Indian coffee exports got increasingly diversified and HI values showed low values of 32.89 and 27.98 in period III and IV respectively. Considering the whole study period from 1980-81 to 2019-20, it could be concluded that coffee exports from India was intensively diversified after liberalization as those policies opened up wider opportunities and increased access for Indian coffee in the international markets.

During the pre-WTO period, when the International Coffee Agreement (ICA) was in force with economic clauses, India's allocated export quota to member countries was only about 0.75 million bags and India was forced to look to non-member markets, such as the former USSR, for export. The share of USSR in Indian exports declined from 22 per cent in TE 1989 to only 13 per cent in TE 1999. Part of the reason for this decline was the collapse of the former USSR. The other main reason was that the breakdown of the ICA economic clauses and the export quota restrictions in 1989, which allowed India to freely export more quantities to ICA member countries.

Figure 24 Change in shares of different countries in Indian coffee exports



In the past, the export figures to the former USSR have been overstated to the extent that the exporters utilized the discounts offered for Rupee against US dollar within the India-USSR bilateral trade agreements by conducting triangular trade and thus boosting the figures, but not the actual exports to USSR (ICO, 2000). In the TE 2019, Italy, USA and Russian Federation were the markets accounting for the major shares in Indian coffee exports.

4.8.4 Structural changes in export of Indian coffee

The structural change in export of coffee from India or the dynamics in the direction of export and the changing pattern of export to different destinations were analysed using the Markov chain model. The analysis for the country-wise export of coffee from India for the period from 1980-81 to 2019-20 was carried out by considering thirty-nine important export markets *viz*., Australia, Belgium, Croatia, Canada, Egypt, Finland, France, Germany, Greece, Hungary, Israel, Italy, Indonesia, Iran, Jordan, Kuwait, Korea, Latvia, Libya, Malayasia, Mali, Netherland, Poland, Portugal, Russia, Saudi Arabia, Singapore, Slovenia, Spain, Switzerland, Syria, Taiwan, Turky, Ukraine, UAE, UK, USA, and Vietnam and the exports to all the remaining countries were categorized under 'Others'.

Table 4.84 Transition probability matrix for coffee exports from India during pre-WTO period (1980-81 to 1994-95)

Country	AUS	BEL	CRO	CAN	EGY	FIN	FRA	GER	GRE	HUN	ISR	ITA	IND	IRA	JAP	JOR	KUW	KOR	LAT	LIB	MAL	MAI	NET	POL	POR	RUS	SAU	SIN	SLO	SPA	SWT	SYR	TAI	TUR	UKR	UAE	UK	USA	VIE	OTH
AUS	**0.03**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.97	0.00	0.00
BEL	0.00	**0.29**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.61
CRO	0.00	0.00	**0.00**	0.00	0.00	0.60	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.19
CAN	0.13	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.40	0.00	0.00	0.26	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EGY	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FIN	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FRA	0.00	0.00	0.00	0.00	0.00	0.00	**0.30**	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.21	0.00	0.00	0.00
GER	0.02	0.00	0.02	0.03	0.01	0.00	0.00	**0.30**	0.04	0.00	0.01	0.43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.00	0.00
GRE	0.00	0.00	0.00	0.00	0.00	0.00	0.35	0.00	**0.00**	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.14	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.16	0.00	0.00	0.00
HUN	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ISR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.63	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ITA	0.02	0.00	0.00	0.00	0.00	0.02	0.02	0.69	0.00	0.00	0.00	**0.02**	0.00	0.00	0.17	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00
IND	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
IRA	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
JAP	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.00	0.51
JOR	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.01**	0.16	0.00	0.00	0.00	0.00	0.07	0.00	0.54	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00
KUW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
KOR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.89
LAT	0.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.53	0.00	0.00	**0.00**	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.00	0.00
LIB	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MAL	0.00	0.00	0.00	0.00	0.00	0.46	0.00	0.00	0.00	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.36	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MAI	0.00	0.00	0.00	0.00	0.52	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.42	0.00	0.00
NET	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
POL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.19	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.20	0.02	0.00	0.00	0.00	0.00	0.03	0.00	0.57	0.00	0.00
POR	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.34	0.00	0.00	0.00	0.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.10**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.00	0.00	0.00
RUS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	**0.78**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20
SAU	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.93	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00
SIN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.21	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.51	0.28	0.00	0.00	0.00
SLO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.30	0.00	0.00	0.00	0.00	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.38	0.00	0.00	0.00	0.05	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.00
SPA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.02**	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.85	0.00	0.00
SWT	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.59	0.00	0.00	0.00	0.00	0.00	0.11	**0.08**	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SYR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.87	0.00	0.00	0.11	0.00	0.00
TAI	0.00	0.07	0.10	0.00	0.00	0.12	0.18	0.00	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.02	0.02	0.02	0.00	0.00	0.00	**0.09**	0.01	0.00	0.00	0.00	0.22	0.00	0.00
TUR	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00
UKR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.70	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.23
UAE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.94	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00
UK	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.26	0.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.32	**0.00**	0.00	0.00	0.00
USA	0.00	0.00	0.03	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.01	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.00	0.04	0.00	0.00	**0.00**	0.00	0.81
VIE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.38	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.60	**0.00**	0.00
OTH	0.00	0.03	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.00	0.00	0.03	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.14	0.00	0.00	0.00	0.01	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.06	0.00	**0.51**

Note: Derived from Markov Chain analysis

Figure 25 Markov probability plots for Indian coffee exports during pre-WTO period (1980-81 to 1994-95)

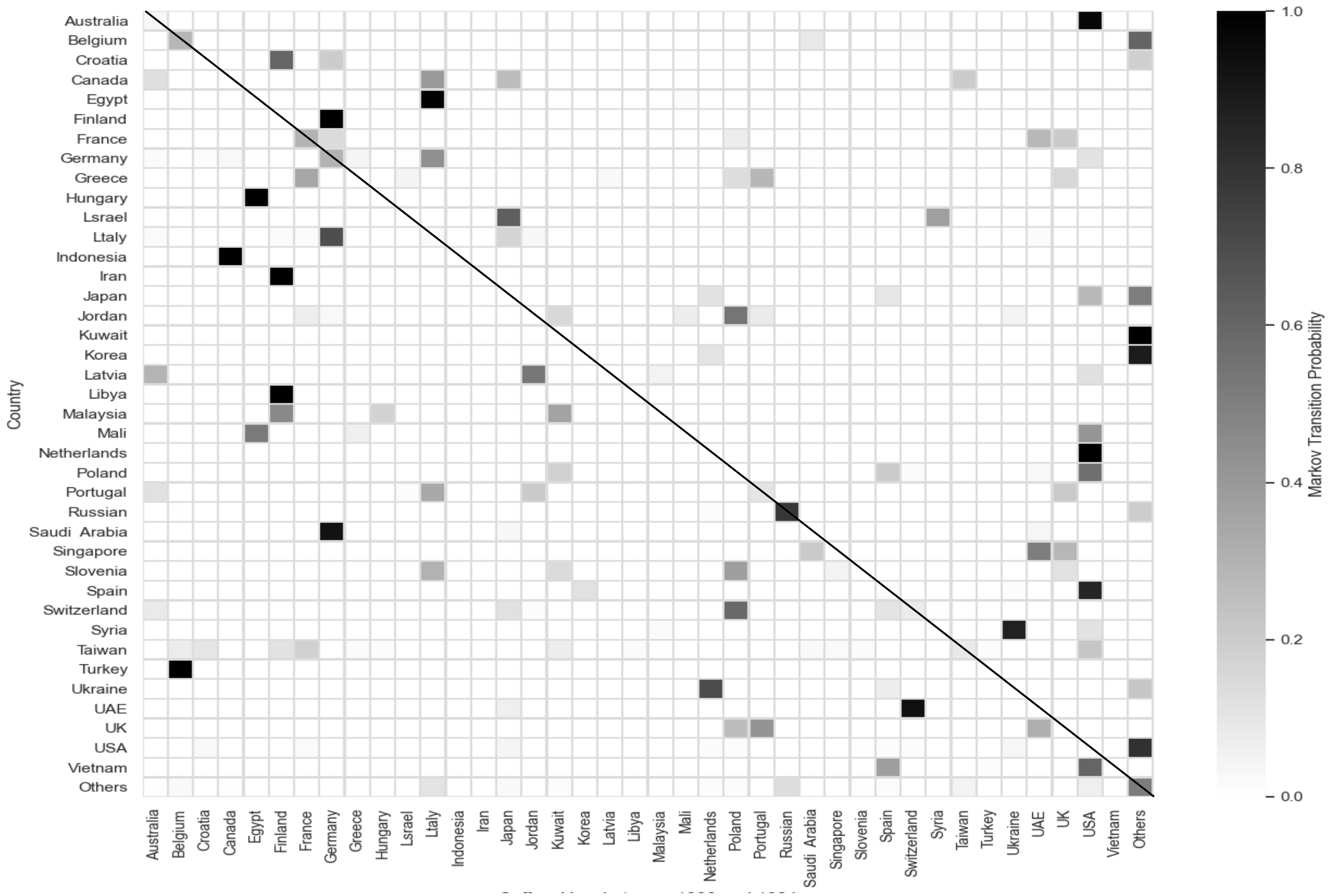


Figure 26 Markov retention probability plots for Indian coffee exports during pre-WTO period (1980-81 to 1994-95)

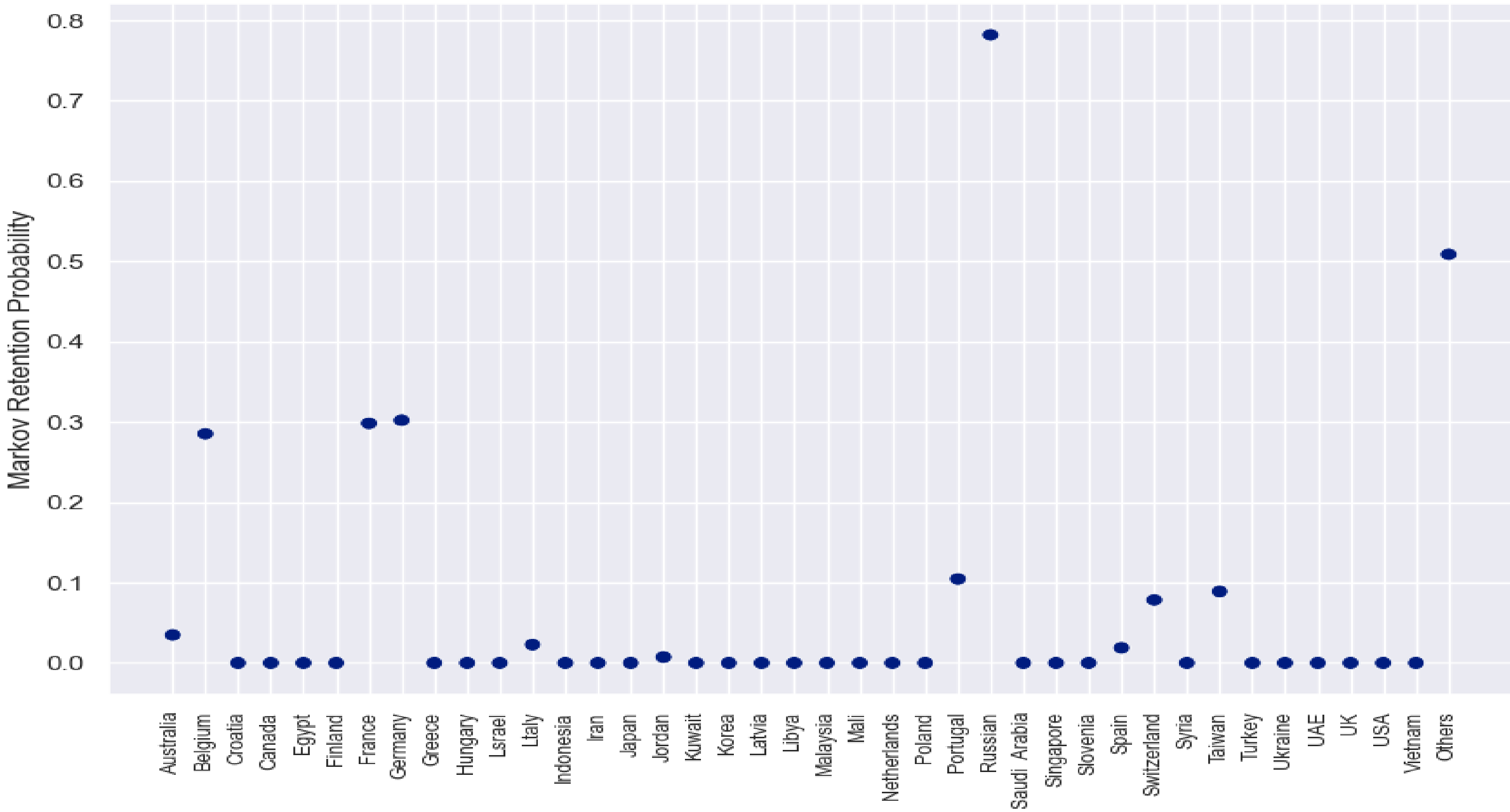


Table 4.85 Transition probability matrix for coffee exports from India during post-WTO period (1995-96 to 2019-20)

Country	AUS	BEL	CRO	CAN	EGY	FIN	FRA	GER	GRE	HUN	ISR	ITA	IND	IRA	JAP	JOR	KUW	KOR	LAT	LIB	MAL	MAI	NET	POL	POR	RUS	SAU	SIN	SLO	SPA	SWT	SYR	TAI	TUR	UKR	UAE	UK	USA	VIE	OTH
AUS	**0.24**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.57
BEL	0.00	**0.39**	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.03	0.00	0.21	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CRO	0.00	0.00	**0.59**	0.00	0.31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CAN	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EGY	0.00	0.00	0.00	0.00	**0.13**	0.00	0.00	0.00	0.00	0.00	0.00	0.82	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FIN	0.00	0.00	0.05	0.00	0.00	**0.52**	0.16	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FRA	0.00	0.00	0.00	0.00	0.00	0.05	**0.08**	0.00	0.21	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.27	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GER	0.00	0.00	0.00	0.00	0.02	0.00	0.00	**0.75**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.14
GRE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.70	0.00	0.00	0.00	0.00	0.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HUN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.60**	0.00	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.06	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ISR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	**0.35**	0.00	0.00	0.00	0.00	0.21	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.14	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ITA	0.03	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.01	0.00	0.01	**0.70**	0.00	0.00	0.00	0.03	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.13
IND	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.26	0.02	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.26	0.00	0.00	0.07	0.00	0.18	0.00
IRA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.17**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.83	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
JAP	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.69**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.07	0.00	0.04
JOR	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	**0.00**	0.00	0.00	0.00	0.08	0.02	0.10	0.00	0.00	0.00	0.00	0.21	0.00	0.00	0.00	0.00	0.27	0.01	0.05	0.00	0.00	0.13	0.00	0.00	0.00
KUW	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.12**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.65
KOR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.04	0.00	0.96	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LAT	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.14	0.00	**0.31**	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.00	0.00	0.00	0.00	0.00	0.00
LIB	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.07	0.00	0.00	0.00	**0.59**	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.03	0.00	0.01	0.00	0.05	0.00
MAL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.05	0.00	0.00	0.00	0.14	0.00	0.00	**0.50**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.00
MAI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NET	0.00	0.00	0.00	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.47**	0.00	0.00	0.06	0.00	0.00	0.00	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
POL	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	**0.48**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.07	0.00	0.26
POR	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.31	0.00	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.27	0.00	0.00
RUS	0.00	0.19	0.00	0.01	0.00	0.00	0.06	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.42**	0.00	0.00	0.05	0.15	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SAU	0.06	0.47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SIN	0.00	0.00	0.00	0.00	0.00	0.30	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.19**	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SLO	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	**0.27**	0.00	0.00	0.00	0.00	0.00	0.11	0.00	0.00	0.00	0.00	0.00
SPA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.66	0.00	0.00	0.00	**0.34**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SWT	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.37**	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SYR	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.35	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.40	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.03**	0.01	0.00	0.12	0.00	0.02	0.00	0.01	0.00
TAI	0.00	0.06	0.00	0.00	0.00	0.02	0.02	0.27	0.00	0.00	0.02	0.21	0.00	0.00	0.02	0.13	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.03	0.00	0.05	0.01	0.01	0.00	0.01	0.00	**0.03**	0.00	0.00	0.01	0.00	0.00	0.00	0.02
TUR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.66**	0.00	0.00	0.00	0.00	0.00	0.00
UKR	0.01	0.00	0.13	0.00	0.00	0.17	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.67**	0.00	0.00	0.00	0.00	0.00
UAE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.34**	0.00	0.00	0.00	0.66
UK	0.00	0.66	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00
USA	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	**0.66**	0.00	0.25
VIE	0.10	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18	0.00	0.00	0.47	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.14**	0.00
OTH	0.02	0.00	0.00	0.00	0.00	0.02	0.01	0.11	0.04	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.35	0.00	0.00	0.07	0.00	0.02	0.00	0.02	0.00	0.00	0.00	0.00	0.04	0.00	**0.00**

