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# Destination And Direction of Pakistan's Textile Exports: An Application of Hidden Markov Chain Approach

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**Abstract:** *The research uses the Hidden Markov Chain Approach to determine Pakistan's textile exports' direction, destination, and prospect. The study is based on the period between 2013-2022. The compound annual growth rate (CAGR) and Instability Index extract the direction and destination of Pakistan's textile exports. At the same time, we use the Hidden Markov Chain Approach for the prospects of Pakistan's exports because it shows the potential of the exports concerning the rest of the world. The study results showed that pullover jerseys, cotton towels, and dyed fabric have favorable growth rates and have great potential to increase future export volume. The results also revealed that pullover jerseys, boys' trousers, and cotton towels have much more potential to find new export markets. Based on the results of the present study it is recommended that policy makers should find out the reasond of negative CAGR of cotton yarn, Boy's Trousers, Women's Trousers, and Bedlinen as some of the products have the scope to meet international demand.*

**Keywords:** Textile sector exports, Hidden Markov Chain Approach, CAGR, Instability Index

## 1. Introduction

Pakistan's manufacturing industry mainly relies on its textile industry. The dominant manufacturing sector contributes around 12.01% of the country's GDP. Among the group-wise analysis of large-scale manufacturing, the textile sector has an overall weight of 18.16%. During FY 2023, the textile sector faced a dip of 16% as compared to 3.23% in the financial year (FY) 2022. Pakistan is the 4th largest producer of cotton with the third largest spinning capacity, whereas the spinning sector is the backbone of Pakistan's textile industry(Arshad & Muykhtar, 2019; Ali et al., 2019; Iqbal et al., 2010). Throughout the assessment period spanning FY 2013-2017, Pakistan's export figures exhibit a consistent year-on-year decline, with a notable downturn reflecting a negative compound growth rate of 4%. Throughout the assessment period spanning FY 2013-2017, Pakistan's export figures exhibit a consistent year-on-year decline, with a notable downturn reflecting a negative compound growth rate of 4%.

The textile industry currently needs more raw materials and challenges due to limited access to foreign exchange for importing essential machinery, causing delays in the production process (Gereffi & Frederick, 2010; Naik, 2020; Iran & Sohail, 2021; Khalid, 2022). Numerous textile firms have halted production, and exports face challenges until conditions return to normal (Khan et al., 2020; Alzahrani & Salah, 2020;

Mufti & Ali, 2022; Wang, 2023). The textile and apparel industry plays a pivotal role in Pakistan's economy, with the most extensive forward and backward linkage to other sectors compared to any other industry. PES 2022-23 shows that it contributes approximately 60% of total exports and 40% to industrial employment.

During July-March FY 2023, the textile group's exports experienced a decline of 12.4%, reaching US$ 12.5 billion compared to US$ 14.2 billion in the corresponding period last year. Our textile sector faces energy shortage, high electricity tariffs, elevated financing costs, and a global slowdown.

Moreover, recent floods have destroyed cotton crops, posing severe industry challenges (Mordecai & Akinsola, 2021; Andreou, 2021; Jaleel, Noor, & Abbasi, 2023). China's zero COVID policy opens up new export opportunities for other countries (Fang et al., 2022). Bangladesh has taken full advantage of this, while Pakistan's domestic economic challenges prevent it from fully capitalizing on this opportunity. Another area for improvement is the time it takes to export goods. It takes about 5 to 6 months to import raw materials, process them, and re-export them, which is much longer than Bangladesh's 1 to 2 months turnaround time.

As per the Pakistan Economic Survey 2022-23, the primary export markets for Pakistan are the USA (19%), China (8%), Afghanistan (4%), United Kingdom (7%), Germany (6%), UAE (5%), Bangladesh (3%), Italy (4%), Spain (5%), France (2%), and other countries (39%). Regarding Pakistan's major exports, cotton manufacturers held a 62% share in 2017-18, which decreased to 59% in 2020-21 and has remained consistent at 59.3% in 2021-22 and 59.3% in July-March 2022-23. Leather exports, accounting for a 4.2% share in 2017-18, declined to 3% in 2021-2022 and increased to a 3.2% share in 2022-23. The third major export is rice. These three textile items collectively contributed to around 68% of Pakistan's major exports in 2022-23.

The primary goal of this study is to determine the direction and destinations of Pakistan's textile exports. The study aims to compare the findings with real-time data, utilizing Volza's global data for a comprehensive analysis. The study also seeks to analyze the switching pattern of textile exports and find a stable market for Pakistan's textile.

## 2. Literature Review

The literature review indicates that most of the research has focused on the Indian economy. Each author has employed the same technique to analyze various products. Guledgudda et al., (2014) examined the export performance of Indian Cashewnut using Markov chain analysis. They observed tough competition from Vietnam and Brazil in importing cashew kernels to India. The result of the Transitional Probability Matrix revealed that the USA was one of the stable countries among major importers of Indian cashew kernels, as indicated by a high retention probability of 70%. Australia also had a high % retention probability of 50%, considered a stable market. They also found that India's major competitors in the world market were Vietnam, Brazil, Indonesia, and Tanzania.

Kusuma and Basavaraja (2014) conducted a study on stability analysis of India's mango export market for ten years from 2001-02 to 2010-11. They used the Compound growth rate to analyze growth in mango production, area, yield, export quantity, and value. They used Markov chain analysis to examine the result using the Transitional Probability Matrix. The result revealed that Bangladesh, the UK, and the UAE are stable markets because of their high retention value. In contrast, Nepal and Saudi Arabia are considered unstable markets for Indian mango exports. They also suggested that efforts are needed to improve the efficiency of production and quality to stabilize the market.