Note: Derived from Markov Chain analysis

Figure 27 Markov probability plot for Indian coffee exports during post-WTO period (1995-96 to 2019-20)

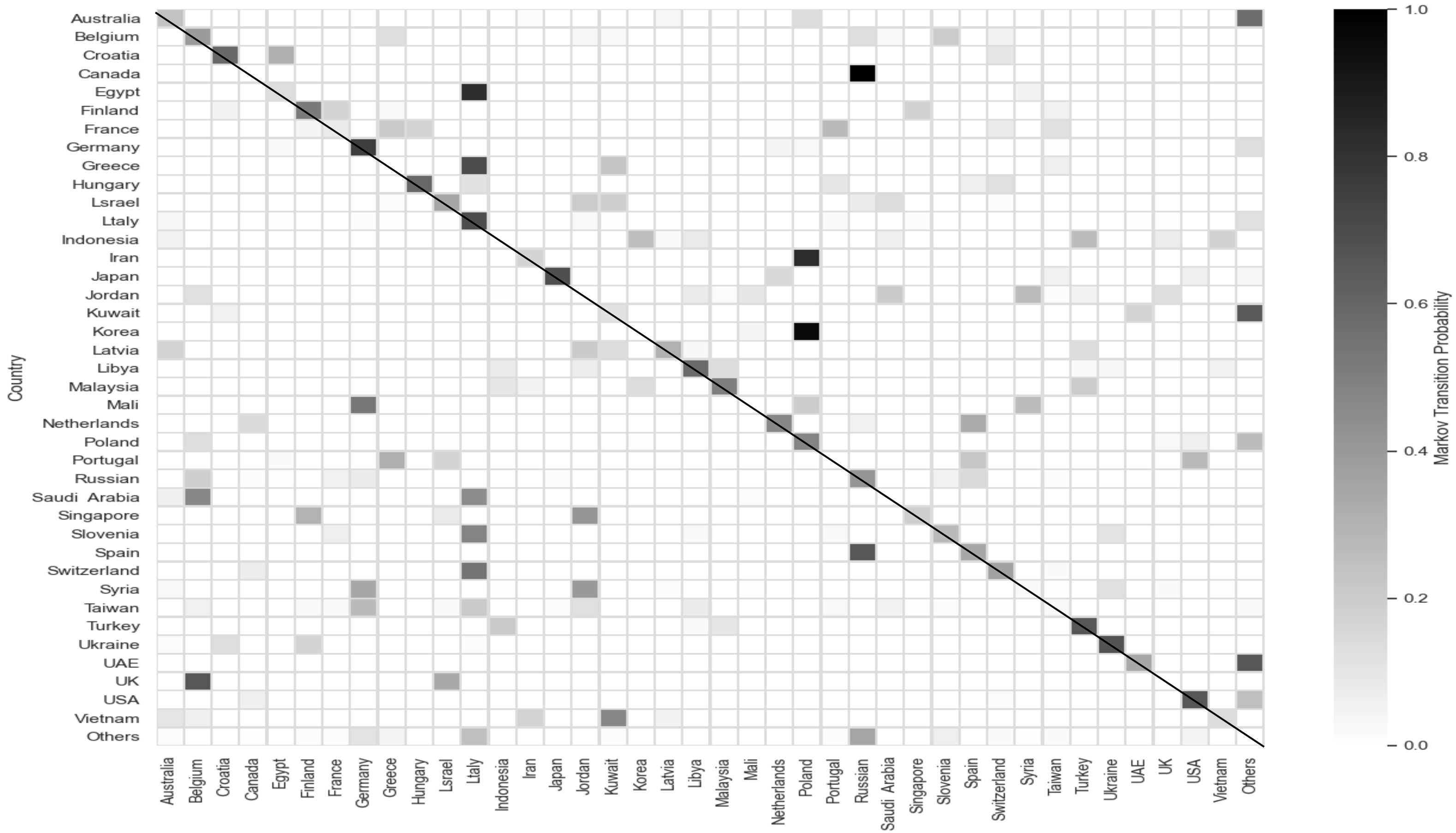


Figure 28 Markov retention probability plot for Indian coffee exports during post-WTO period (1995-96 to 2019-20)

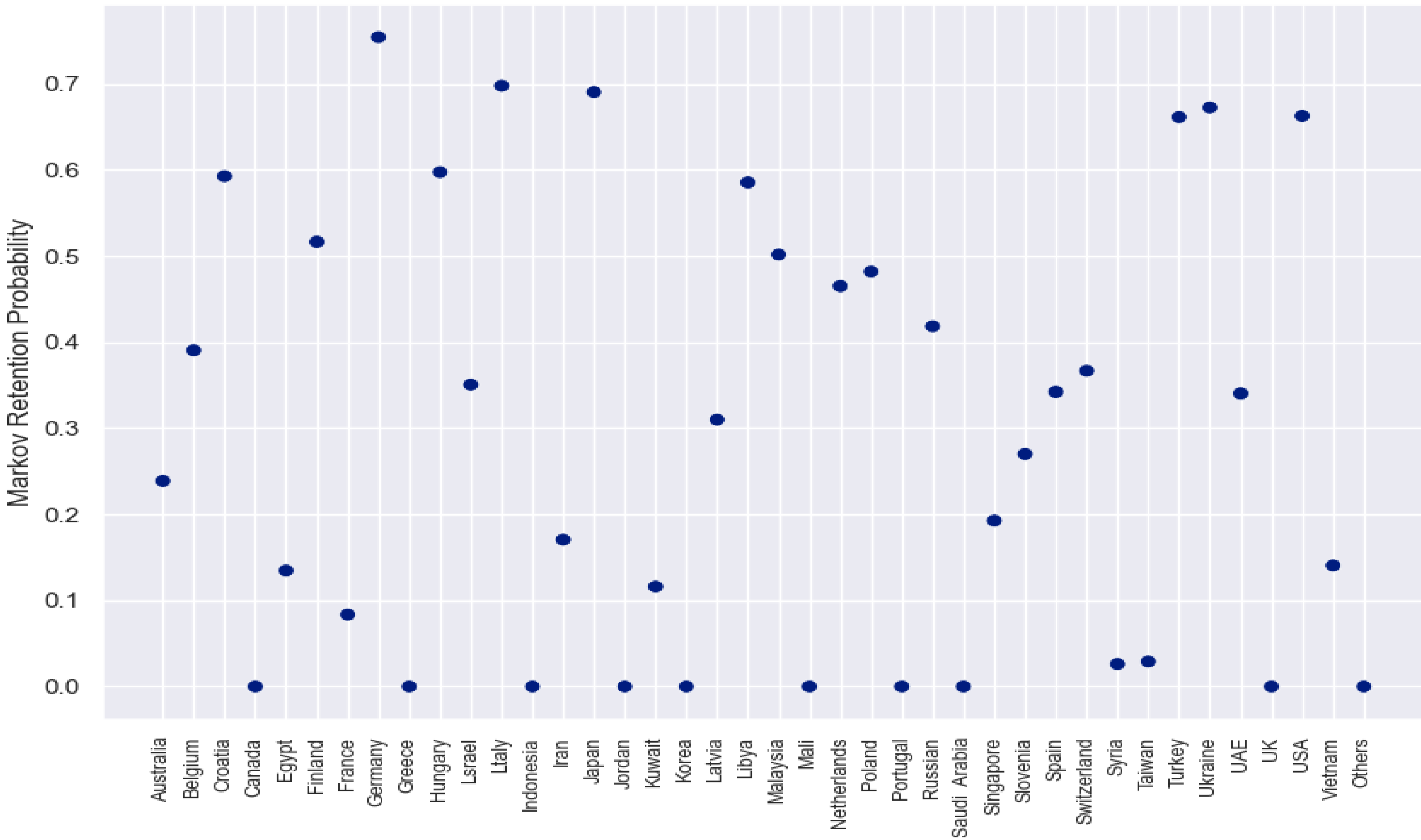


Table 4.86 Transition probability matrix for coffee exports from India during overall period (1980-81 to 2019-20)

Country	AUS	BEL	CRO	CAN	EGY	FIN	FRA	GER	GRE	HUN	ISR	ITA	IND	IRA	JAP	JOR	KUW	KOR	LAT	LIB	MAL	MAI	NET	POL	POR	RUS	SAU	SIN	SLO	SPA	SWT	SYR	TAI	TUR	UKR	UAE	UK	USA	VIE	OTH
AUS	**0.39**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.56	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BEL	0.00	**0.78**	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.12	0.00	0.00	0.03	0.00	0.00	0.00	0.01	0.00	0.02	0.00	0.00	0.00	0.00	0.00
CRO	0.01	0.00	**0.62**	0.00	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CAN	0.00	0.00	0.00	**0.00**	0.00	0.00	0.03	0.00	0.00	0.00	0.08	0.02	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.11	0.08	0.00	0.00	0.38	0.00	0.00	0.00	0.00	0.02	0.00	0.00
EGY	0.00	0.00	0.00	0.00	**0.11**	0.00	0.00	0.00	0.00	0.00	0.00	0.89	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FIN	0.00	0.00	0.03	0.00	0.00	**0.51**	0.07	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.00	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FRA	0.00	0.00	0.00	0.00	0.00	0.04	**0.38**	0.00	0.09	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.34	0.00	0.00	0.01	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00
GER	0.02	0.00	0.00	0.04	0.00	0.00	0.01	**0.79**	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.02	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.03	0.00	0.00
GRE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.02**	0.00	0.00	0.98	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HUN	0.00	0.00	0.00	0.11	0.00	0.00	0.10	0.00	0.00	**0.70**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ISR	0.00	0.00	0.00	0.00	0.13	0.00	0.00	0.00	0.23	0.00	**0.31**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ITA	0.01	0.00	0.00	0.00	0.01	0.01	0.00	0.03	0.02	0.00	0.02	**0.79**	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.01	0.02	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
IND	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.17	0.04	0.05	0.07	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.27	0.00	0.00	0.07	0.00	0.19	0.00
IRA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.21**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.79	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
JAP	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	**0.61**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
JOR	0.05	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	**0.00**	0.00	0.00	0.01	0.05	0.01	0.09	0.00	0.00	0.00	0.00	0.22	0.00	0.00	0.00	0.00	0.22	0.04	0.00	0.09	0.00	0.15	0.00	0.00	0.00
KUW	0.00	0.00	0.15	0.00	0.00	0.00	0.00	0.85	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
KOR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.17**	0.00	0.00	0.00	0.13	0.05	0.42	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.16
LAT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.72	0.00	0.00	**0.00**	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.00	0.00	0.00	0.00	0.00	0.00
LIB	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	**0.72**	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.02	0.00
MAL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.06	0.00	0.00	0.00	0.16	0.02	0.00	**0.56**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00
MAI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.05**	0.00	0.31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.61	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00
NET	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.48**	0.00	0.00	0.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
POL	0.00	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.03	**0.63**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.00
POR	0.00	0.00	0.00	0.00	0.00	0.00	0.27	0.00	0.67	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.03**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RUS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	**0.65**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.33
SAU	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.09	0.29	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00	**0.06**	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00
SIN	0.02	0.00	0.00	0.00	0.11	0.02	0.00	0.00	0.00	0.03	0.10	0.00	0.00	0.00	0.00	0.40	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.22**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00
SLO	0.00	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	**0.60**	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00
SPA	0.00	0.07	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.00	0.00	0.04	**0.72**	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SWT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	**0.29**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SYR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.00	0.48	0.00	0.00	0.06	0.13	0.00	0.02	0.00	0.00	0.00	0.14	0.00	0.03	0.00	0.00	0.00	**0.03**	0.00	0.00	0.01	0.00	0.07	0.00	0.00	0.00
TAI	0.00	0.00	0.00	0.00	0.00	0.04	0.05	0.21	0.00	0.01	0.00	0.20	0.00	0.00	0.02	0.08	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.05	0.01	0.00	0.00	0.01	0.00	**0.04**	0.01	0.01	0.01	0.00	0.00	0.00	0.19
TUR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.72**	0.00	0.00	0.00	0.00	0.00	0.00
UKR	0.10	0.00	0.07	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.75**	0.00	0.00	0.00	0.01	0.00
UAE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.20	0.00	0.00	0.00	0.00	**0.43**	0.00	0.00	0.00	0.37
UK	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.31	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.09**	0.00	0.00	0.00
USA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	**0.57**	0.00	0.35
VIE	0.00	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.00	0.00	0.39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00	**0.18**	0.00
OTH	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.05	0.00	0.00	0.03	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.01	0.00	0.11	0.00	**0.54**

Note: Derived from Markov Chain analysis

Figure 29 Markov probability plot for Indian coffee exports during overall period (1980-81 to 2019-20)

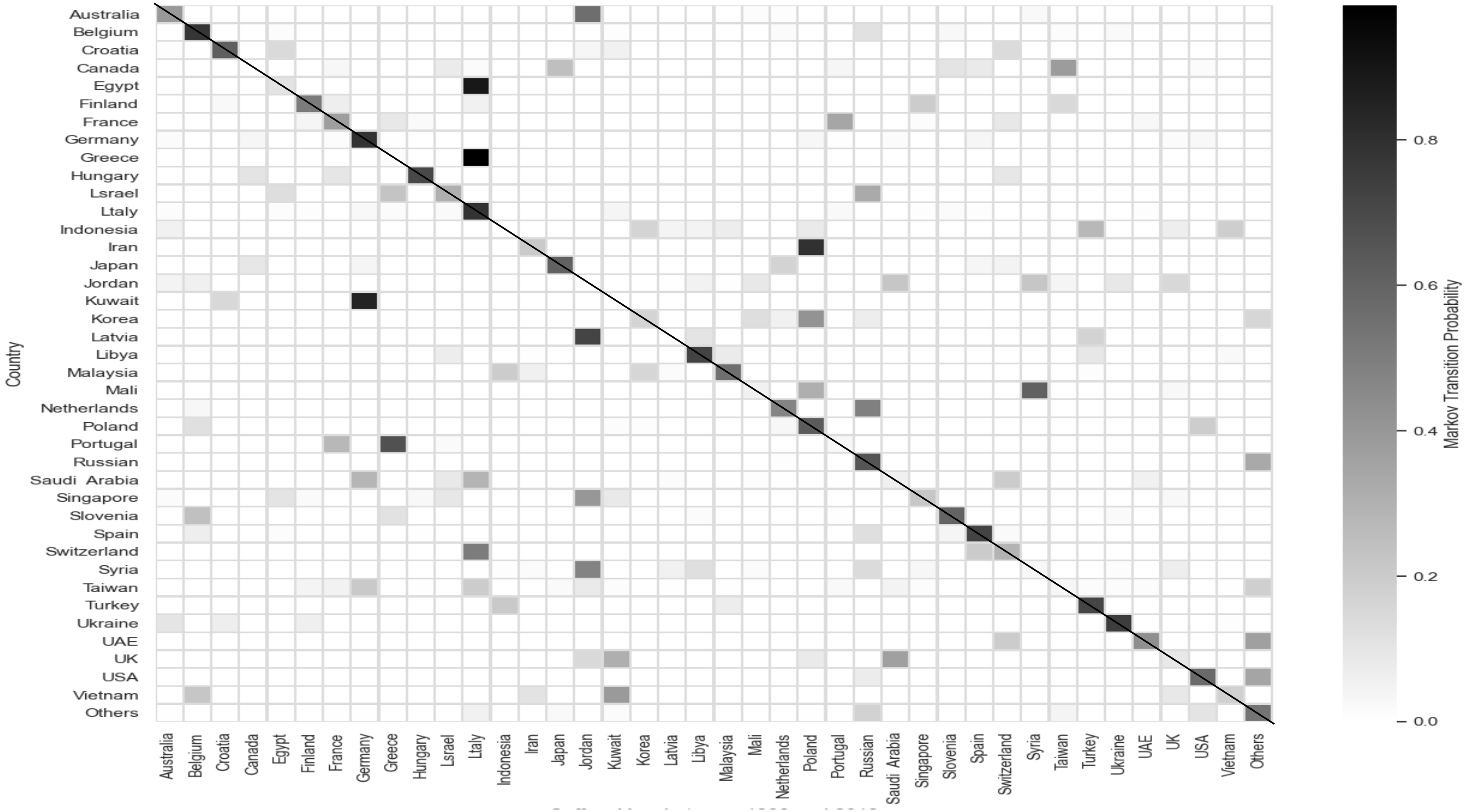


Figure 30 Markov retention probability plot for Indian coffee exports during overall period (1980-81 to 2019-20)