Beeraladinni et al., (2016) analyzed the Stability of Indian raw cotton exports. They used the Markov Chain Approach to use secondary data for ten years, ranging from 2005 to 2015. The compound annual growth rate result suggested a significant positive impact on growth in the area, production, and productivity of raw Indian Cotton. Their results highlighted that China, Bangladesh, Vietnam, and other countries,

including Hong Kong, Thailand, and Malaysia, were stable markets for Indian raw cotton exports. On the other hand, Pakistan, Turkey, Taiwan, and Indonesia were unstable markets. They also concluded that China's raw cotton imports were declining from India, so India was not very dependent on China. India had to concentrate on Bangladesh, Vietnam, and Taiwan, whose shares were expected to increase in the future. They also highlighted that India needs to establish a world-class manufacturing unit to increase the production of finished products, which will improve.

Manjunath et al., (2017) analyzed the direction of trade and the changing pattern of India's export of marine products. The study was based on secondary data from 2006-2015. They used Markov Chain analysis to find the structural change and direction of trade in India's marine product exports. They found a positive compound annual growth rate in value and volume terms. The result of the Markov chain suggested that the European Union, South East Asia, and China are stable importers of Indian Marine Products. They also indicated that government efforts are needed to promote exports to these countries by stabilizing the market.

Shilpa et al., (2017) assessed the trade performance of poultry products in India. They used the Markov chain approach for this purpose. They used secondary data from the period 1991-2011. They found exports of poultry meat had increased drastically after 2010. The results of the TPM showed that India's exports of poultry products to Afghanistan were retained at 36%.In comparison, the other 64% were diverted to Germany and other countries. Regarding imports, Brazil's market maintained 46%, and the remaining 54% was shifted to the Netherlands. They suggested measures were taken up to international standards and other measures to increase livestock exports.

Devi et al., (2019) examined the direction and destination pattern of Indian mango and mango pulp exports by using Markov chain analysis. They explored growth dimensions, instability, sources of growth, and variability of mango and mango pulp exports with India's major importing countries. They used secondary data for 30 years, starting from 1987 to 2016. This result highlighted that UAE and Kuwait were stable markets for fresh mango, and Saudi Arabia, UAE, and the Netherlands were stable for mango pulp. They also predicted that the quantity of mango exported to countries like KSA, Kuwait, and the UK would increase.

In contrast, the amount exported to UAE, Bangladesh, and other countries was expected to decline from 2016-17. The forecasting of mango pulp revealed that in terms of quantity, its exports to the UK, UAE, Netherlands, and USA would rise, and the amount exported to KSA and other countries would decline. They also suggested more concentration on export promotion to tap the potential and strengthen existing units by giving more access to information on modern technology, etc.

Maharjan and Grover (2019) attempted to analyze the compound growth rate of pulse exports and imports and examined the change in the direction of pulse trade in India. They used secondary data for the period between 2001-15. The compound growth rate represents positive and significant Value in Imports, while the growth rate declined in the case of the export of Pulses over the decades. The result of TPM revealed that India was not retaining the import of pulses to Tanzania compared to Canada and Myanmar because of more than 50% of their retained value. While TPM also revealed the export result of Indian Pulse, UAE, and Sri Lanka were loyal to customers of Indian Pulse export.

Bagal et al., (2020) analyzed the export of spices from India using the instability index. They used secondary data for 17 years varying from 2000-01 to 2016-17. The study showed a significant growth in spices exports from India during the study period. The annual compound growth rate of Indian spices exports accounted for 23.84% at 5% significance level. The instability index for export quantity from India for all continents was 51.82%. They found instability in exports during study periods for all world continents. Also, they observed that instability indices for export values at current and constant prices were also unstable on all continents of the world.

Gogoi et al., (2022) analyzed the export performance of bamboo products in India using the Markov Chain method. The result was based on secondary data from 2009 to 2018. The study revealed that the Compound annual growth rate of bamboo products was 32%. The result of the Markov chain showed that the major countries that import Indian bamboo-based products are Bhutan, Bangladesh, the USA, UAE, and Nepal. TPM revealed that the stable market for Indian Bamboo poles was Bhutan and Bangladesh, and Bamboo Charcoal was in Bhutan. The steady market for bamboo polywood was Nepal, and the regular import for bamboo paper-based products was UAE. HC and Srivastava (2020) studied the trade direction of the export of FCV tobacco from India. They collected secondary data on observed variables for a period ranging from 2010-11 to 2015-16. They used first-order Markov chain analysis for their study. The result revealed that West Europe and Africa, followed by North and South America, are loyal importers of unmanufactured tobacco from India. Meanwhile, they suggest that India does not depend upon these markets but needs to diversify its market.

Yeledhalli and Soumya (2021) conducted a study on Australian wool export stability analysis. They used data from 2008 to 2017. They used different data analysis tools, such as compound annual growth rate, Cuddy-Della Valle index, and Markov chain. They found the growth rate in terms of quantity was negative, but in terms of value, it was positive, where the instability index was low in terms of quantity and medium in terms of value. The Markov chain analysis showed that China was a stable market for Australian wool exports. They suggested that Australia needed to diversify its wool exports.

Sunil and Singh (2021) examined structural change in India's groundnut export market. They used secondary data for ten years, from 2009-10 to 2019-20. They used the Markov chain approach for the desired results. The result shows that Malaysia and Russia are stable markets for Indian groundnut exports. Traditional importing countries such as Indonesia and Thailand were considered unstable markets. Other markets, such as the Philippines, Vietnam, Ukraine, and UAE, are the most inconsistent for Indian groundnut imports. They concluded that groundnuts or peanuts are the most essential and significant oilseed of India, and there is an opportunity for stakeholders to invest more in the Indian groundnut trade.

Suman et al., (2022) investigated the growth, stability, and competitiveness of sugar and cotton exports from India. They used secondary data from 2001-02 to 2019-20. They used compound annual growth rate, instability index, and Balassa index, which revealed a comparative advantage for this analysis. The result showed that sugar and cotton exports from India to the world increased by 13.54% and 26.93% per annum, with a high instability index of 48.66 and 47.80 percent during the study period. The result also revealed that for cotton exports, all destinations were found to have positive and significant growth. India's total sugar imports from Brazil supplied around 80% during the study period, registering the highest and most influential 62%, with the most elevated instability of 75%.

Chavan et al., (2023) analyzed the trade directions of Indian basmati rice exports. They used a period from 2010 to 2022 and obtained secondary data from APEDA. They used the Markov chain approach to analyze the data. Their study found that the export of Indian basmati rice increased in quantity over the study period because of strong demand in the international market and other prominent reasons. The growth rates revealed that Iraq and Iran showed the highest growth rates in terms of both quantity and value of exports, while the UAE had high stability. The study also revealed that UAE and Saudi Arabia are stable markets for Indian basmati rice exports, with probability retention of around 76% and 55%, respectively. At the same time, the UK was an unstable market with zero retention probability.

Moreover, the study showed that basmati rice exports increased over time and were a competitive export product. They also suggested that the government had to improve processing facilities, transportation facilities, and quality

maintenance to facilitate the export of Indian basmati rice. Zahid et al., (2023) analyzed the direction and destination pattern of mango exports from Pakistan by using Markov Chain analysis. Their study investigates the importation patterns of top importers of Pakistan's mango exports, such as UAE, Oman, Saudi Arabia, United Kingdom, and Qatar. This research was based on secondary data from 2017 to 2022. The result based on the Transition Probability Matrix revealed that in terms of quantity, Pakistan Will mainly rely on the UAE and others.

The literature review suggests that relatively few studies have been conducted on Pakistan. The present study has been designed to fill this gap by analysing trends and dynamics of Pakistan's textile exports, which share the most significant part of Pakistan's exports.

## 3. Methodology

### 3.1 Data Source

The data on textile variables are collected and compiled from the Pakistan Bureau of Statistics. This is time-series data spanning the period from 2013 to 2022. The analysis encompasses seven textile products: cotton yarn, pullovers and jerseys, boys' trousers, women's or girls' trousers, bed linen, towels, and dyed cotton fabrics.

### 3.2 Description of Variables

#### 3.2.1 Cotton Yarn

The product with HS Code 52051200 is cotton yarn measured in kilograms (KG). Pakistan's major product export countries are China, Bangladesh, Turkey, Hong Kong, and Portugal, whereas the rest of the world is categorized as other countries.

#### 3.2.2 Pullover, Jerseys

Products like jerseys, pullovers, and related products made of cotton are categorized under HS code 61102000. Pakistan mainly exports items to the Netherlands, Spain, the USA, the UK, Italy, and other countries (the rest of the world). These items are measured in Dozens.

#### 3.2.3 Boys Trousers

The products with HS code 62034200 are boys' trousers made of cotton. Pakistan's major product export partners are Belgium, Italy, Netherlands, Norway, and Germany, whereas the rest of the world is under other countries. Its unit of measurement is a dozen.

#### 3.2.4 Women/Girls Trousers

The Products with HS Code 62046290 are Women's or girls' cotton trousers. Pakistan's major exporting countries are France, Germany, Poland, Spain, and the USA, whereas other countries include the rest of the world. Its unit of measurement is a dozen.

#### 3.2.5 Bed Linen of Cotton

The products with HS Code 63023190 are cotton bed linen. Pakistan exports bed linen Cotton to Belgium, France, Germany, the USA, and the UK, whereas other countries include the rest of the world. Its unit of measurement is kilogram (KG).

#### 3.2.6 Cotton Towels

Towels made up of cotton came under HS Code 63026010. Pakistan mainly exports towels to Italy, Spain, the USA, UAE, and the UK, whereas other countries, including the world, exclude these. Its unit of measurement is Kilogram (KG).

#### 3.2.7 Dyed Cotton Fabrics

Dyed fabrics made of cotton came under HS Code 60062200. Its unit of measurement is a square meter (SQM). Pakistan exports this product mainly to Bangladesh, Haiti, Kenya, Sri Lanka, and UAE, whereas the rest of the world comes under other countries' categories.