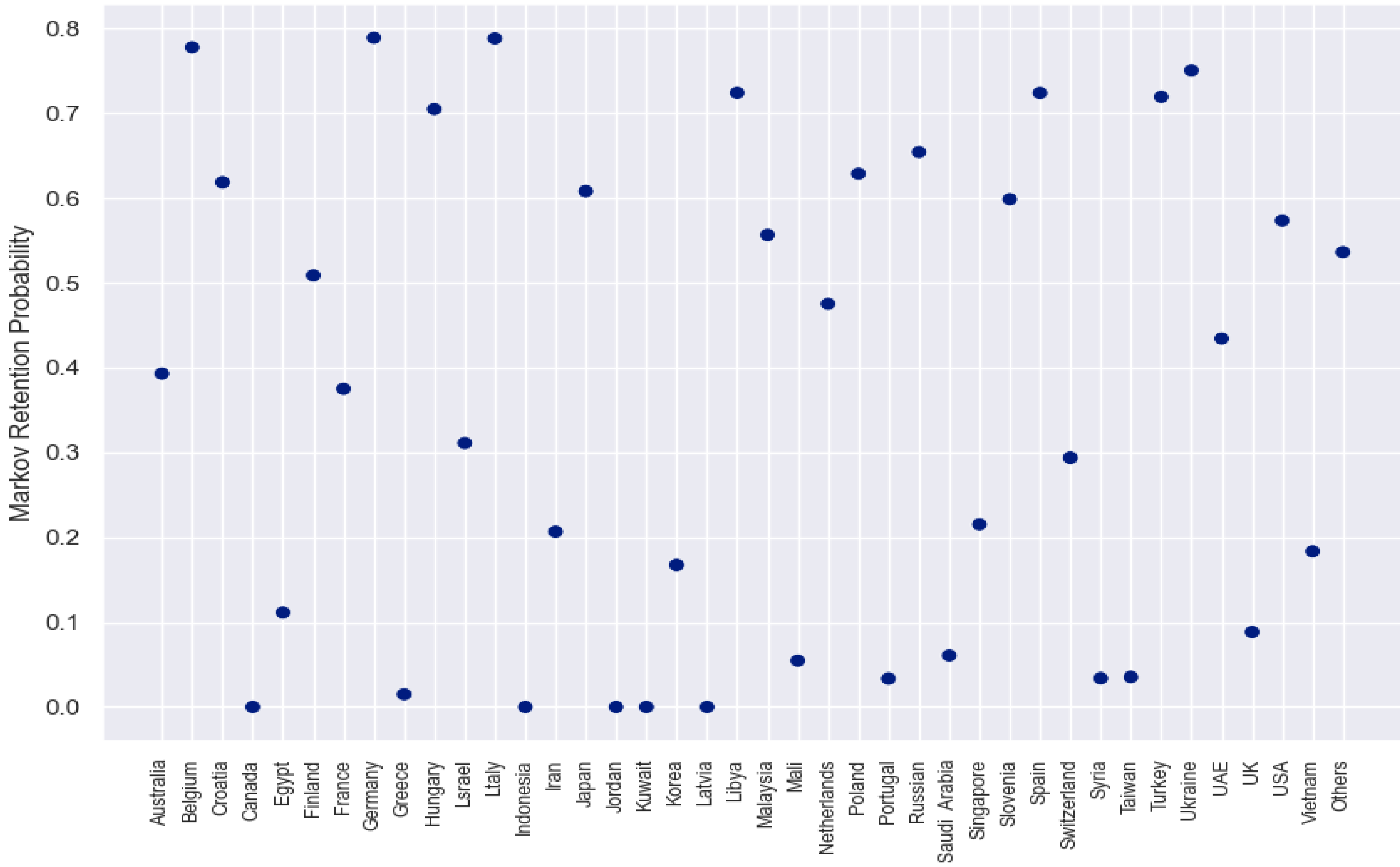


Table 4.87 Transition probability matrix for Indian coffee exports during Period I (1980-81 to 1989-90)

Country	AUS	BEL	CRO	CAN	EGY	FIN	FRA	GER	GRE	HUN	ISR	ITA	IND	IRA	JAP	JOR	KUW	KOR	LAT	LIB	MAL	MAI	NET	POL	POR	RUS	SAU	SIN	SLO	SPA	SWT	SYR	TAI	TUR	UKR	UAE	UK	USA	VIE	OTH
AUS	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
BEL	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.24	0.00	0.76
CRO	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.98
CAN	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EGY	0.00	0.00	0.00	0.00	**0.00**	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FIN	0.00	0.00	0.00	0.00	0.00	**0.47**	0.00	0.53	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FRA	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
GER	0.00	0.00	0.00	0.00	0.00	0.06	0.00	**0.56**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.32	0.00	0.00	0.00	0.00	0.00	0.00	0.06
GRE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.95	0.00	0.00
HUN	0.00	0.00	0.00	0.00	0.34	0.21	0.00	0.00	0.00	**0.44**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ISR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
ITA	0.01	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.17**	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.77
IND	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
IRA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
JAP	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.35	0.00	0.00	**0.17**	0.00	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.01	0.00	0.02	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.05	0.04	0.00	0.00	0.00
JOR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
KUW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
KOR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
LAT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.80	**0.00**	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00
LIB	0.00	0.00	0.00	0.00	0.05	0.61	0.00	0.00	0.34	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MAL	0.00	0.00	0.00	0.00	0.00	0.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MAI	0.00	0.00	0.00	0.00	0.62	0.00	0.00	0.00	0.38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NET	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
POL	0.06	0.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.17	0.01	0.00
POR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.16	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.84	0.00	0.00
RUS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.00	**0.68**	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.27
SAU	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.99
SIN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.66	0.00	0.00	0.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SLO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SPA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
SWT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.00	0.18	**0.54**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SYR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.67	0.00	0.00	0.00	0.00	0.00
TAI	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.90	0.00	0.00
TUR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00
UKR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	1.00
UAE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	1.00
UK	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00
USA	0.00	0.02	0.02	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.01	0.58	0.00	0.00	0.00	0.01	0.02	0.00	0.00	0.00	0.03	0.02	0.01	**0.14**	0.00	0.00
VIE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	**0.00**	0.00
OTH	0.01	0.00	0.01	0.01	0.00	0.00	0.01	0.07	0.00	0.00	0.00	0.11	0.00	0.00	0.03	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.02	0.01	0.00	0.09	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00	**0.50**

Note: Derived from Markov Chain analysis

Figure 31 Markov probability plot for Indian coffee exports during Period I (1980-81 to 1989-90)

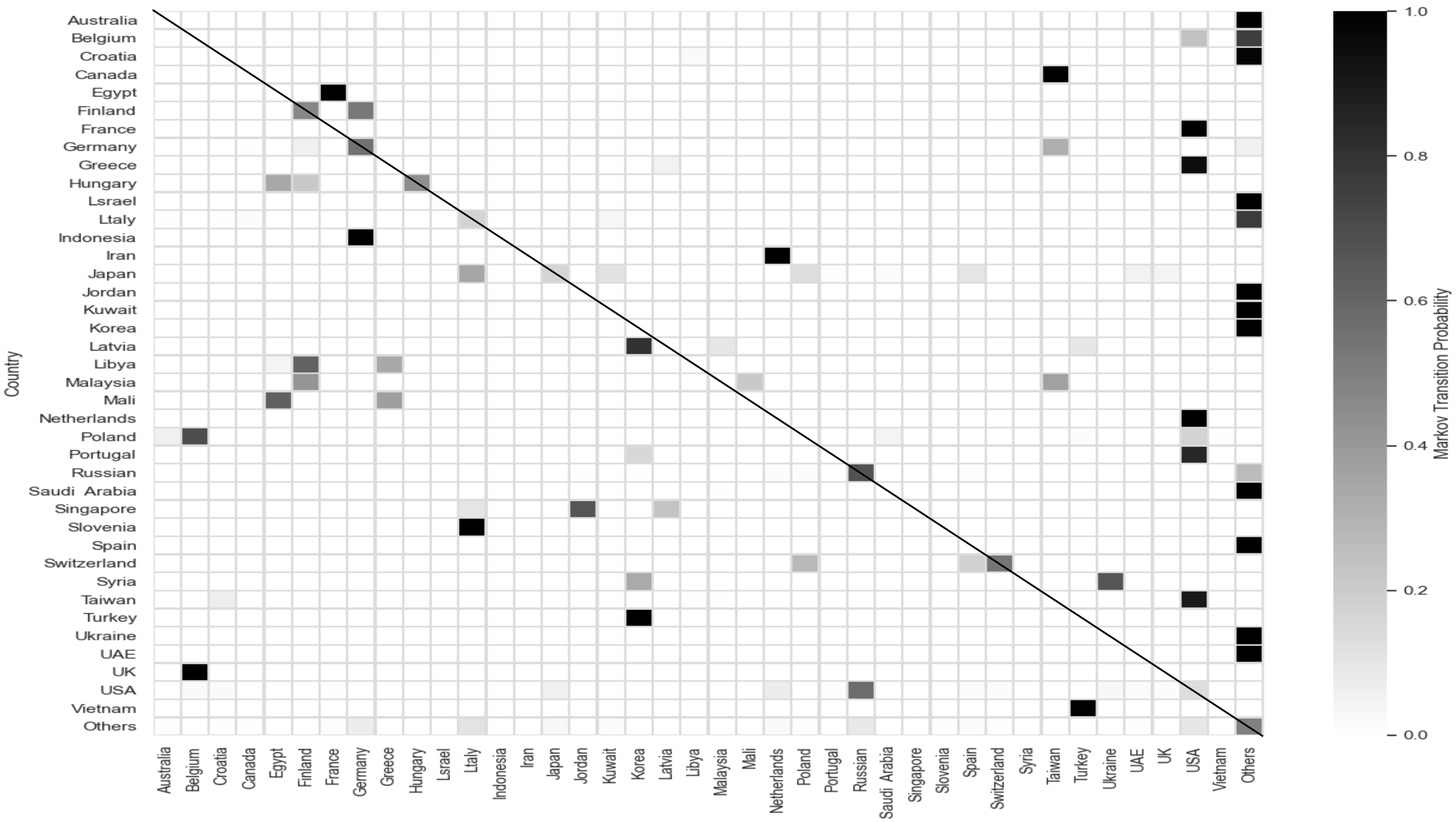


Figure 32 Markov retention probability plot for Indian coffee exports during Period I (1980-81 to 1989-90)

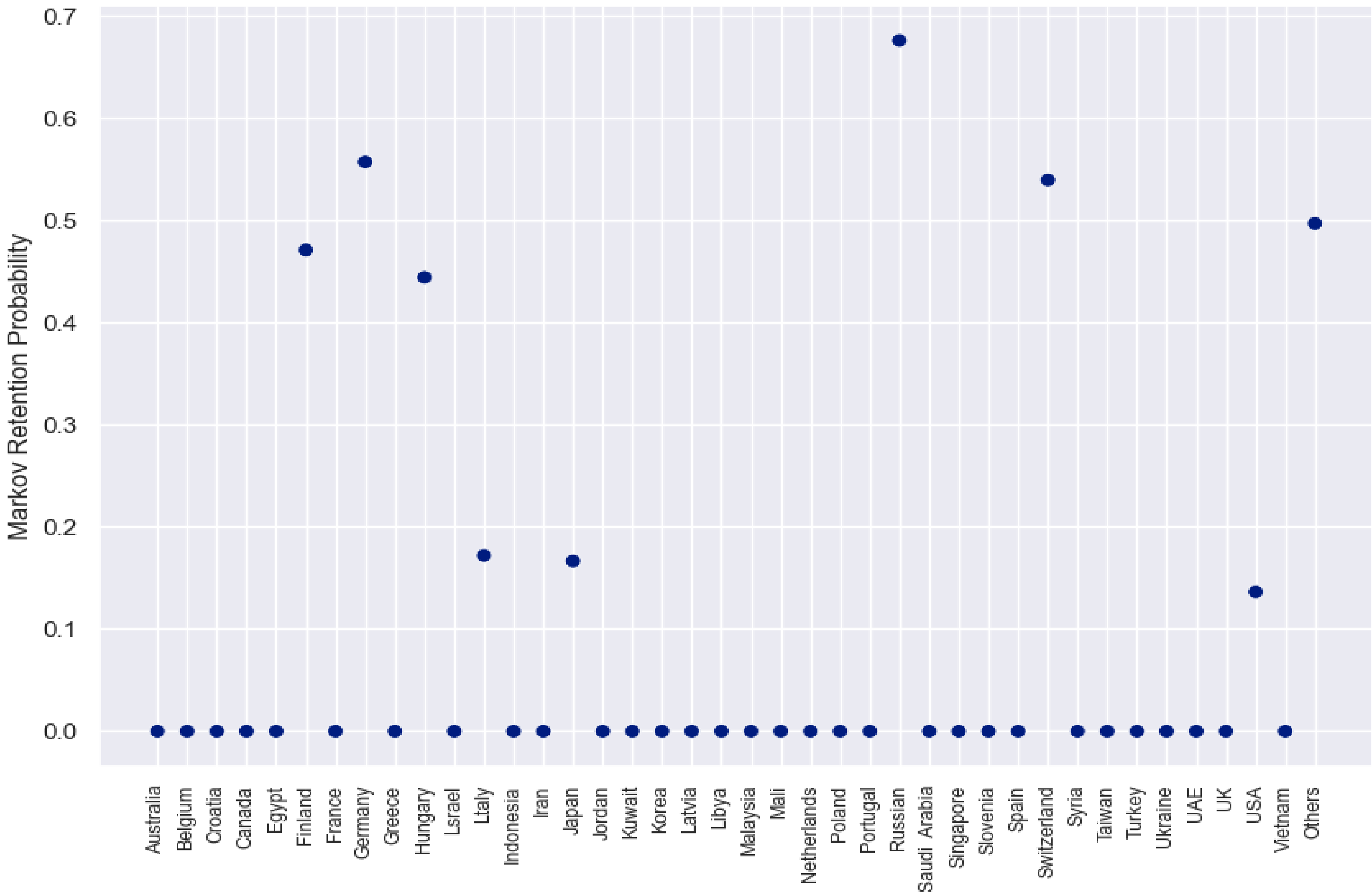


Table 4.88 Transition probability matrix for coffee exports from India during Period II (1990-91 to 1999-20)