### 3.3 Compound Annual Growth Rate

The Compound Annual Growth Rate (CAGR) in textile exports assesses the yearly expansion of a country's exports. Various authors, including Gogoi et al. (2022), Meali (2021), Irfan & Sohail (2021), Yeledhalli and Soumya (2021) and Sun & Chang (2020) have employed this method to compute the annual growth rate. The exponential function of the following form estimates the CAGR.

$$y = ab_t$$

Y represents variables for which the growth rate is calculated, such as exports of textile products.

t = time variable

It takes the form when applying log

log Y = log a + t log b

It can also be written as

$$lnY = lnb_0 + b_1 lnt$$

The Compound Annual Growth Rate (CAGR%) is obtained as:

$$CAGR\ (\%) = (Antilog b_1 - 1) * 100$$

**3.4 Instability Index**

The extent of variability in terms of quantity and value of exports can be determined using the Cuddy-Della Valle (CDV) Index. This is because a simple coefficient of variation overestimates the level of instability in time series data, but CDV corrects the Coefficient of variation. Many authors, like Cizakca (2024), Gogoi et al. (2022) and Yeledhalli and Soumya (2021), used this index to capture the instability of variables.

The following formula can calculate the CDV index.

$$CDV\ (\%) = C.V * (\sqrt{1 - adjR^2})$$

Where,

CDV = Cuddy-Della Valle Index

CV = Coefficient of Variation, and it can calculated by the ratio of Standard Deviation to Mean

CV = Standard Deviation/ Mean Value

$AdjR^2$= Adjusted $R^2$

**3.5 Assumption of HMM**

1. Markov property: The system's future state depends only on the current state and is independent of the past states, given the current state.
2. Hidden states: The export behaviour of the countries is represented by a set of hidden states that are not directly observable.
3. Emission sequences: The observed export data are emissions the underlying hidden states generate.
4. Stationary process: The transition probabilities between states and the emission probabilities remain constant.

**4. Results and Discussion**

**4.1 Compound Annual Growth Rate (CAGR)**

The compound annual growth rate (CAGR) is the average compound growth rate for the duration. The compound annual growth rate is different from the growth rate because the growth rate is a linear measure that does not factor in compound growth. Simply put, CAGR is a subject's mean annual growth rate over a period longer than one year. The formulation

and procedure to calculate CAGR are discussed in Chapter 3. The results of the compound annual growth rate are discussed in Table 1.

**Table 1 Compound Annual Growth Rate**

| Product Name | Product Code | CAGR/Quantity | CAGR/Value |
|---|---|---|---|
| Cotton Yarn | 52051200 | -7.793 | -2.104 |
| Pullover, Jersey (Cotton) | 61102000 | 8.798 | 21.665 |
| Boys Trouser | 62034200 | -5.400 | 0.208 |
| Girls /Women Trouser | 62046200 | -16.946 | -12.580 |
| Bedlinen of Cotton | 63023190 | -11.388 | 3.897 |
| Cotton Towels | 63026010 | 2.314 | 9.7109 |
| Dyed Cotton Fabrics | 60062200 | 6.370 | 19.770 |

Source: Author's Calculation

When the compound annual growth rate of product export is positive, it means that over time, the product export value and quantity increase on average. The product is gaining popularity in the international market and increasing revenue. However, the negative compound annual growth rate is the opposite. The product export value and quantity have, on average, been decreasing. A negative CAGR suggests that the product might be losing its demand in the international market and facing competition and challenges.

Table 1 represents the compound annual growth rate of respective textile products in terms of quantity and value. The textile products with HS Code 61102000, 63026010, and 600622 have a positive growth rate in terms of quantity and value, while the textile products with HS Code 52051200 and 620462 have a negative growth rate in terms of both quantity and value. The textile products with HS Code 61102000 and 60062200 have the highest growth rate in terms of value, 21.66% and 19.77%, respectively. The same two products also have the highest growth rates in quantity, 8.79% and 6.37%, respectively. The Products with HS Code 62034200 and 63026010 have negative growth in quantity and positive value growth.

Pakistan is struggling with many problems; as an agricultural country, Pakistan is facing natural uncertainties such as climate threats, floods, drought, etc. The main problem with cotton productivity is some pets, like cotton bollworms and pink bollworms, which badly affect cotton yield. That is why we can also consider the negative growth rate of bed linen. Cotton is the raw material, while readymade garments like boy's or girl's trousers are the final product. The top exporters of readymade garments around the world are China, Bangladesh, Vietnam, Italy, and Germany are leading exporters of readymade garments; in the case of women's trousers, the share of Pakistan's in world exports is only 0.02%, which is too low as compared to other countries.

### 4.2 Instability Index

The instability index is the measure to check whether the product is stable or not. For this purpose, we use the Cuddy Della Valle Index. Proper formulation and procedure are described in Chapter 3. Result inferences are based on the calculated value. Values between 0-15 represent low instability, values between 16-30 indicate medium instability and values greater than 30 indicate higher instability. Results of the Cuddy Della Valle instability index are shown in Table 2.

**Table 2: Cuddy Della Valle Instability Index**

| Product Name | Product Code | Quantity | Value | Inference |
|---|---|---|---|---|
| Cotton Yarn | 52051200 | 12.93 | 14.40 | Low Instability in Quantity and Value |
| Pullover, Jersey's | 61102000 | 24.81 | 29.77 | Medium Instability in Quantity and Value |

| | | | | |
|---|---|---|---|---|
| Boys Trouser | 62034200 | 17.55 | 23.87 | Medium Instability in Quantity and Value |
| Girls /Women Trouser | 62046200 | 28.93 | 33.88 | Medium Instability Quantity and High Instability Value |
| Bedlinen of Cotton | 63023190 | 54.79 | 49.17 | High Instability in Quantity and Value |
| Cotton Towels | 63026010 | 6.36 | 19.87 | Low Instability in Quantity and Medium Instability in Value |
| Dyed Cotton Fabrics | 60062200 | 29.55 | 54.69 | Medium instability in quantity and High instability in value |

Source: Author's calculations

The result shows that cotton yarn with HS code 52051200 has low instability because the value of both quantity and value lies between 0 and 15. The product is medium unstable if the value lies within 16-30. If the value is greater than 30, it is precarious. Pullovers and Jerseys with HS code 61102000 have medium instability in quantity and value, as the value is more than 15 and less than 30. Boy's trousers with HS code 62034200 have medium instability in quantity and value. Girl's trousers with HS code 62046200 have medium instability in quantity and high instability in value. Bedlinen of Cotton with HS code 63023190 has high instability in both quantity and value. Cotton towels with HS code 63026010 have low instability in quantity and medium instability in value. Dyed fabrics Cotton has medium instability in quantity and high instability in value.

The stability of the product depends upon the demand for that product when demand for the product increases in the international market. High and medium levels of instability represent the variation in demand in respective products. As in the case of cotton bed linen, it shows high instability. It shows that the product is in higher demand and that countries are trying to produce more. The case of cotton yarn that has low instability represents that Pakistan is a cotton-producing country and faces intense competition. Also, its productivity, exports, and prices are somehow stable.

### 4.3 Result of Hidden Markov Chain Analysis

The Hidden Markov Chain is based on the assumption of the Markov chain, but it also considers some hidden states or factors while analyzing results. Seven textile sector products with the HS Code are analyzed, and the results of the Transition Probability Matrix are given in the tables below.

#### 4.3.1 Cotton Yarn (HS Code: 52051200)

The transition Probability Matrix is estimated using hidden Markov chain analysis, and its result interpretations are discussed in Table 3.

**Table 3 Transition Probability Matrix Cotton Yarn**

| | China | Bangladesh | Turkey | Hong Kong | Portugal | Other countries |
|---|---|---|---|---|---|---|
| China | 0.0016 | 0.34 | 0 | 0.4475 | 0 | 0.2109 |
| Bangladesh | 0.2111 | 0.785 | 0 | 0.0039 | 0 | 0 |
| Turkey | 0.9852 | 0.0001 | 0.0034 | 0.0103 | 0.0008 | 0.0003 |
| Hong Kong | 0.0032 | 0.7023 | 0.2926 | 0.0014 | 0.0004 | 0 |
| Portugal | 0.1824 | 0.8095 | 0 | 0.0072 | 0.0006 | 0.0004 |
| Other countries | 0 | 0.0198 | 0.0005 | 0.841 | 0.1387 | 0 |

Source: Author's calculations

Pakistan exports cotton yarn (HS Code 52051200) to China, Bangladesh, Turkey, Hong Kong, Portugal, and the rest of the world. The values in the diagonal represent each country's retained value to Pakistan. Each row represents

the loss of market share with each competing country, While the column represents the gain of market share from each competing country. According to the above Transition Probability matrix, diagonal values represent retaining each country. Bangladesh is much more stable than Pakistan in terms of cotton yarn exports, and countries like China, Turkey, Hong Kong, and Portugal are not as durable. In the future, Pakistan lose its market with them.

The analysis of each row and column explores the direction and destinations of Pakistan's cotton yarn exports. China lost 34% of its market to Bangladesh, 44% of its Market to Hong Kong, and 21% of its market share to other countries. On the other hand, China gained 21% of the market share from Bangladesh, 98% from Turkey, and 18% from Portugal. Bangladesh lost 21% from China and gained market share from China, Hong Kong, and Portugal; their shares are 34%, 70% and 80% respectively. Turkey lost 98% of its market share from China and gained 29% of its Market share from Hong Kong. Hong Kong Lost 70% of its market share to Bangladesh and 29% to Turkey.

On the other hand, Hong Kong will gain Market share from China and Other Countries with 44% and 84%, respectively. Portugal will lose 80% of its market share to Bangladesh and 18% to China. Portugal will gain 13% of its Market Share from other countries. Other countries will lose 84% to Hong Kong and 13% to Portugal, while Portugal will earn 21% from China.

According to the latest figures of Volza's Pakistan that were updated on 25 May 2023, the top 3 exporters of cotton yarn are Vietnam with 117,632 shipments, followed by Pakistan with 14,771 shipments, and Turkey with 5,847 shipments worldwide. The top importers are China, Bangladesh, Vietnam, Macao, Turkey, Portugal, South Korea, Italy, Germany, Netherlands, Hong Kong, Japan, and Poland.

Pakistan is the 2nd largest exporter of cotton yarn. Bangladesh is considered a stable market for Pakistan's cotton yarn exports, but there is a need to explore other countries to export cotton yarn. According to the latest figures of Pakistan's Volza Data, updated on 23 May 2023, Pakistan is exploring a new market for cotton yarn export, Japan.

### 4.3.2 Pullover, Jerseys Cotton (HS Code 61102000)

The transition Probability Matrix is estimated using hidden Markov chain analysis, and its result interpretations are discussed in Table 4.