Country	AUS	BEL	CRO	CAN	EGY	FIN	FRA	GER	GRE	HUN	ISR	ITA	IND	IRA	JAP	JOR	KUW	KOR	LAT	LIB	MAL	MAI	NET	POL	POR	RUS	SAU	SIN	SLO	SPA	SWT	SYR	TAI	TUR	UKR	UAE	UK	USA	VIE	OTH
AUS	**0.42**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.30	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BEL	0.00	**0.60**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.36	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
CRO	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.66	0.00	0.00	0.00	0.29
CAN	0.00	0.00	0.00	**0.00**	0.01	0.00	0.00	0.00	0.00	0.00	0.06	0.75	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.05	0.00	0.00	0.00
EGY	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FIN	0.00	0.00	0.06	0.00	0.00	**0.05**	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.06	0.42	0.00	0.00	0.00
FRA	0.00	0.00	0.00	0.00	0.14	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.11	0.00	0.00	0.00
GER	0.02	0.00	0.02	0.00	0.00	0.01	0.00	**0.51**	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.01	0.00	0.00	0.11	0.00	0.25
GRE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.00	0.00	0.00	0.00	0.00	0.19	0.08	0.00	0.00	0.24	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HUN	0.00	0.00	0.00	0.00	0.27	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18	0.00	0.00	0.00	0.00	0.00	0.55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ISR	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.00	0.00	0.00	**0.06**	0.00	0.00	0.00	0.00	0.48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00
ITA	0.00	0.00	0.00	0.09	0.00	0.00	0.06	0.00	0.07	0.00	0.02	**0.31**	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18	0.00	0.00
IND	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
IRA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.93	0.00	0.00	0.00	0.07	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
JAP	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	**0.31**	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.55	0.00	0.00
JOR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.42	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.46	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.00
KUW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
KOR	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LAT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00
LIB	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
MAL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.80	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00
MAI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.63	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NET	0.00	0.47	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.34**	0.00	0.00	0.00	0.00	0.04	0.00	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
POL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
POR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.19	0.00	0.00	0.00	0.00	0.04	0.00	0.77	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RUS	0.00	0.02	0.00	0.00	0.00	0.03	0.00	0.35	0.00	0.00	0.00	0.12	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	**0.19**	0.06	0.00	0.01	0.05	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.09
SAU	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SIN	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.19	0.00	0.00	0.00	0.66	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SLO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.31**	0.55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SPA	0.00	0.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.09	0.00	0.00	0.00	**0.64**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SWT	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.74	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.00	0.00
SYR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TAI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TUR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.49	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.46	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00
UKR	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.83	0.00	0.00	0.00	0.00
UAE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	1.00
UK	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.28	**0.00**	0.00	0.00	0.00
USA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.72	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.01	0.00	0.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	**0.00**	0.00	0.00
VIE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	1.00
OTH	0.01	0.00	0.01	0.00	0.00	0.01	0.01	0.14	0.00	0.00	0.00	0.07	0.00	0.00	0.10	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.29	0.01	0.01	0.00	0.00	0.01	0.00	0.05	0.00	0.00	0.00	0.00	0.12	0.00	**0.11**

Note: Derived from Markov Chain analysis

Figure 33 Markov probability plot for Indian coffee exports during Period II (1990-91 to 1999-20)

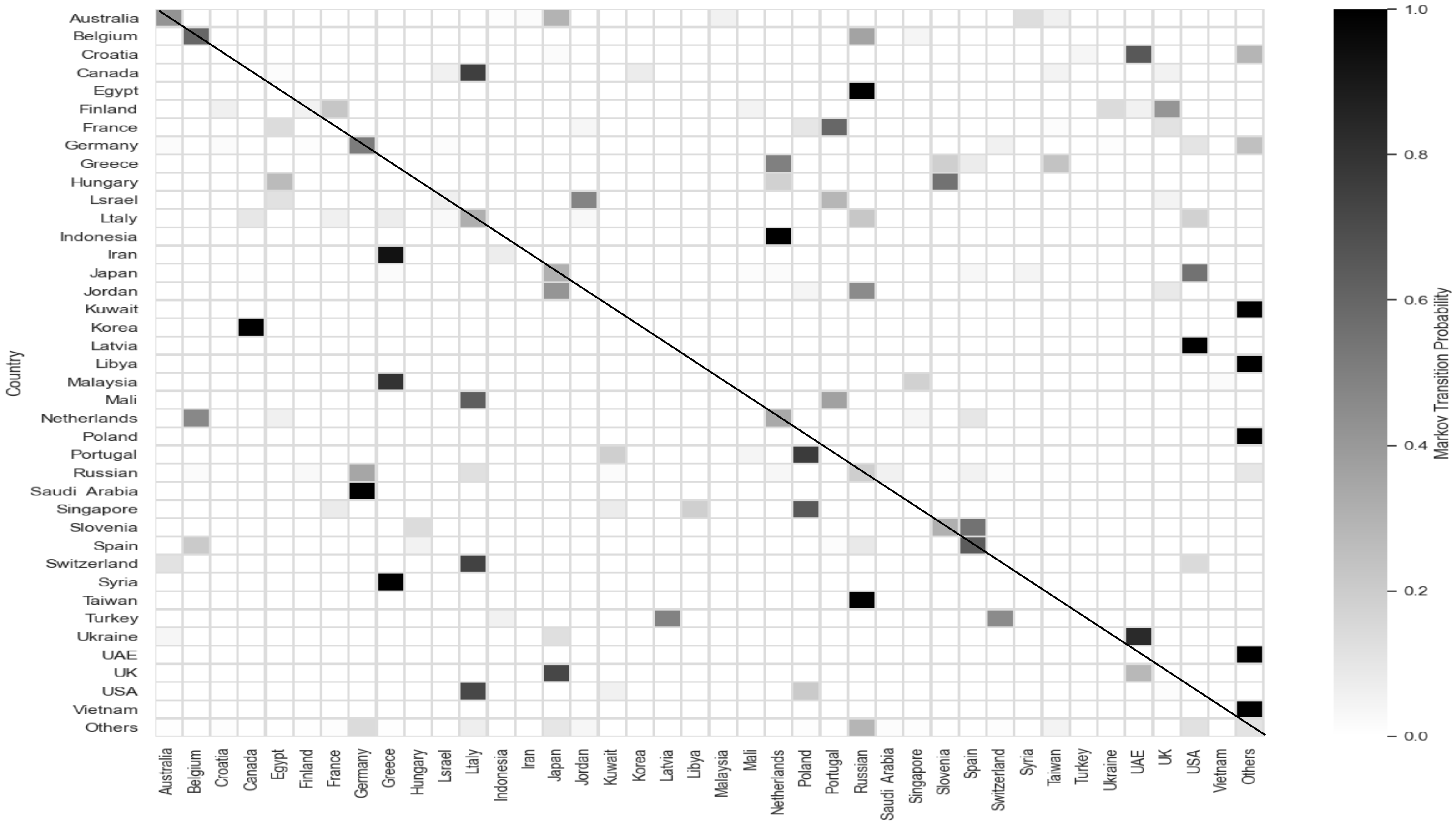


Figure 34 Markov retention probability plot for Indian coffee exports during Period II (1990-91 to 1999-20)

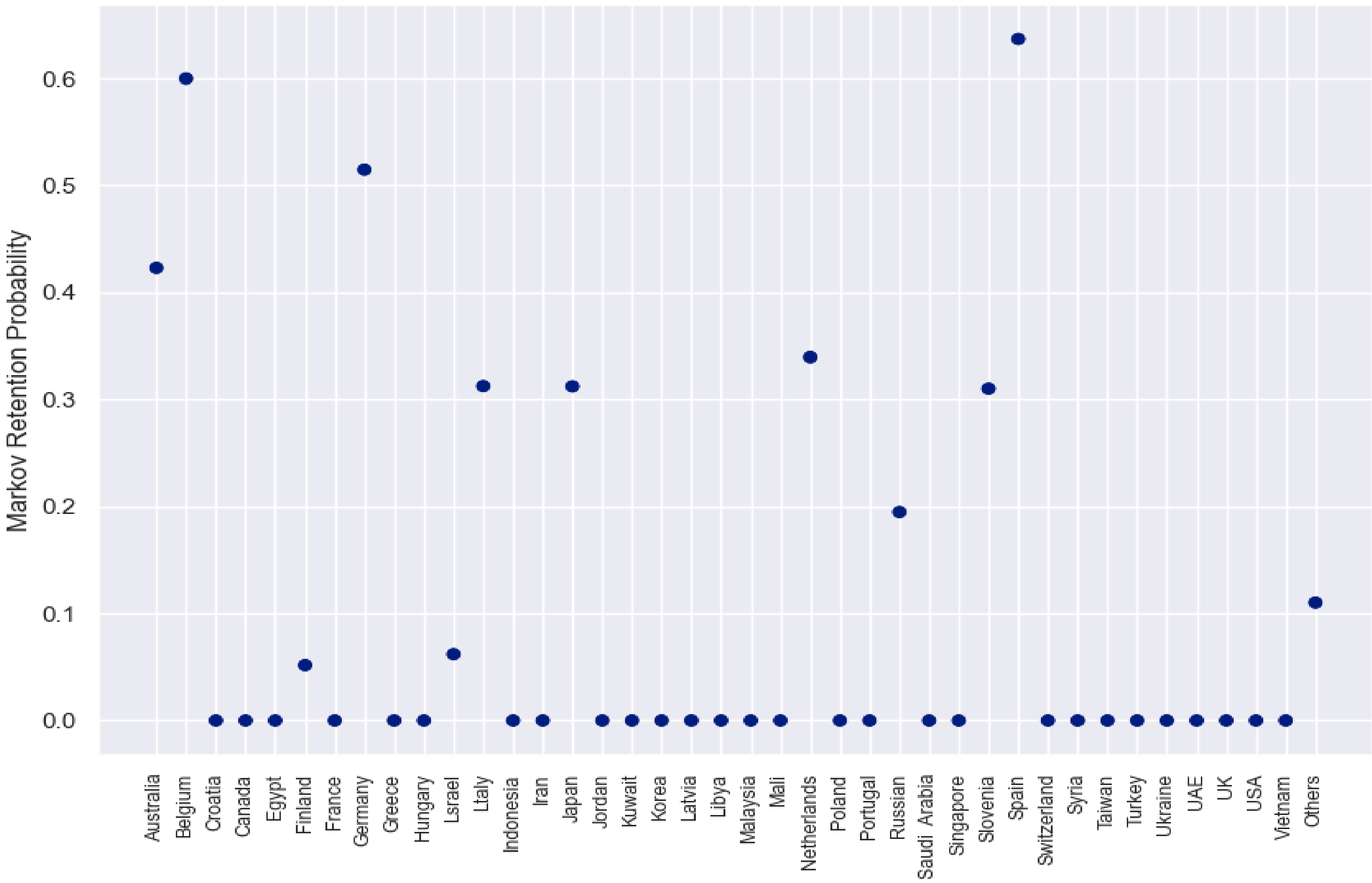


Table 4.89 Transition probability matrix for coffee exports from India during Period III (2000-01to 2009-10)

Country	AUS	BEL	CRO	CAN	EGY	FIN	FRA	GER	GRE	HUN	ISR	ITA	IND	IRA	JAP	JOR	KUW	KOR	LAT	LIB	MAL	MAI	NET	POL	POR	RUS	SAU	SIN	SLO	SPA	SWT	SYR	TAI	TUR	UKR	UAE	UK	USA	VIE	OTH
AUS	**0.33**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.17	0.00	0.00
BEL	0.00	**0.00**	0.00	0.03	0.00	0.00	0.00	0.64	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.01	0.00	0.00	0.04	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.22
CRO	0.04	0.00	**0.00**	0.00	0.00	0.15	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.64	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.01	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00
CAN	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
EGY	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FIN	0.00	0.00	0.15	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.19	0.00	0.00	0.00	0.00	0.31
FRA	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.02	0.07	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.11	0.00	0.40	0.00	0.01	0.00	0.00	0.00
GER	0.00	0.20	0.00	0.00	0.00	0.00	0.00	**0.01**	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.64	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.06	0.00	0.00
GRE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.07	0.00	0.51	0.00	0.00	0.00	0.00	0.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HUN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.92
ISR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.38	0.31	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.29	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ITA	0.03	0.01	0.00	0.01	0.00	0.03	0.02	0.00	0.05	0.03	0.01	**0.70**	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.01	0.00	0.00	0.00	0.00	0.03	0.00	0.00
IND	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
IRA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.58	0.00	0.42	0.00	0.00	0.00	0.00	0.00	0.00
JAP	0.00	0.04	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.75	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00
JOR	0.00	0.00	0.06	0.00	0.02	0.00	0.00	0.00	0.08	0.00	0.00	0.00	0.01	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.14	0.00	0.50	0.09	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00
KUW	0.00	0.09	0.04	0.00	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.05	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.17	0.00	0.00	0.32	0.00	0.00	0.00	0.00
KOR	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LAT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.98
LIB	0.00	0.00	0.00	0.00	0.00	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	**0.26**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.28	0.00	0.00	0.00
MAL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.51	0.00	0.00	0.00	0.00	0.00	0.00	0.47	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00
MAI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	**0.00**	0.00	0.00	0.41	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.00	0.00	0.00	0.00
NET	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	**0.31**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.66
POL	0.00	0.00	0.00	0.57	0.00	0.00	0.00	0.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
POR	0.00	0.00	0.00	0.00	0.00	0.00	0.55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.08	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.36	0.00	0.00	0.00	0.01	0.00
RUS	0.00	0.23	0.00	0.00	0.00	0.00	0.03	0.19	0.00	0.00	0.00	0.04	0.00	0.00	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.18	0.12	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.08
SAU	0.00	0.19	0.00	0.00	0.00	0.00	0.00	0.81	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SIN	0.00	0.00	0.94	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00
SLO	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.22	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.00	0.00	0.00	0.00	0.00	**0.12**	0.33	0.00	0.00	0.00	0.00	0.07	0.01	0.00	0.00	0.00	0.00
SPA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SWT	0.00	0.00	0.00	0.00	0.39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.52
SYR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.13	0.84	0.00	0.00
TAI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.31	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.34	0.00	0.18	**0.00**	0.00	0.00	0.00	0.17	0.00	0.00	0.00
TUR	0.00	0.00	0.18	0.00	0.00	0.82	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00
UKR	0.00	0.00	0.00	0.00	0.00	0.35	0.00	0.00	0.00	0.06	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18	0.00	0.00	0.00	0.10	0.00	0.02	**0.16**	0.00	0.00	0.00	0.02	0.00
UAE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.38	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00
UK	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.96	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.04**	0.00	0.00	0.00
USA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.29	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.22	0.13	0.00	0.03	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.19
VIE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00
OTH	0.03	0.00	0.00	0.00	0.01	0.00	0.00	0.10	0.01	0.01	0.01	0.37	0.00	0.00	0.00	0.01	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.28	0.02	0.00	0.00	0.02	0.02	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**

Note: Derived from Markov Chain analysis

Figure 35 Markov probability plot for Indian coffee exports during Period III (2000-01to 2009-10)

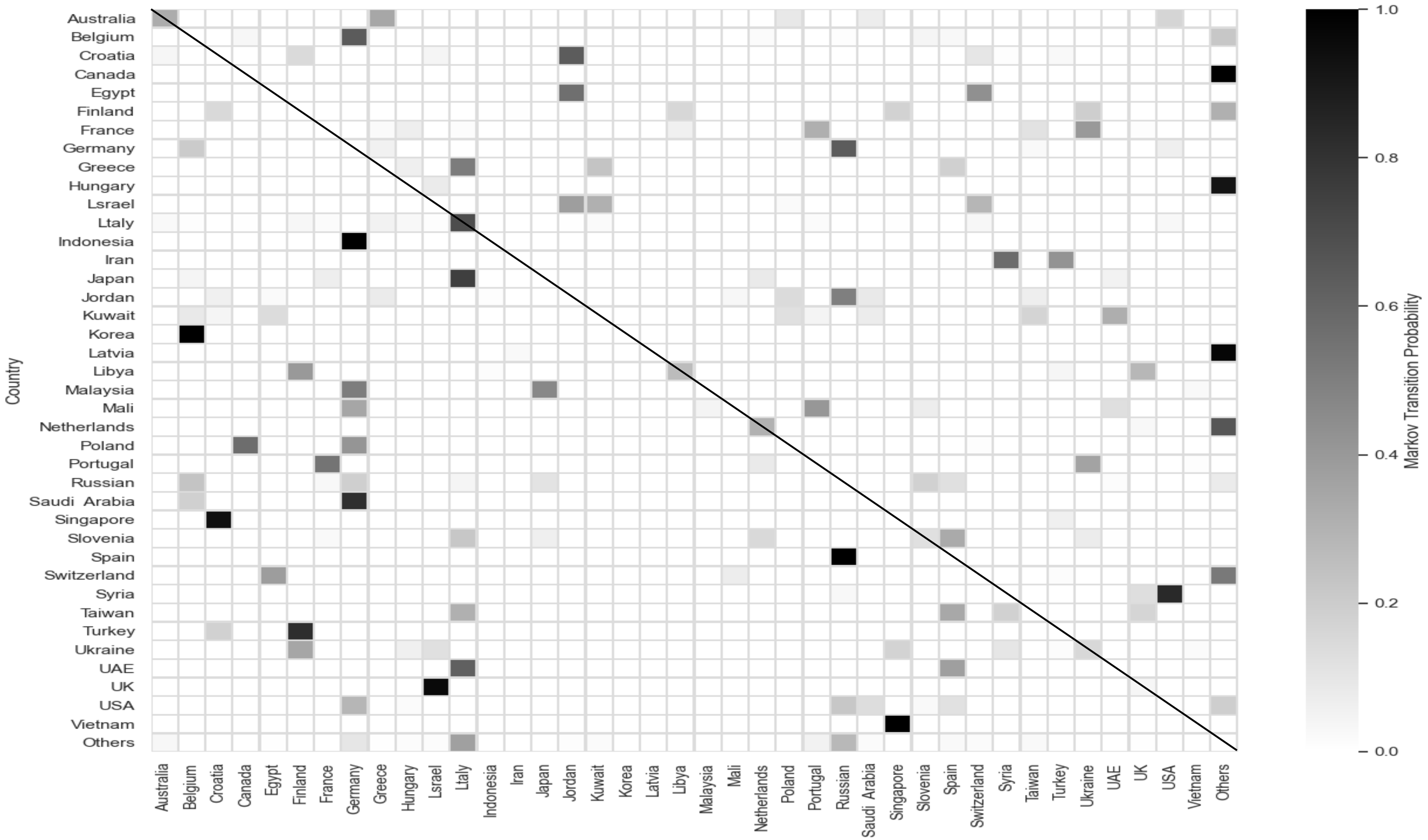


Figure 36 Markov retention probability plot for Indian coffee exports during Period III (2000-01to 2009-10)