**Table 4: Transition Probability Matrix Pullover, Jersey Cotton**

| Transition Probability Matrix | | | | | | |
|---|---|---|---|---|---|---|
| | Netherland | Spain | USA | UK | Italy | other Countries |
| Netherland | 0.003 | 0 | 0 | 0 | 0.991 | 0.006 |
| Spain | 0.393 | 0.426 | 0 | 0.000 | 0.176 | 0.005 |
| USA | 0.0073 | 0.427 | 0.001 | 0.565 | 0 | 0 |
| UK | 0 | 0.775 | 0.167 | 0.058 | 0 | 0 |
| Italy | 0.990 | 0 | 0 | 0 | 0 | 0.010 |
| other Countries | 0.143 | 0 | 0 | 0 | 0.694 | 0.162 |

Source: Author's calculation

Pakistan exports Jersey Pullovers made of cotton (HS Code 61102000) mainly to the Netherlands, Spain, the USA, the UK, Italy, and some other countries. Suppose we see the diagonal values that retain values and describe each country's loyalty. Spain will be much more loyal to Pakistan's exports of Jersey and Pullover because it owns 42% of the Market share.

In the future, the Netherlands will lose 99% of its market share to Italy and gain 39% from Spain, 98% from Italy, and 14% from other countries. Spain Will lose 39% of its Market Share from the Netherlands and 17% from Italy.

Spain Will gain its Market Share from the UK and USA, 77% and 42% respectively. The United States will lose its market share from Spain and the UK with probability values of 42% and 56%, respectively, and will gain 16% of its market share from the United Kingdom. The UK will lose 77% from Spain and 16% from the USA and will earn 56% from the USA. Italy will lose 98% of its market share to the Netherlands, While it will gain its market share from the Netherlands and Spain with probability values of 99% and 17%, respectively.

The top 3 exporters of Pullover Jerseys (HS Code 61102000) are Vietnam with 673307 Shipments, followed by Bangladesh with 629643 shipments and China with 402788 Shipments. Other emerging export competitors are India, Indonesia, Spain, Turkey, and Pakistan. Pakistan has only 46415 export shipments. According to the latest information, Pakistan exports Products with HS Code 61102000 to Vietnam, the United States, and Indonesia. The top importers of these products are India, the United States, Chile, South Korea, and Bangladesh. Vietnam, Indonesia, Costa Rica, Hongkong, United Kingdom, Germany. Italy, Netherlands, Japan, Spain, and Australia are also importers but have less demand than top importers.

#### 4.3.3 Boy's Trousers (HS Code: 62034200)

The transition Probability Matrix is estimated using hidden Markov chain analysis, and its result interpretations are discussed in Table 5.

**Table 5: Transition Probability Matrix Boy's Trousers**

| | Belgium | Italy | Netherland | Norway | Germany | other |
|---|---|---|---|---|---|---|
| Belgium | 0.0962 | 0 | 0.1279 | 0.0056 | 0.0016 | 0.7686 |
| Italy | 0.1349 | 0 | 0 | 0.0029 | 0.8076 | 0.0547 |
| Netherland | 0.0012 | 0.0341 | 0.9626 | 0 | 0.0021 | 0 |
| Norway | 0.0006 | 0 | 0.0205 | 0.0003 | 0.0001 | 0.9785 |
| Germany | 0.001 | 0.092 | 0.8838 | 0.023 | 0.0002 | 0 |
| other | 0.0028 | 0.0001 | 0.3188 | 0.002 | 0.0025 | 0.6738 |

Source: Author's calculation

Pakistan exports Trousers made of Cotton (HS Code 620342) to Belgium, Italy, Netherlands, Norway and Germany. The Netherlands and some other countries are the most stable market for Pakistan exports of Boy's Trousers, with retaining values as shown by the diagonal at 96% and 67%, respectively. The Transition Probability Matrix revealed that Belgium will lose 76% of its market share from other countries and 12% from the Netherlands. Belgium will gain 13% of its market share from Italy. Italy will lose 80% of its market share from Germany and 13% from Belgium. Italy will gain 9% from Germany, and Italy will not gain much from any of the countries and lose its confidence in Pakistan's cotton trousers exports, which is the most unstable market. The Netherlands will lose its market share from Italy (3.4%), but it's not as much, and it will gain 88% of its market share from Germany and 31% from other countries. Norway will lose 97% of its market share from other countries, will not gain too much from other countries, and lose its confidence in Pakistan's exports of the relevant textile products. Germany will lose 88% of its market share from the Netherlands and will gain 80% of its market from Italy. Other countries will lose 31% of their market share from the Netherlands, and they will gain 76% of their market share from Belgium and 97% from Norway.

According to Volza's Pakistan export data, the top 3 world exporters of the product HS Code 62034200 are Bangladesh, with 829,804 shipments, followed by India, with 388,329

Shipments and Spain, 121,082 shipments. Other exporting countries are China, Sri Lanka, the United Kingdom, Pakistan, Turkey, Brazil, and Italy. Pakistan is the 7th largest exporter of these products, with shipments of around 55,318.

The top countries that import are the United States, the United Kingdom, Germany, Italy, the Netherlands, Spain, Uruguay, Guatemala, France, and the United Arab Emirates. The retention probability of other countries shows that, in the future, Pakistan will search other markets for exports. According to the latest data from Volza, Pakistan exports data reveal that Pakistan now exports its products with HS Code 62034200 to the United States, United Kingdom and Germany.

#### 4.3.4 Girl's / Women's Trouser (HS Code 62046200)

The transition Probability Matrix is estimated using hidden markov chain analysis, and its result interpretations are discussed in Table 6.