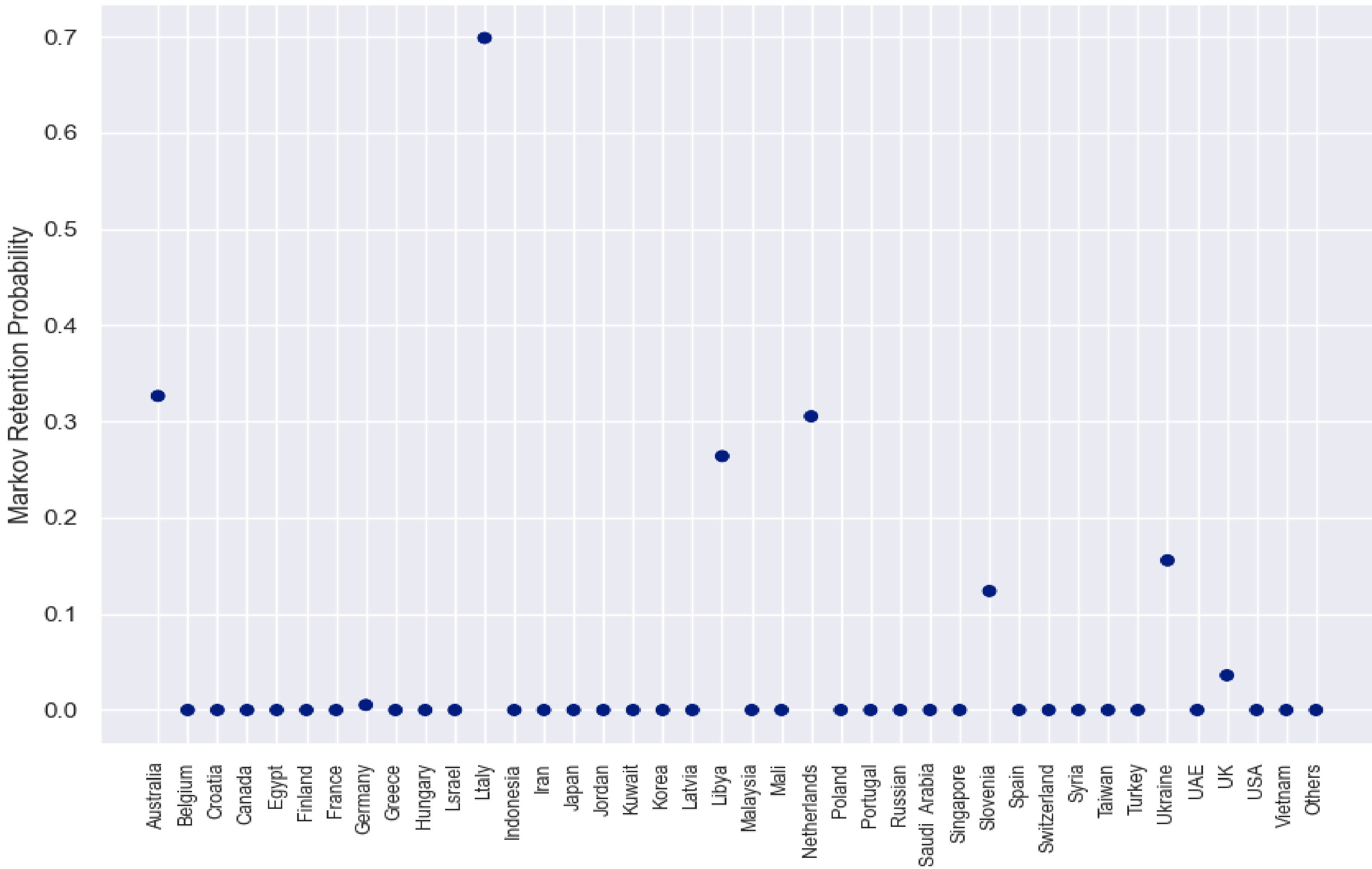


Table 4.90 Transition probability matrix for coffee exports from India during Period IV (2010-11 to 2019-20)

Country	AUS	BEL	CRO	CAN	EGY	FIN	FRA	GER	GRE	HUN	ISR	ITA	IND	IRA	JAP	JOR	KUW	KOR	LAT	LIB	MAL	MAI	NET	POL	POR	RUS	SAU	SIN	SLO	SPA	SWT	SYR	TAI	TUR	UKR	UAE	UK	USA	VIE	OTH
AUS	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BEL	0.00	**0.07**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.00	0.02	0.00	0.00	0.04	0.00	0.00	0.00	0.16	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00	0.01	0.00	0.07	0.00	0.12	0.03	0.00	0.09	0.00	0.16
CRO	0.00	0.00	**0.26**	0.00	0.39	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.34
CAN	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
EGY	0.00	0.50	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.43	0.00	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FIN	0.00	0.00	0.00	0.00	0.00	**0.15**	0.00	0.00	0.03	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.61	0.00	0.00	0.00	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00
FRA	0.00	0.00	0.00	0.06	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.93	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
GER	0.00	0.19	0.00	0.00	0.00	0.00	0.07	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.29
GRE	0.00	0.76	0.00	0.00	0.00	0.00	0.00	0.00	**0.04**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	0.00
HUN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
ISR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.48	0.00	0.00	0.00	0.07	0.17	0.00	0.00	0.00
ITA	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.38	0.06	0.00	0.00	**0.19**	0.00	0.00	0.00	0.05	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.03	0.04	0.03	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.12
IND	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.02	0.00	0.00	0.00	0.00	**0.48**	0.00	0.00	0.00	0.00	0.13	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.02	0.13	0.00	0.13	0.00
IRA	0.00	0.00	0.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.28**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.59	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
JAP	0.00	0.00	0.00	0.00	0.00	0.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.30**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
JOR	0.00	0.21	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.49	0.06	0.02	0.01	0.00	0.00	0.00
KUW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
KOR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.23	**0.00**	0.00	0.00	0.00	0.02	0.00	0.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
LAT	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.98	0.00	0.00	0.00	0.00	0.00	0.00
LIB	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.44	0.00	0.00	0.00	0.01	0.00	0.00	**0.23**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	0.09	0.04	0.00	0.15	0.00
MAL	0.12	0.14	0.00	0.00	0.00	0.00	0.00	0.21	0.00	0.00	0.09	0.24	0.01	0.00	0.00	0.00	0.08	0.00	0.00	0.06	**0.00**	0.00	0.00	0.00	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MAI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.32	0.00	0.00	0.00	0.00	0.00	0.00	0.43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.25	0.00	0.00
NET	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.64	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.36	0.00	0.00	0.00	0.00	0.00
POL	0.00	0.00	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03	**0.63**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.01	0.00
POR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
RUS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.81	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.02	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SAU	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.22	0.00	0.47	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.23	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SIN	0.00	0.00	0.00	0.00	0.00	0.63	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.03**	0.00	0.00	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SLO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.77	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.18	0.00	0.00	0.00	0.00	0.00	0.00
SPA	0.00	0.00	0.06	0.00	0.16	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.14	0.00	0.00	0.12	0.05	0.03	0.00	**0.05**	0.02	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SWT	0.00	0.00	0.00	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.41	0.38	0.09	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SYR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.44	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.12	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.09	**0.00**	0.00	0.00	0.34	0.00	0.00	0.00	0.00	0.00
TAI	0.02	0.06	0.00	0.00	0.00	0.03	0.08	0.00	0.00	0.00	0.00	0.45	0.00	0.00	0.05	0.13	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.07	0.00	0.01	0.00	**0.01**	0.00	0.00	0.01	0.00	0.00	0.00	0.00
TUR	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.29	0.00	0.00	0.00	0.00	0.00	0.19	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.44**	0.00	0.00	0.00	0.05	0.00	0.00
UKR	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.28	0.00	0.00	0.00	0.23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.23	0.00	0.00	0.00	**0.19**	0.02	0.00	0.00	0.00	0.00
UAE	0.00	0.96	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00	0.00
UK	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00	0.00	0.00
USA	0.05	0.00	0.00	0.06	0.00	0.00	0.00	0.07	0.00	0.00	0.06	0.17	0.00	0.00	0.00	0.31	0.00	0.00	0.00	0.09	0.00	0.00	0.00	0.00	0.04	0.00	0.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.07	0.00	**0.02**	0.00	0.00
VIE	0.00	0.00	0.00	0.00	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.12	0.00	0.00	0.00	0.66	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**0.00**	0.00
OTH	0.10	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.05	0.00	0.03	0.51	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.03	0.00	0.03	0.00	0.00	0.01	0.00	0.00	0.00	0.13	0.00	0.01	0.00	0.01	0.03	0.00	0.00	0.00	0.00	0.00	**0.00**

Note: Derived from Markov Chain analysis

Figure 37 Markov probability plot for Indian coffee exports during Period IV (2010-11 to 2019-20)

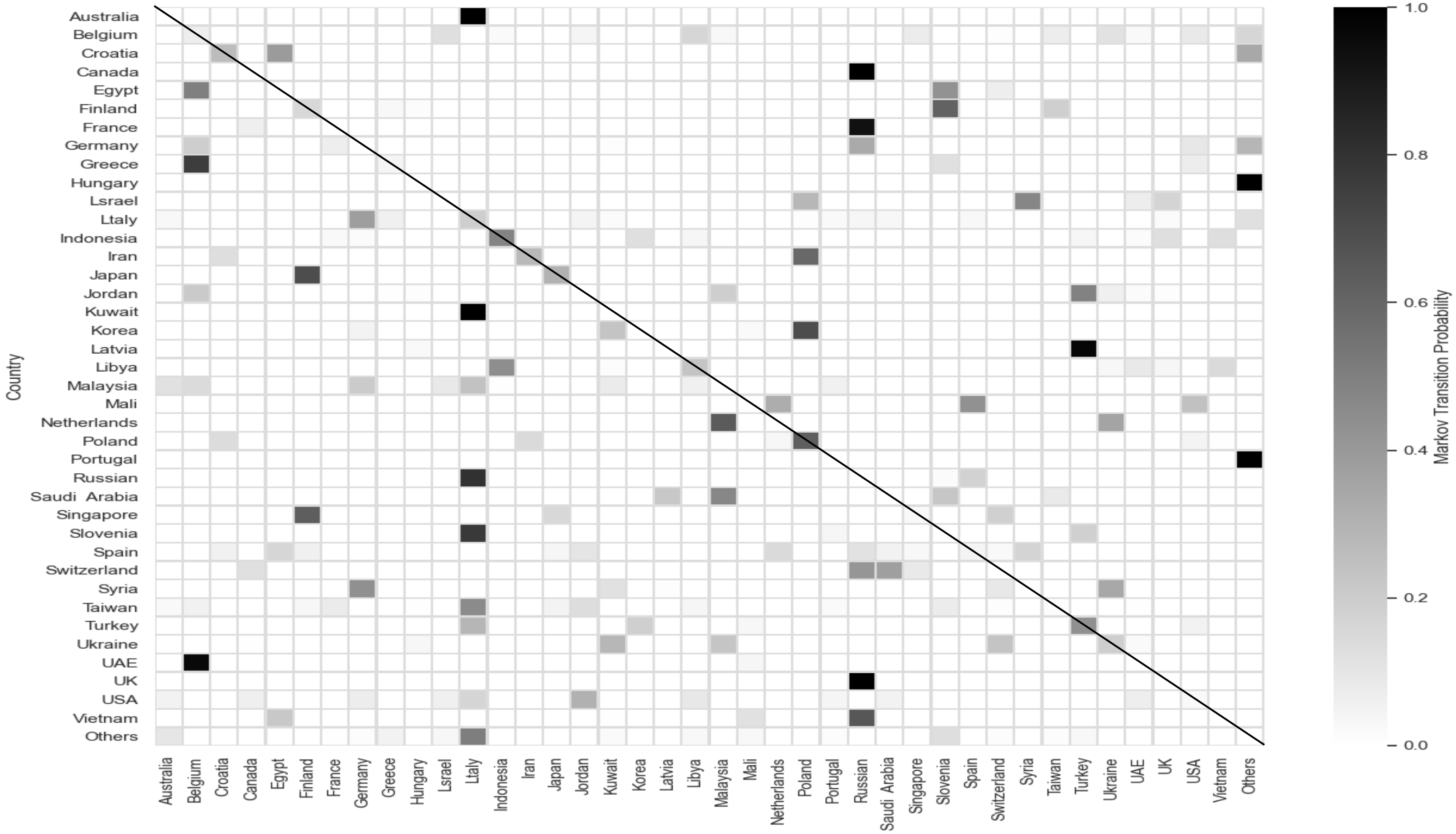


Figure 38 Markov retention probability plot for Indian coffee exports during Period IV (2010-11 to 2019-20)