**Table 6 Transition Probability Matrix Girl's / Women's Trouser**

| | France | Germany | Poland | Spain | USA | other |
|---|---|---|---|---|---|---|
| France | 0.000 | 0 | 0 | 0 | 0 | 1 |
| Germany | 0.0082 | 0.000 | 0 | 0 | 0.9918 | 0 |
| Poland | 0 | 0.8611 | 0.000 | 0.1389 | 0 | 0 |
| Spain | 0 | 0 | 0 | 0.000 | 1 | 0 |
| USA | 0 | 0 | 0 | 0 | 0.000 | 1 |
| other | 0 | 0 | 1 | 0 | 0 | 0.000 |

Source: Author's calculation

Pakistan exports trousers HS Code (62046200) mainly to France, Germany, Poland, Spain, and the USA. Diagonal Values show neither country can retain Pakistan's exports (HS Code 62046200). In the future, Pakistan will have to depend upon new markets for its exports of women's trousers. If we analyze rows and columns to observe the movement of exports from country to country, France loses its share to other countries worldwide, and France gains nothing from competing countries. Germany will lose 99.18% to the USA and gain 86.11% from Poland. Poland will Lose 13.89% to Spain and 86.11% to Germany, While Poland will gain 100% from other countries. Spain will lose 100% to the USA and gain 13.89% from Poland. The USA will gain 100% from Spain and, in return, lose 100% from other countries and its market share. Other countries will gain 100% of the Market share from France and 100% of the Market share from the USA, but they will lose only 100% of the Market share to Poland, and in return, there will be a shift of Market share to other countries. Pakistan should Keep searching for new export markets with HS Code 62046200.

According to Volza's latest figures, the world's top 3 exporters are Bangladesh with 786,576 Shipments, China with 441,495 Shipments, and the third largest exporter in India with 265,299 Shipments. Other countries are Vietnam, Turkey, Columbia, Spain, and Pakistan. Pakistan stands as the 8th largest exporter of products with HS Code (62046200). According to Volza's latest figures, Pakistan exports this product to Peru, Ecuador, and Indonesia. This supports the argument that Pakistan has to shift its market toward other countries in future.

#### 4.3.5 Bed Linen of Cotton (HS Code 63023190)

The transition Probability Matrix is estimated using hidden markov chain analysis, and its result interpretations are discussed in Table 7.

**Table 7: Transition Probability Matrix Bed Linen of Cotton**

| | Belgium | France | Germany | USA | UK | other |
|---|---|---|---|---|---|---|
| Belgium | 0.5259 | 0.0005 | 0.4202 | 0.0133 | 0.0001 | 0.0401 |
| France | 0.0003 | 0.0024 | 0.995 | 0.0023 | 0 | 0 |
| Germany | 0 | 0.1821 | 0.8178 | 0 | 0 | 0.0001 |
| USA | 0 | 0 | 0 | 0 | 0.0038 | 0.9962 |
| UK | 0 | 0 | 0 | 1 | 0 | 0 |
| other | 0.0001 | 0.9618 | 0.0381 | 0 | 0 | 0.0001 |

Source: Author's calculation

Pakistan Exports Products with (HS Code-63023190) to Belgium, France, Germany, the USA, the UK and other countries. The Diagonal values represent that Germany retained the highest retained value of 81.78%. After That, Belgium would have a 52.59 retained value. Belgium will lose 42% to Germany and will gain nothing from any of the competing countries. France will lose 99.50 % to Germany and will gain 18.21% from Germany. Germany will gain 42% from Belgium and 99.50% from France and not lose its market share to France, around 18.78%. The USA will not gain as much from competing countries, but it will lose almost 99.62% to other countries. The UK will lose 100% of its market share to the USA and gain nothing from its competitors. Other countries would gain 99.62% from the USA and, in return, will lose 96.18% to France.

The top three exporters of HS Code 63023190 are Pakistan, with shipments of over 32197, followed by South Africa with 3040 shipments and China with 1226 shipments. India, the United States, Sri Lanka, Hong Kong, and Spain are world exporters. Top world importers of this product are the United States, Netherlands, United Kingdom, Belgium, Germany, Australia, France, Italy and other countries. According to the latest export data, Pakistan exports its Products HS Code 63023190 to the United States, Netherlands and the United Kingdom.

### 4.3.6 Cotton Towels (HS Code 63026010)

The transition Probability Matrix is estimated using hidden markov chain analysis, and its result interpretations are discussed in Table 8.

**Table 8: Transition Probability Matrix**

| | Italy | Spain | USA | UAE | UK | other |
|---|---|---|---|---|---|---|
| Italy | 0.0008 | 0 | 0.9992 | 0 | 0 | 0 |
| Spain | 0 | 0.001 | 0.0001 | 0.9916 | 0 | 0.0073 |
| USA | 0 | 0.0005 | 0.5778 | 0 | 0 | 0.4216 |
| UAE | 0 | 0 | 0 | 1 | 0 | 0 |
| UK | 0.345 | 0 | 0.0004 | 0 | 0.6546 | 0 |
| other | 0 | 0.6012 | 0.0001 | 0 | 0 | 0.3987 |

Source: Author's calculation

Pakistan exports Cotton Towels (HS-63026010) mainly to Italy, Spain, the USA, UAE, the UK and other countries. According to TPM, the diagonal values represent the retaining values as

UAE will have the highest retaining Value of 100%; the UK will have 65.46% retaining probability, the USA will have 57.78%, and other countries will have 39.87% retaining probability. Italy will lose 99.92% of its market share to the USA, but Italy will gain only 34.50% from the UK. Spain will lose 99.16% of its market share to the UAE and will gain 60.12% of its market share from other countries. The USA will lose 42.16% of its market share to other countries, but the USA will gain 99.92% from Italy. UAE will lose nothing but gain 99.16% of Spain's market share. The UK will lose 34.50% of its market share to Italy and gain nothing from any country. Other countries lose 60.12% from Spain and will gain 42.16% of the market share from the USA.

According to Volza Pakistan export data, the top three exporters of product HS Code 63026010 are India with 292 shipments, followed by Pakistan with 141 Shipments and China with only 51 Shipments. Sri Lanka and Spain are also the leading exporters of this product. Pakistan is the second largest exporter of Product 63026010. One of the top importers of this product is the United States, followed by the United Kingdom. Meanwhile, with time, demand for it has increased. Pakistan also shows progress in producing the products HS code 63026010 with a positive compound annual growth rate in terms of both Value and Quantity. So, in the future, Pakistan will explore more markets to export this product.

### 4.3.7 Dyed Cotton Fabric (HS Code 60062200)

The transition Probability Matrix is estimated using hidden markov chain analysis, and its result interpretations are discussed in Table 9.

**Table 9: Transition Probability Matrix**

| | Bangladesh | Haiti | Kenya | Sri Lanka | UAE | other |
|---|---|---|---|---|---|---|
| Bangladesh | 0 | 0 | 0 | 1 | 0 | 0 |
| Haiti | 0 | 0 | 1 | 0 | 0 | 0 |
| Kenya | 0 | 0 | 0.6071 | 0 | 0.0052 | 0.3876 |
| Sri Lanka | 0 | 1 | 0 | 0 | 0 | 0 |
| UAE | 0.0106 | 0 | 0 | 0 | 0.9894 | 0 |
| other | 0 | 0 | 0.0028 | 0 | 0.9868 | 0.0104 |

Source: Author's calculation

Pakistan exports dyed cotton fabrics (HS Code 600622) to Bangladesh, Haiti, Kenya, Sri Lanka, UAE, and other countries. The diagonal values represent maximum retention by UAE at 98.94% and then Kenya at 60.71%. At the same time, Bangladesh will lose all market share to Sri Lanka in the future and will not gain as much as it can compensate. Haiti lost its 100% market share to Kenya and will gain 100% from Sri Lanka. Kenya will lose 38.76% of its market share to some other countries and will gain 100% from Haiti. Sri Lanka Will lose 100% of its market share to Haiti and gain 100% from Bangladesh. UAE will not lose much of its market share but will get 98.68% of its market share from other countries. Other countries will gain only 38.76% of their market share from Kenya but lose 98.68% to UAE.

The world's largest Dyed fabrics export is Vietnam, with shipments of 820040, followed by China with 345,928 shipments and then India with shipments of over 261846. Pakistan stands at number 18th among the world exporters of dyed fabric with shipments around 6683. South Korea, Turkey, Indonesia, Peru, Malaysia, Hong Kong, Sri Lanka, Taiwan, Bangladesh, Italy, Japan, Brazil and Germany are also categorized under World exporter of products with HS Code 60062200. Top importers are Sri Lanka,

Bangladesh, Vietnam, Kenya, the United Arab Emirates, and the United States. According to the hidden Markov chain results, the UAE and Kenya will be stable markets for Pakistan's exports.

Table 1 shows a positive growth rate in the Value and Quantity of HS Code 60062200. Pakistan's top exporters of this product are Sri Lanka, Bangladesh and Vietnam. However, there is a need to explore the new market for this product.

## 5. Conclusion and Policy Suggestions

To predict the direction of Pakistan's textile exports, we use the compound annual growth rate. Our examination shows that three textile items—pullover jerseys, cotton towels, and dyed fabric—demonstrate a favorable compound annual growth rate in both quantity and value. In contrast, cotton yarn and women's trousers indicate a negative growth rate in terms of both quantity and value. Meanwhile, boys' trousers and cotton bed linen indicate a decline in growth rate in terms of quantity and an increase growth rate in terms of value.

Pakistan has to focus more on productivity and exports of cotton yarn and towels because they have low instability in quantity. The market for Pakistan's export of textile products is limited, so Pakistan must focus on market diversification. Concerning the result of the study, the market for cotton towels, boy's trousers, pullovers, and jerseys needs some market diversification. Bed Linen Cotton represents high instability in quantity and value because it faces several challenges in the international market, global market conditions, shifts in consumer preferences, or external, economic and geopolitical events. Products like pullovers, jerseys, boy's trousers, women's trousers, and dyed fabrics needed more concentration by policymakers because these products had the compatibility to compete in the international market due to high demand and more competitiveness.

Policymakers should address why the CAGR of cotton yarn is negative and create strategies to increase its productivity, help to increase its value and make it compatible. Policymakers should also make strategies and address the reason for the negative CAGR of Boy's Trousers, Women's Trousers, and Bedlinen, as some of the products have the scope to meet international demand. Results of TPM revealed that some products like pullover jerseys, boy's trousers, and cotton towels,have the export potential, so more markets need to be explored. Products like dyed fabrics and women's trousers needed less concentration on the part of policymakers as a result of TPM.

The Pakistani government and industry stakeholders should work together to improve infrastructure, ensure a steady supply of energy, enforce strict quality control measures, streamline trade facilitation procedures, and investigate new markets in order to remove obstacles and increase textile exports. Furthermore, it is crucial to establish strong trading ties with importing nations.

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