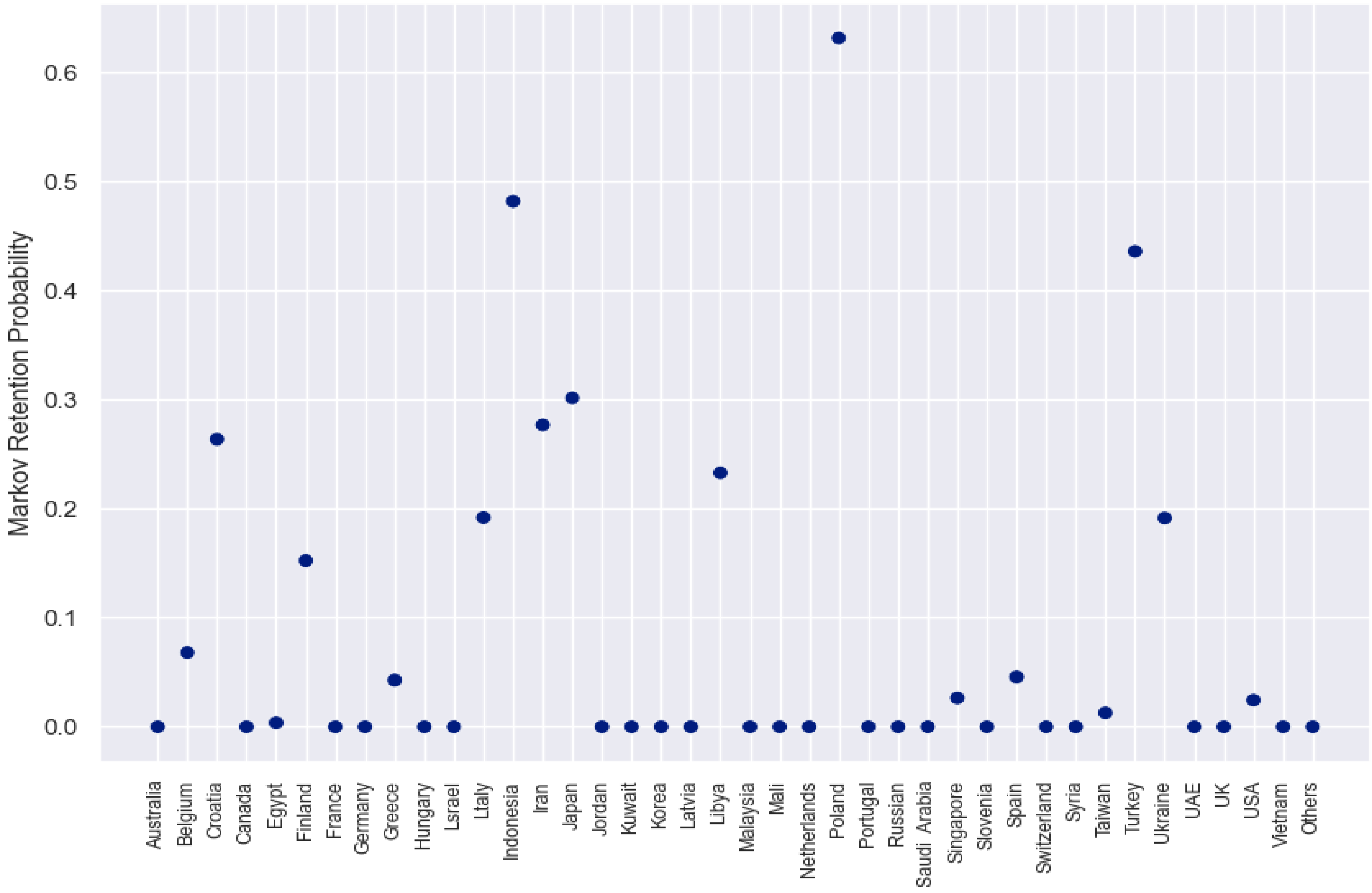


Table 4.91 Major export markets of Indian coffee in the order of decreasing stability

Period	**Countries**
Pre-WTO (1980-81 to 1994-95)	Russia (0.78), France (0.30), Germany (0.30), Belgium (0.29)
Post-WTO (1995-96 to 2019-20)	Germany (0.75), Italy (0.70), Japan (0.69), Ukraine (0.67), USA (0.66), Turkey (0.66), Hungary (0.60), Croatia (0.59), Libya (0.59)
Overall (1980-81 to 2019-20)	Germany (0.79), Italy (0.79), Belgium (0.78), Ukraine (0.75), Spain (0.72), Libya (0.72), Turkey (0.72), Hungary (0.70), Russia (0.65), Poland (0.63), Croatia (0.62), Japan (0.61), Iran (0.61), Slovenia (0.60), USA (0.57) Malaysia (0.56)
Period I (1980-81 to 1989-90)	Russia (0.68), Germany (0.56), Switzerland (0.54), Finland (0.47), Hungary (0.44)
Period II (1990-91 to 1999-20)	Belgium (0.68), Spain (0.64), Germany (0.51)
Period III (2000-01 to 2009-10)	Italy (0.70), Australia (0.33), Netherland (0.31)
Period IV (2010-11 to 2019-20)	Poland (0.63), Indonesia (0.48), Turkey (0.44)

Table 4.92 Dynamics in stability of export markets of Indian coffee

Period	Stable markets	Markets gained	Market lost
Pre-WTO (1980-81 to 1994-95)	Russia		
Post-WTO (1995-96 to 2019-20)	Germany, Italy, Japan, Ukraine, USA, Turkey	Japan, Ukraine, USA, Turkey, Hungary, Croatia, Libya, Finland, Malaysia, Poland, Netherland, Switzerland, Israel, UAE, Latvia, Slovenia, Singapore, Iran, Vietnam, Egypt, Kuwait, Taiwan	Portugal, Thailand, Spain, Jordan
Overall (1980-81 to 2019-20)	Germany, Italy, Belgium, Ukraine, Spain, Libya, Turkey, Hungary, Russia		
Period I (1980-81 to 1989-90)	Russia, Germany, Switzerland, Finland, Hungary		
Period II (1990-91 to 1999-20)	Spain, Belgium, Germany,	Spain, Belgium, Australia, Netherland, Slovenia, Israel	Switzerland, Hungary, USA
Period III (2000-01 to 2009-10)	Italy, Australia, Netherland,	Libya, Ukraine, UK	Spain, Belgium, Germany, Japan, Russia, Israel, Finland
Period IV (2010-11 to 2019-20)	Poland, Indonesia, Turkey,	Poland, Indonesia, Turkey, Japan, Iran, Croatia, Finland, Belgium, Greece, Spain, Singapore, USA	Australia, Netherland, Slovenia, UK

The stable markets were identified based on the diagonal elements of the transition probability matrices obtained from the Markov chain analyses. The horizontal elements for the specific country indicate the probabilities of losing the export markets by India and gained by the rest of the countries. The column values indicate the probabilities of gaining the export markets by India and probabilities of losing the markets by the rest of the countries. The results for different time periods are presented from Table 4.84 to Table 4.90. The graphical representation of transition probability matrices of Indian coffee exports to different export markets and the plots of the retention probabilities are presented from Figure 25 to Figure 38. The details of the stable markets for Indian coffee exports and the markets gained and lost by Indian coffee exports during the study period are summarised in Table 4.91 and Table 4.92.

In the pre-WTO period, Russia was found to be the most stable market for Indian coffee as its probability of retaining the previous period's market share was 79 per cent, while the group of 'others' was the second most stable market with 51 per cent probability retention, followed by France, Germany, Belgium and Portugal. Compared to the pre-WTO period, a significant change in the coffee trade was observed in the post-WTO period. India's minor coffee markets *viz*., Portugal, Thailand, Spain and Jordan were lost during the same period, and a large number of countries opened their trade windows for India's coffee trade. Germany emerged as the most stable market for Indian coffee with a retention probability of 75 per cent, while in the pre-WTO period, the retention probability for Germany was only 30 per cent. The Germany is considered to be the coffee giant without growing a single bean. Germany is the second largest exporting country of roasted coffee in the world, behind Brazil. About 98 per cent of the German imports of green coffee is from developing countries including India. Italy was the second most stable market in post-WTO period with a retention probability of 70 per cent. Japan, Ukraine, USA could be considered as the trustable or stable markets during the post-WTO period.

Russian Federation and Germany were the most stable export markets for Indian coffee during period I. Russia exhibited a retention probability of 76 per cent, while Germany exhibited a retention probability of 55 per cent during the same period. In period II, India lost stable markets like Switzerland, USA and Hungary and gained markets like Spain, Belgium, Australia, Netherland, Slovenia and Israel. Among the export destinations, Spain and Belgium were the most stable markets during the period II with retention probabilities of 65 and 60 per cent respectively.

The share of USSR in Indian exports declined in period II. Part of the reason for this decline was the collapse of the former USSR. The other main reason was that the breakdown of the ICA economic clauses and the export quota restrictions in 1989, which allowed India to freely export more quantities to ICA member countries. In the past, the export figures to the former USSR have been overstated to the extent that the exporters utilized the discounts offered for Rupee against US dollar within the India-USSR bilateral trade agreements, have conducted triangular trade and thus boosting the figures but not actual export to USSR (ICO, 2000).

Italy emerged as the most stable market for Indian coffee in period III, with a retention probability of 70 per cent. In period III, India gained three new markets *viz*., Libya, Ukraine and UK, while India lost Spain, Belgium, Germany, Japan, Russia, Israel, and Finland during period III. In period IV, Poland, Indonesia, Turkey were the most stable markets for Indian coffee with retention probabilities of 65, 49 and 45 per cent respectively.

Considering the country-wise export data during the overall period, Germany was the most stable export market with a retention probability of 80 per cent, while Italy and Belgium emerged as the second and third most stable markets. Even though India had an upper hand in loyal markets like Germany, Italy and Belgium, the country was facing stiff competition from low-cost producers like Uganda in these loyal markets. The transition matrix and depicted figures clearly indicate the increasing diversification of India’s coffee exports. India is not concentrating on any single market for more than 10 years and Indian coffee exporters are significantly finding new markets for export, thereby reducing the risk associated with coffee trade.

4.8.5 Competitiveness of Indian coffee exports

The export competitiveness of Indian coffee was assessed by estimating using the Nominal Protection Coefficient (NPC). The NPC measures the divergence between domestic price and international price of a commodity. The NPC helps to find out the level of protection and level of government interventions in the system.

The NPC value of less than one for a commodity indicates that the commodity is perfectly competitive and is worthy for export with its quoted price. In the pre-WTO period, Indian coffee exhibited an average NPC value of 0.92, which implies that Indian coffee was competitive in the international market, whereas in the post WTO period, Indian coffee exhibited an average NPC of 1.25, which indicates that price of coffee in India was higher than the international prices. The increase in domestic consumption demand and increasing cost of cultivation of coffee could be attributed to the increase in domestic prices of coffee (Tanuja, 2017). Among all the decadal periods, period I (before liberalization or Free Sale Quota policy) only exhibited an NPC value of less than one and these findings are in accordance to the findings of Naik (2018).

Table 4.93 Nominal Protection Coefficient (NPC) of Indian coffee

Year	NPC	Period II	NPC	Period III	NPC	Period IV	NPC
1980	0.63	1990	1.33	2000	1.37	2010	1.31
1981	0.78	1991	1.02	2001	1.15	2011	1.48
1982	0.92	1992	1.13	2002	1.06	2012	1.40
1983	0.78	1993	0.97	2003	1.09	2013	1.21
1984	0.68	1994	1.31	2004	1.15	2014	1.44
1985	0.78	1995	1.04	2005	1.29	2015	1.48
1986	0.88	1996	1.14	2006	1.17	2016	1.44
1987	0.83	1997	1.09	2007	1.16	2017	1.36
1988	0.83	1998	1.30	2008	1.26	2018	1.19
1989	0.87	1999	1.00	2009	1.36	2019	1.35

Table 4.94 Nominal Protection Coefficient (NPC) of Indian coffee in different periods

Year	NPC
Pre-WTO	0.92
Post-WTO	1.25
Overall	1.12
Period I	0.80
Period II	1.13
Period III	1.21
Period IV	1.36

Note: pre-WTO period from 1980-81 to 1994-95, post-WTO period from 1995-96 to 2019-20, Over-all period from 1980-81 to 2019-20, Period I from 1980-81 to 1989-90, Period II from 1990-91 to 1999-20, Period III from 2000-01 to 2009-10, and Period IV from 2010-11 to 2019-20.

Even though the average NPC value in post-liberalization period was greater than one, India's concentration on coffee export was with a focus on organic coffee and geographically specific speciality coffee, which fetch premium prices in the international market (Nagoor, 2010; Harbig, 2017) and the surplus production conditions that prevail in India in coffee sector also induce pressure on coffee traders to export coffee from India.

Summary and Conclusion

5. SUMMARY AND CONCLUSION

This study entitled "Coffee economy of Kerala-An analytical study" envisioned to estimate the economics of cultivation and marketing of coffee in Kerala, asses the implications of changes in prices at farm level and constraints in production, analyse the price behaviour, formation and transmission between Indian and international markets, study the magnitude and determinants of volatility in prices of coffee and analyse India's export performance and competitiveness in coffee trade.

The study on the economics of coffee cultivation revealed that the total cost of cultivation and production of coffee in Kerala state were ₹1,51,877 per hectare and ₹67 per kg respectively. The total establishment cost per hectare of coffee in Kerala was estimated as ₹4,22,696, while the costs incurred from the 1st to 4th year of establishment were estimated as ₹1,65,935, ₹75,198, ₹94,078 and ₹87,485 respectively.

The total cost incurred for maintaining coffee garden during the yield increasing phase was estimated as ₹93,251 per hectare, whereas in the yield stabilizing and declining phases, the costs were ₹1,04,872 and ₹74,379 per hectare respectively. The weighted average annual maintenance cost of coffee gardens during the yielding phase was ₹97,903 per hectare. The intensive use of chemical inputs and labour requirement throughout the year resulted in high cost of cultivation. In spite of this, coffee cultivation in Kerala state was found to be profitable, with farmers earning a net return of ₹41,652 per hectare. Increased awareness on judicious and optimum utilization of chemical fertilizers and effective subsidies for setting up of irrigation structures could enhance coffee production and reduce the cost of cultivation.

To study the economics of coffee marketing, various marketing channels were identified and the marketing costs, margins, price spread and efficiency for each channel were estimated. The major marketing channels identified for coffee were, Channel I: Farmer – Wayanad Social Service Society (WSS) – Consumer;

Channel II: Farmer – Village trader – Wholesaler – Upcountry wholesaler–Retailer–Consumer; Channel III: Farmer – Brahmagiri Development Society (BDS) – Consumer; Channel IV: Farmer – Exporter – Consumer; Channel V: Farmer – Exporter – Export agent – Consumer. Among the sample respondents, 52 per cent of the farmers sold their produce to WSS and produce from 19 per cent of the sample respondents were procured by BDS. Out of the 160 respondents, 21 per cent sold their produce to village traders. Only four per cent of the sample respondents sold their produce to exporters.

Among the different marketing channels, highest marketing cost was incurred in channel IV in which exporters employed high quality machines and sophisticated processes to maintain superior quality of the produce, which in turn resulted in higher marketing cost. The least marketing cost was observed in channel II, which was the longest marketing channel in the study area in which the products were sold in the domestic market itself and hence required only minimal processing. In channel I, WSS earned the maximum marketing margin of ₹138.88 per kg of coffee, whereas in channels II, III, IV and V, the highest marketing margins of ₹85 ₹162.5, ₹161.6 and 114.75 were earned by retailers, BDS, exporters and exporters respectively. From the estimates of marketing margin, it was clearly evident that all the market intermediaries were gaining sufficient income from coffee trade.

While considering all the five marketing channels, channel I with WSS had the highest producer's share in consumer rupee of 25.81 per cent. Almost all the channels showed similar values for producer's share in consumer rupee. The low producer's share in consumer rupee or the high price spread value indicates that even with the participation of cooperatives in coffee trade, the farmers were not getting a reasonable price, especially in comparison with the price paid by the consumers for coffee. The total marketing cost was found to be highest in channel IV, whereas the highest marketing margin was observed in channel II. Channel I showed the highest marketing efficiencies of 0.34 and 1.33, while using Acharya's approach and Shepherd's formula respectively, while it was found to be the lowest in Channel V. The study found that all the marketing channels were inefficient in coffee trade because farmers were getting only a very nominal portion of the price paid by the consumers. The higher marketing margin claimed by market intermediaries, lack of proper infrastructure, high concentration of market power in the hands of very few intermediaries and lack of transparency in price setting contributed significantly to the inefficiency in the marketing of coffee. It could be concluded that for the betterment of coffee farmers, transparency of the marketing system needs to be improved and farmer-oriented trade policies also have to be developed.

Among the eleven constraints confronted by coffee farmers of Kerala, low farmgate price of coffee constrained the farmers critically. The period of study also coincided with the lowest farmgate price during the last three years in the study area. The intermediaries were the winners in coffee trade and, they were found to grab a lion share of the price gains in the markets. The climatic aberrations or fluctuations were the second most important constraint in coffee cultivation. The irregular and inadequate blossom showers (rainfall at the time of flowering) and backing showers (rainfall at the time of fruit setting) led to lower yield and most of the farmers reported quality deterioration of coffee beans due to fluctuations in temperature. The per day rate of wages ranged between ₹500 and ₹600 in coffee farmsteads during 2020. While comparing with other coffee growing areas in India, the wage rate was very high in Kerala, in turn resulting in higher production cost in the state. Most of the sample farmers reported the high wage rate prevailing in Wayand as one of the major constraints in coffee cultivation. The farmers in the study area were also affected by the fluctuations in coffee prices. The period of the study also coincided with the lowest quoted farmgate price for coffee in the last three years. The increase in input price was also reported as a constraint in coffee cultivation, which directly increased the cost of production. The market conditions made coffee cultivation increasingly difficult and caused shift from coffee to more profitable and low risk crops like black pepper. The constraints like labour shortage, diseases and pest incidences, wild animal attack, lack of government support and non-availability of quality planting materials of coffee also significantly affected coffee cultivation in Kerala.

The implication of price changes on farm level decision making was notably observed during the study. The farm level decisions affected by changes in farm gate prices in the short run were decision on labour, inputs and other additional benefits given to the permanent labourers. The farm-household level decisions affected by price changes were decisions on health care expenses, savings and borrowings. Coffee is a perennial plant, with 30 years of economic life and hence, most of the farmers took decisions on area allocations or changes in area only based on the age and productivity of the coffee plants. Hence, it could be concluded that the price volatility was not a determining factor in short run on the area allocation decisions of coffee farmers. Kerala economy is a labour-oriented economy and the labour wages in the study area were predetermined due to better bargaining power of the labourers and the wages were not changed according to the changes in farmgate prices. So, the price volatility has no direct role in wage determination. The decisions on food and educational expenses were also not affected by the volatility of coffee prices in the study area.

Considering the overall time period from 1994 January to 2019 December, the highest intra-annual price volatilities were observed for ICE New York futures market price in rupees and Arabica plantation price in US dollars in Hyderabad, with volatility indices of 7.47 and 7.56 respectively. The general patterns visible in both international and Indian markets were that of decreased volatilities in second and third periods in comparison to the first period. Few exceptional trends were observed as in the case of ICO indicator price of Robusta in rupees, and London futures price in rupees as well as US dollars. In these three series, a nominal increase in price volatility was seen in period II when compared to period I. There were no significant variations between intra-annual price volatility indices for coffee prices in Rupees and US Dollar. A high intra-annual price volatility could be observed for most of the price series during the period from 1994 to 1999 period (Period I), which could be attributed to the effects of liberalization. After the trade liberalization in

Indian coffee, the extremity in intra-annual price volatility of coffee prices have considerably reduced. But the seasonal nature and rapid expansion of production capacity in producing countries and slow growth of global consumption results in Intra-annual volatility in the system. In general, it could be concluded that the coffee prices show high intra-annual price volatility and this makes short term market predictions difficult.

The inter-annual price volatility of coffee prices was estimated by using the Parkinson's index. The highest inter-annual price volatility in domestic market was observed in Hyderabad market for Arabica coffee, whereas the highest inter-annual price volatility in international market was observed for New York futures market prices. While comparing the estimated inter-annual price volatility value in period I, II and III it could be observed that in general an increasing trend was observed in inter-annual price volatility from period I to III. With increased trade liberalization and integration with the world market, the year-to-year fluctuations in coffee prices have increased in both international and Indian markets and the intra-annual volatility exhibited similar patterns in both the markets.

As similar to the intra-annual price volatility, the high inter-annual price volatility was attributed to the increased integration of international market with the domestic coffee markets after the trade liberalization in 1990. In addition to the implications of trade liberalization in inter-annual price volatility, the frequent production surpluses in the producing countries like Brazil, Vietnam and India, depreciation of currencies of the producing countries against US Dollars and involvement of speculative investors in the international market also have influenced the inter-annual price volatility of coffee.

The Cuddy-Della Valle index and Coppock's instability index were used to analyse the instability in annual coffee prices. As per the CDV index, during the overall period in domestic market, Arabica coffee prices in Bangalore had relatively high instability, whereas in the international market, London futures market price exhibited relatively high instability. A similar trend in instability was also observed for prices in US Dollar also. In the domestic market, all the price series have shown an increase in price instability from period I to period II and then a decrease in period III. In the international market, with the exception of ICO indicator price of Arabica coffee, all the price series have shown increasing trend in the CDV index from period I to II and subsequently, a decline in period III. It was also observed that the prices in both Rupee and US dollar have exhibited similar trends in instability throughout the study period.

Similar to the CDV index, all the market prices have exhibited high Coppock's instability indices during the study period. During the period from 1994-95 to 2019-20, Robusta coffee prices in Chennai market showed a relatively lower instability, whereas the Arabica coffee price in Bangalore market had the highest value for the instability index. During the same period, in the international market, the London futures market price exhibited the maximum instability, while it was lowest for the ICO composite indicator price. With the exception of few estimates of instability indices, all the market price series expressed a general trend of increasing instability from period I to II, subsequently declining in period III. While comparing CDV index and CII, it could be inferred that with minimal exceptions, the instability estimated using both the indices have shown similar pattern of highly unstable coffee prices in national and international markets during the study period. In comparison with the price instability of other crops, coffee prices in domestic as well as international market have exhibited high price instability throughout the study period. Hence, it could be concluded that coffee prices are highly unstable in the international as well as Indian markets and this trend was reflected even in the domestic wholesale prices as well as the farmgate prices. The existence of high instability was due to the increased market integration, technological development and uninterrupted information flow from international market to the domestic market, especially after liberalization.

To discuss about statistical significance as well as persistence of volatility in coffee prices, a GARCH (1,1) model was fitted for all the price series in domestic as well as international markets. All the GARCH (1,1) models fitted for coffee prices were statistically significant and validated with Ljung Box and, LM Arch tests. Most of the domestic as well as international price series of coffee have exhibited a high to very highly persistent and significant price volatility. In some of the cases, the volatilities were highly explosive, which could be attributed to the unavailability of coffee in the international market as the result of lower production in producing countries due to weather related constraints such as frost and drought and, sudden export policy shifts. All the GARCH estimates indicated the persistence of high volatility in coffee market in the post-liberalization era. While considering the period from 1994 to 2019, it could be concluded that a relative decrease in price volatility and significance were also observed in some of the price series. It was due to the increased production and improved inventory management at domestic markets as well as the importing countries. This situation reduced the pressure on volatility, which in turn led to a decline in significance of price volatility. The findings of the GARCH analyses clearly point to the significant and persistent volatile nature of coffee prices in both Indian and international markets.

A linear regression model was fitted and step-wise regression analysis was employed to understand the factors contributing to price volatility in domestic coffee markets. Among the 18 independent variables, eight independent variables were chosen for the fitted linear regression model after step-wise regression analysis. Among the eight, only six independent variables were found to be statistically significant. The adjusted R2 value of 0.76 indicates that the 76 per cent of the variation in volatility in coffee prices in India could be attributed to eight independent variables included in the model.

The iterated regression estimates of the variable, Indian production indicated that one unit increase in production (one metric ton) from the mean level would result in 3.56 units (per cent) change in wholesale price volatility of coffee from the mean level. Similarly, a one unit (metric ton) increase in consumption from the mean level was found to increase the price volatility by 1.41 per cent. The present study, thus confirmed the direct implications of production and consumption changes on volatility of coffee prices in India. A one unit increase in temperature (oC) in the first and third quarters were found to result in 8.08 and 2.79 per cent change in coffee price variability. The second and fourth quarter relative humidity (per cent) and fourth quarter rainfall also were found to have significant implications on price volatility. A one unit increase in fourth quarter rainfall was found to decrease the price volatility. Similarly, the second quarter relative humidity also was found to cause a decline in price volatility by 7.45 per cent, whereas a one percent increase in the fourth quarter relative humidity was found to result in 1.92 per cent increase in price volatility. Other than market factors, climatic factors such as rainfall, temperature and relative humidity had significant implications on price volatility of coffee. The Rupee-US dollar exchange rate in the specified model was also found to be having significant effect on volatility of coffee prices. A unit increase in exchange rate (value of Indian rupee against US dollar) was found to cause a 2.42 per cent decline in price volatility. It could be concluded that the volatility in prices of Indian coffee is significantly influenced and dependent on various factors such as production and consumption of coffee, weather parameters and currency exchange rates.

The formation as well as the behavior of coffee prices and the extent as well as direction of price transmission between Indian and International markets of coffee prices were studied. Regarding the behaviour of monthly coffee prices, while comparing Robusta and Arabica prices, it could be observed that all the price series were moving in unison during the study period. The ICO composite indicator price acted as mean price which demarcated Arabica and Robusta coffee price movements. While analyzing the behaviour of prices in different sub-periods, it could be concluded that, compared to period I and II, both Arabica and Robusta coffee prices have shown increasing divergence during period III. As any other agricultural commodity, coffee is also seasonal in production and hence the prices of coffee exhibited considerable seasonality throughout the study period. The seasonality indices of coffee prices exhibited a general pattern of increase in domestic markets during the month of June to September which was coincided with a decreasing trend of the seasonality indices in the international market and this pattern also coincided with the winter season in Brazil and monsoon season in Kerala. The consumption of coffee peaks during colder, winter months and dips during summer months and these consumption patterns also had significant implications on seasonal nature of coffee prices. Coffee prices also exhibited cyclical patterns in both Indian and international markets.

The stationarity tests results revealed that for the overall period, all the price series in rupees and US dollars were non-stationary at levels and stationary at first difference. The study confirmed the co-integration or movement of all the coffee price combinations in domestic as well as international market, with the exception of the combination of Robusta cherry price in Hyderabad market with London futures market prices during the overall period. The transmission of price signals between Indian and international markets were also confirmed for period I, II and III. Thus, the price of coffee in one market was found to be having considerable influence on the prices prevailing in the other market. In general, almost all the coffee markets in India were cointegrated or move together with international markets. The study also confirmed the existence of strong co- movement of prices between the markets of coffee within the country. The findings indicate that the liberalization reforms, subsequent measures and technological revolution have led to effective and spontaneous transmission of price signals between international and domestic market and between the domestic markets, resulting in high integration of the coffee markets.

Multiple cointegration analysis of all the combinations of market prices in dollars as well as rupees in all the time periods, except very few have exhibited at least two co-movement among prices. The transmission of price signals and integration of markets depends on various factors such as presence of tariff barriers, degree of protection and border and domestic policies after liberalization and Free Sale Quota (FSQ). Reduction in these trade barriers as well as policy changes have led to better integration and transmission of prices between the markets in the post-WTO period. The price series of coffee in different markets were moving together in almost all the periods considered. Even though there is price variation among different varieties of coffee, the overall demand for the commodity in the domestic market is irrespective of its quality and variety, which in turn could be the reason for the co-movement of prices in different markets of coffee.

The Error Correction models confirmed the presence of short-run disequilibrium in different price series of coffee and the statistically significant coefficients in all the cases implied that the series were once in disequilibrium and the system tries to come back to its equilibrium state with varying speed of adjustments in different time periods. As higher value of error correction term indicates higher rate of adjustment towards equilibrium, the speed of convergence for short-run price movements to become stable along the long-run equilibrium path was found to be increasing during the overall period. This could be attributed to the outward market orientation of coffee and liberalization has considerably influenced the market integration in coffee. In most of the cases of integration with international prices, the international markets exhibited better information flow and quick adjustment of short-run disequilibrium than the domestic markets. Among the domestic markets, coffee prices in Chennai market exhibited better information transmission and quick adjustments during the overall study period. The study revealed that there were effective transmissions of coffee price signals between international and domestic market, and in between domestic markets resulting in high integration of the markets.

The Granger causality test provides additional evidence as to whether and in which direction, the price transmission occurs between two price series. Arabica coffee price and composite indicator price in ICO market significantly granger caused Arabica coffee price in all the three domestic markets. A significant price signal transmission from ICO market to domestic market was observed. A bi-directional causation was also observed between New York futures market with Bangalore and Chennai Arabica coffee markets, whereas the Hyderabad Arabica coffee prices was found to be unidirectionally granger caused by New York futures market. The Arabica coffee price in Bangalore market granger caused Arabica coffee price in Chennai as well as Hyderabad markets, whereas the Arabica coffee price in Chennai market was also granger caused by Arabica coffee price in Hyderabad market. The causality in Robusta coffee price was found to be similar to that of Arabica coffee prices.

During the overall study period, a general trend of price signal transmission from international market to domestic market was observed for coffee prices in rupees as well as US dollars. In very few cases, the study found a bi-directional price transmission, possibly due to the comparative dominance of India in the international coffee market. India, the fifth largest producer of coffee in the world, could influence the international coffee prices through its export and import decisions. But the severe competition from traditional as well as emerging coffee growers and, high price of Indian coffee in the international market and less motivated exporters have constrained the performance of Indian coffee in the international market. These factors could possibly explain the inefficiency of India to transform price signals from domestic market to the international market throughout the period.

The export performance and competitiveness of Indian coffee were analysed by growth and instability models, diversification indices, decomposition models, Markov chain analysis and Nominal Protection Coefficient (NPC).

The Compound Annual Growth Rates (CAGR) of quantity exported and export value were 4.42 and 10.37 per cent respectively. It could be observed that the growth in value of coffee exports from India was contributed mainly by growth in unit value rather than quantity in the overall period. The Indian coffee exporters achieved a growth of 4.67 per cent in quantity, 8.39 per cent in value (`) and 3.55 per cent in Unit value (₹/kg) during the pre-WTO period, where as in the post-WTO period, the exports exhibited a comparatively lower growth. The second decade including the liberalization period showed the highest growth in export quantity, value as well as the unit values. Among the four decades, the third decade exhibited a significant negative growth in quantity exported as this period was severely affected by climatic fluctuations like inadequate rainfall in coffee belts and frequent droughts, ultimately reflecting as retarded growth in production as well as export. In addition, competitions from high quality coffee produced in Brazil and Colombia and cheap quality coffee from Vietnam and Indonesia in the world market, induced retardation of 1.93 per cent in third decade. Even with heavy competition from Nepal and Vietnam in EU market, the fourth decade was hopeful for Indian coffee exporters, and the coffee exports achieved a growth of 2.52 per cent in export quantity and 4.62 per cent in export value. The growth in unit value of coffee exports in Indian rupee was 5.69, while in US dollar it was 6.25 per cent during the forty-year period from 1980-81 to 2019-20. The trade liberalization has opened wide opportunities to the Indian coffee farmers and exporters, but due to climatic aberrations, bottlenecks in export business including quality issues, and heavy competition from traditional as well as emerging coffee growers and traders in the international market, overall growth of Indian coffee sector was adversely affected. Even with all these constraints, India still stands as the major coffee producer and exporter in the international market.

The change in average value of exports of coffee from India between two years or periods could be attributed to the changes in mean export unit value and export quantity, their interaction and the changes in quantity-unit value covariance. The increase in mean export value of coffee in the post-WTO period as compared to the pre-WTO period was mainly due to the changes in mean export unit value and it occurred even when there was a negative change or decline in mean export quantity. While comparing with change in mean export unit value, other sources of growth such as change in export quantity, interaction between change in mean export quantity and mean export unit value and change in export unit value covariance were negligible.

In all the study periods, including pre-WTO and post-WTO periods, exports of coffee from India exhibited similar level of instabilities. While comparing the different periods, it could be observed that the export value and unit value exhibited high instabilities in the pre-WTO period, whereas the quantity exported exhibited a constant lower instability in both pre-WTO and post-WTO periods. A reduction in the instabilities of the export values in the post-WTO period could be attributed to the decline in the unit value instabilities in the same period. The instability in quantity exported could be because of the policy shifts including the changes in the policy of interference by Coffee Board in export activities, the instability in value and unit value could be due to increased competition in trade and volatility in exchange rate of rupees against US dollar.

The stability in the export value of coffee was assumed to be affected by ten components of change and 83 per cent of increase in the variance of export value in the post-WTO period in comparison with pre-WTO period was attributed to the changes in variability of export unit value followed by a significant contribution of 24 per cent change in the covariance between export quantity and export unit value. In all the segmented study periods, changes in variance of export value significantly contributed by change in variance of export unit value. The changes in the variance of export unit value could be considered as the core factor caused the major changes in variance of export value between period I and II. More than 96 per cent of the change in variance contributed by the same one, where in period II & III and III & IV the same component contributed the lion share of change in variance of export value by 67 and 76 per cent respectively. Considering other components attributing change in variance of export value, the change in variance of export quantity contributed a reduction in variance by 7.5 per cent in pre-WTO and post-WTO period, change in variance of export quantity have a stabilizing effect on the system.

A significant difference was observed between the geographic concentration indices of coffee exports from India during the pre-WTO and post-WTO periods and the values of index in the whole period ranged from 25 to 66. The pre-WTO period was found to be having an average Hirschman Index value of 59.24, which indicates that the Indian coffee exports were highly dependent on few importing countries or few international markets, which in turn increased the risk and instability in the income earned from exports. After liberalization, the diversity of markets as well as the market access significantly improved, and it could be observed that the mean HI values reduced to 31.10. The lower HI values indicate that India coffee exports were getting increasingly diversified after liberalization and were in a relatively better position than in the pre-WTO period. Considering the whole study period from 1980-81 to 2019-20, it could be concluded that coffee exports from India was intensively diversified after liberalization as those policies opened up wider opportunities and increased access for Indian coffee in international market. The policy changes (Free Sale Quota and liberalization policies) which were initiated in coffee trade have reflected in the HI values. The International Coffee Agreement (ICA) with economic clauses, were constrained India's export allocation in pre-WTO period which reflected in our over dependency on former USSR, for export. This was changed with the collapse and disintegration of the former USSR and breakdown of the ICA economic clauses and the export quota restrictions in 1989 allowed India to freely export more quantities to ICA member countries during and after liberalization.

The structural change in export of coffee from India or the dynamics in the direction of export and the changing pattern of export to different destinations were analysed using the Markov chain model. In the pre-WTO period, Russia was found to be the most stable market for Indian coffee as its probability of retaining the previous period's market share was79 per cent, followed by France, Germany, Belgium and Portugal. Compared to the pre-WTO period, a significant change in the coffee trade was observed in the post-WTO period. India's minor coffee markets viz., Portugal, Thailand, Spain and Jordan were lost and during the same period, a large number of countries opened their trade windows for India's coffee trade. Germany emerged as the most stable market for Indian coffee with a retention probability of 75 per cent, while in the pre-WTO period, the retention probability for Germany was only 30 per cent. Italy was the second most stable market in post-WTO period with a retention probability of 70 per cent. Japan, Ukraine, USA could be considered as the trustable or stable markets during the post-WTO period. Considering the country-wise export data during the overall period, Germany was the most stable export market with a retention probability of 80 per cent, while Italy and Belgium emerged as the second and third most stable markets. These probability values indicate the increasing diversification of India's coffee exports and India is not concentrating on any single market for more than 10 years and Indian coffee exporters are significantly finding new markets for export, thereby reducing the risk associated with coffee trade.

The Nominal Protection Coefficient (NPC) measures the divergence between domestic price and international price of the commodity. In the pre-WTO period, Indian coffee exhibited an average NPC value of 0.92, which implies that Indian coffee was competitive in the international market, whereas in the post WTO period, Indian coffee exhibited an average NPC of 1.25, which indicates that price for coffee in India was higher than the international prices. The increasing labour cost in the cultivation of coffee and increasing consumption demand could be attributed to the increase in domestic prices of coffee. Among all the decadal periods, period I (before liberalization or Free Sale Quota policy) only exhibited an NPC value of less than one. Even though the average NPC value in post-liberalization period was greater than one, India's concentration on coffee export was with a focus on organic coffee and geographically specific specialty-coffee which fetch premium price in the international market and the surplus production conditions that prevail in India in coffee production also induce pressure on coffee traders to export coffee from India.

Policy implications

The policy recommendations based on the present study are as follows:

- Conducting awareness as well as training programmes in the coffee growing regions on the use of chemical inputs could help in judicious, economic and optimum usage of chemical inputs, without affecting the soil health. This would in turn help in improving the quality of the commodity and reduce the cost of cultivation, which in turn could increase the export competitiveness of Indian coffee.

- Providing enhanced irrigation subsidies at a reasonable rate to the farmers would help them to cope with the climatic constraints such as inadequate and irregular rainfall and also increase the yield of coffee.
- The problem of price volatility and inefficient marketing could be overcome by price stabilization measures and improved transparency in the marketing system. A market intelligence system with emphasis on price forecasting and proper training of the farmers on the use of market intelligence in making decisions on period of storage, place and time of sale are needed to tackle the wide volatility in coffee prices and to ensure a stable income for the coffee farmers.
- The farmers should be helped to move up in the value chain by encouraging value addition and branding of coffee at the farm level or by the formation of Producer Cooperatives or Farmer Producer Companies.
- In order to promote the export of coffee and improve India's competitiveness, farmers should be encouraged to produce high quality coffee. India needs to develop trade policies after duly considering the needs of the stable export markets and also try to gain entry into non-traditional export markets.

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COFFEE ECONOMY OF KERALA-AN ANALYTICAL STUDY

By

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(2018-21-045)

ABSTRACT OF THE THESIS

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Doctor of Philosophy in Agriculture

(Agricultural Economics)

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KERALA, INDIA

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ABSTRACT

Coffee is considered as the favourite drink of civilized world and the second largest traded commodity after petroleum. For many nations in the tropic, coffee is a major source of foreign exchange. India is the third largest producer and exporter of coffee in Asia. The trade liberalization policies have brought challenges as well as opportunities for plantation crops including coffee because of the increased integration of the country with the world, with serious implications for price stability and trade competitiveness.

In this context, the present study was undertaken with the objectives; to study economics of coffee cultivation and marketing, asses the implications of changes in prices at farm level and constraints in production, analyse the price behaviour, formation and transmission between Indian and international markets, study the magnitude and determinants of volatility in prices of coffee and analyse India’s export performance and competitiveness in coffee trade.

The total cost of cultivation and production of coffee in Kerala state were estimated as ₹1,51,877 per hectare and ₹67 per kg respectively, while the net return was worked out as ₹41,652 per hectare. The major marketing channels identified for coffee were, Channel I: Farmer-Wayanad Social Service Society (WSS) - Consumer; Channel II: Farmer-Village Trader-Wholesaler- Up-country Wholesaler-Retailer-Consumer; Channel III: Farmer-Brahmagiri Development Society-Consumer (BDS); Channel IV: Farmer-Exporter-Consumer and Channel V: Farmer-Exporter-Export Agent-Consumer. Majority of the farmers (52 per cent) sold their produce to the WSS, while 21 per cent farmers sold to village traders. The marketing efficiency was relatively high in channel I because of the highest producer’s share in consumer’s rupee, while it was lowest in channel V.

The changes in farmgate prices of coffee influence the farm level decisions of coffee farmers by affecting their decisions on inputs, special benefits provided to farm labourers, health care expenses, savings and borrowings. Among the

constraints faced by coffee farmers, low farmgate price, climatic issues and lack of irrigation facilities were critically constraining coffee cultivation in Kerala.

The intra-annual volatility of Indian and international monthly prices of coffee declined marginally in period II and III, while the inter-annual volatility of Indian and international monthly prices of coffee increased in period II and III. The results of the instability analysis in annual coffee prices showed that the magnitude of volatility indices have increased in period II, while it decreased in period III. The determinants of price volatility of coffee were identified as production and consumption at national level, Rupee-US Dollar exchange rate and climatic factors such as temperature, rainfall and relative humidity.

The co-movement between the coffee prices in the Indian and international markets was confirmed in period I, II and overall periods, while there was decreased integration in period III. The Error Correction Model (ECM) indicated the presence of short-run disequilibrium between the Indian and international prices, which got corrected with varying speeds of adjustment. The Granger causality tests confirmed that the price transmission was from international market to Indian market in the long-run.

The rate of growth and instability in coffee export decreased in the post-WTO period as compared to the pre-WTO period. The export unit value contributed 108.20 per cent growth in the export value of coffee between pre- and post-WTO period. Nearly 83 per cent of change in the export value variance between pre- and post-WTO period was found to be due to the changes in the variability of export unit value variance.

The geographic concentration of coffee exports from India was high in pre-WTO period, while it decreased in the post-WTO period. There was a changing pattern in the stable export markets for Indian coffee and Germany, Italy and, Japan were found to be the most stable markets in the post-WTO period. The Nominal Protection Coefficient (NPC)) was greater than one (1.25) in the post-WTO period, indicating lower export competitiveness of Indian coffee.

The challenges in coffee cultivation can be addressed by implementing awareness programmes on optimal input usage and providing irrigation development subsidy to the farmers. A market intelligence system with the crop specific price stabilization mechanism is needed to tackle the high volatility in coffee prices. A stable income for coffee farmers could be ensured by value addition and branding of coffee at the farm level or in cooperative lines. More transparency is required in the marketing channels to reduce the asymmetric information flow to the farmers. In order to promote the export and improve India's competitiveness, farmers should be encouraged to produce high quality coffee at reduced cost and the country also needs to formulate trade policies for stable export markets and develop strategies for entry into non-traditional export markets.

Appendices

APPENDIX I

Survey questionnaire

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Coffee economy of Kerala-An analytical study

(Abhinav, M.C. 2018-21-045)

<u>This information is gathered for the purpose of research work of the PhD programme in KAU and the data will be kept strictly confidential</u>

<u>Interview Schedule</u> **Block:** **Panchayath:**

1 Name of the respondent :

2 Address & Contact Number :

3 Age :

4 Experience in farming (Years) and experience in coffee cultivation :

5 Family details and consumption :

Sl No	Member (code)	Age	Education (code)	Occupation (code)		Annual Income	
				Primary	Secondary	Primary	Secondary

Code for member	Codes for education	Codes for occupation
1 Head of the HH 2. Spouse 3. Unmarried child 4. Married child 5. Son/Daughter in law 6. Grand child 7. Parents 8. Father/Mother/ in laws 9. Others	1. Primary or less 2. Upper primary up to secondary 3. Secondary passed but have no Degree 4. Degree holders general 5. Degree agriculture 6. Other Professional degree (specify)	1. Farming 2. Employed in State /Central Govt. 3. Employed in Semi Govt. Aided school/college, co-operative /local administrative bodies 4. Employed in Private sector 5. Self employed 6. Unpaid family work 7. Agricultural labour 8 Animal husbandry/diary/poultry/ fishing/ 9. Labourers in non-agric. Sector 10. Job seekers 11. Student 12. Pensioners, too old to work/ handicapped 13. Employed abroad

6. Details of the Land Holding:

Area of Operational Holding (ha)

Total area	Owned – with title deed (pattayam)	Owned – without title deed	Leased-in (From which year)	Leased-out (From which year)	Monocrop coffee			Mixed crops	Other monocrop
					Total area	Mature plants (Nos.)	Immature plants (Nos.)		

7. Details of non-crop/Allied activities:

Sl No	Activities	Area/No	Annual maintenance expenses	Gross returns
1	Dairy			
2	Poultry			
3	Fish farming			
4	Self-employment			
5	Others			

8. Cropping Pattern:

Sl.No.	Crop	Variety - Local/HYV	Area
I	Perennial Crops		
Mono-crop – Specify Pre-bearing / Peak-bearing / Over-aged – denote age			
Mixed –crop			
II Annual Crops			

If replanting of over-aged plants not done, reasons for that

9. Production and Price of coffee

Year / Crop	**2021**	**2020**	**2019**
Quantity Produced / Sold Average Price Peak Price Lowest Price			

10. Cost of Cultivation of Coffee

Fixed inputs	Year of purchase	Initial cost (Rs)	Present cost (Rs)	Useful life (years)
Land value				
Farm building				

Machinery and equipment's	Quantities	Year of purchase	Initial cost	Subsidy (if any)	Maintenance cost	Useful life (years)

Rental value of land	
Land revenue	
Interest on fixed capital	
Interest on working	

Age of plantation: Start of commercial year:

Wage Rates (Rs./day): Male………….. Female…………. Special wages: ……………………

Change in wages in last few years:

Change in input prices in last few years:

Changes in cultivation cost:

	2019	2020	2021
Area:			
Production (Qtls)**:**			
Price (Rs/ Qtl)**:**			

Particulars	Input		Human labour					
			Hired labour		Family Labour		Total labour cost	
	Nos	Cost	Nos	Amount	Nos	Amount	Nos	Amount
Establishment cost								
Land preparation								
Irrigation								
Digging of pits& filling up of pits								
Planting material (coffee)								
Planting material (shade tree)								
Staking or pegging								
Hutting								
Maintenance cost								

Gap filling								
Planting material (coffee gap filling)								
Planting material (shade tree gap filling)								
Manure								
Fertilizer								
Plant protection chemicals								
Weeding								
Pruning/Training								
Harvesting								
Processing								
Land tax/cess								
Other expenses								
TOTAL								

* Establishment cost: For total establishment to be converted to annual share

11. Implication of price change on farm level decisions on

Price change (%) / Implications	**Area**	**Labour**	**Wage**	**Input application**	**Savings/ Borrowings**	**Food /Health/ Education expenses**
-50						
-25						
0						
25						
50						

Code for decision making:
0-No change 1-Increase 2-decrease

12. Replanting, land improvement and others (last five years)

Activity	Extent of coverage	Total expenditure	Amount of subsidy & Source	Year
Replanting (number of plants)				
Replanting (No. of plants) – Shift to other crops				
Land improvement (area)				
Irrigation (area)				
Farm machinery				
Any other investment				

13. Details on Marketing:

Farm Level Details			
1		Main mode of Disposal	
2		Total Marketed Quantity	
3		When do you sell the produce? (Code 1. During harvest 2. Later)	
4	a.	To whom/where do you sell the produce?	
	b.	Reason	
5		Distance to the market and auction centre	
6		Any market charges (commission/brokerage)	
7		Mode of Transport and cost incurred	
8		Do you sort/grade produce? (Code: 1. Yes 2. No) If yes, where do you get it done?	
9		Do you own a cardamom curing/polishing facility? (Code: 1. Yes 2. No) If no, distance to curing house	
10		Cost incurred in curing	
11		Price received per kg	
12		Mode of Payment	
13		Storage	
(i)		Time period of storage	
(ii)		Method of storage	
(iii)		Cost of Storage	
(iv)		Other remarks	
14		Loading and unloading charges	
15		Transport charges	
16		Other charges if any	
17		Source of information on price	

14. Known marketing channel through which produce reach ultimate consumer

15. Production Constraints

Ranking of Constraints		
Sl No	**Problems**	**Rank**
1	Price volatility	
2	Climatic issues (Inadequate rainfall & increase in temperature)	
3	Labour shortage	
4	High wage rate	
5	Low price of produce	

6	High input cost	
7	Irrigation problems	
8	Disease and pest incidence	
9	Non availability of planting material/quality material	
10	Lack of government support	
11	Wild animals attack	

16. Other details:

a. Are you member of any producer organization / Cooperative / SHG

b. Any contractual agreement of selling of the produce. If yes, since which year?

c. How the price is determined

d. Is there any incentive/bonus

17. Participation in social groups

Sl no	**Social group**	**Yes (tick marke)**
1	SHG/Co-operative society	
2	NGOs	
3	FPOs	
4	Agricultural group in social media	
5	Coffee cluster	
6	Agricultural magazines	
7	Agricultural training programmes	
8	Political party	

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INTERVIEW SCHEDULE FOR INTERMEDIARIES

1. Name and address of respondent:
2. Age:
3. Sex:
4. Type of market intermediary:

   Village merchant/ auction agents/wholesaler/ retailer/ exporter

5. No of years of experience in cardamom trading:
6. Main product(s) dealt with:
7. Quantity (volume) of transaction/year:
8. Do you have any shop or stall for marketing the produce?
9. Place of operation:
10. From whom you mostly purchase?
11. Mode of purchase:
12. Quantity purchased/ year:
13. Average price paid/unit:

14. Purchase place and distance from market:

15. Mode of transport:

16. Transporting charges:

    Details (in case of export: fright charges, tariffs etc.)

17. Loading and unloading charges:

18. Processing charges if any (Mention the processing done) :

19. Packaging cost:

20. Storage cost:

21. Average loss in handling:

22. Brokerage:

23. Other expenses:

24. Average retention time:

25. To whom the product sold:

26. Mode of sales:

27. Market fee:

28. Other charges:

29. Price received /kg:

30. Known marketing channel through which produce reach ultimate consumer:

31. Challenges faced:

APPENDIX II

Details of secondary data with source and duration

Particulars	Period	Sources
Annual and monthly domestic and international prices of coffee	1994-95 to 2019-20	Coffee Board (www.indiacoffee.org)
Country wise export of coffee	1980-81 to 2019-20	Coffee Board (www.indiacoffee.org) World Integrated Trade Solution (wits.worldbank.org) International Coffee Organization (www.ico.org)
Country and state wise area, production and productivity of coffee in India and Kerala	1980-81 to 2019-20	Coffee Board (www.indiacoffee.org)