EVALUATION OF THE POTENTIAL IMPACT OF EXPORTS & IMPORTS COMMODITIES INTO THE SRI LANKAN ECONOMY

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ABSTRACT

The research attempts to evaluation impact of the Exports and Imports commodities in the country economic. Mainly, following objectives are elaborated, behavior of the exports and imports, to determine which type of commodity is mainly impact to the country economic, to understand theoretically link between the total exports and imports commodities groups and to revisit the total exports and imports groups by investigating hidden factors which are impacting to county economic. The data are collected mainly from 2007 to 2017 monthly basis from Central Bank of Sri Lanka and Census & Statistic Department Sri Lanka. Although total Exports and Imports commodities have been studied with many statistical and economical methods. The researcher has tried to study the similarities of commodities groups and differences. Various statistical techniques have been used such as Basic Statistical, Principle Components (*PCA*), Factor Analysis (*FA*) and VARI-MAX Factor Rotation. With the strong based on the preliminary analysis, there are strong correlations among the commodities. This paper is adopted the Principle Component and Factor Analysis to assess eights commodities groups by finding out the level of redundancy among them from the correlations matrix and grouping indicators with higher similarities into the same factors in Exports and Imports separately. According to the similarities, Agriculture Exports, Mineral Exports and Consumer Imports and Investment Goods Imports are categories accurately. But there is no proper grouping for Industrial Exports & Intermediate Imports. Based on the rearrangement of commodities, seven components are identified for Total Exports and eight components are identified for Total Imports according to Factor analysis and improving the results using *VARI-MAX* Rotations. Also, there are no rapid improvement for all commodities except Garments, Tea and Petroleum sectors. These groups are highly impact to the Gross Domestic Product (*GDP*) and it need reliable improvement to eliminate the negative impact for country economic. Furthermore, Balance of the Trade is a negative value. When determining which type of commodity is mainly impact to the country economic, Garment & Textile, Tea & Petroleum Products are critical in Export sector. But, there are lack of attention for agriculture sector.

Key Words: *PCA, FA* and *VARI-MAX FA*

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LIST OF ABBREVIATIONS

PCA - Principle Component Analysis

PC - Principle Component

FA - Factorial Analysis

GDP - Gross Domestic Products

GSP+ - Generalized Scheme of Preference Plus

CHAPTER 01

INTRODUCTION

1.1: BACKGROUND

Sri Lanka is the Democratic, Socialist and Republic country. It is in the Indian Ocean and it's South Asian country. Sri Jayewardenepura Kotte is a capital city and Colombo is the largest city which is called a center of commerce. The country has a population about 21 million with majority 70% of Sinhalese, 13% of Hinduism, 10% of Islam, 7% of Christianity and 0.5% of others. Sri Lanka has a rich cultural heritage around 3,000 years history. The island's geographical location and rich resources made the greatest strategical importance from ancient Silk Road through to modern Maritime Silk Road. The location is a major trading hub due to mainly in luxury goods and spices which are attracted traders of many nations. From North India, Sinhalese arrived in Sri Lanka the late 6^{th} century B.C and mainly the greatest civilization developed at the cities of Anuradhapura and Polonnaruwa. During these periods, the country governed by several nations namely in 16^{th} Century by Portuguese, Dutch in 17^{th} Century and British in 1796's. In British, this was becoming a crown colony in 1802 under British rule, their control over the whole island in 1948. Furthermore, Ceylon became a republic and adopted it's current name in 1972. Sri Lanka's recent history has been made by 26-year civil war which was ended by the Sri Lanka Army Forces by defeating the Liberation Tigers of Tamil Eelam in 2009.

Sri Lankan economy has a longest history. In 1830, the British began experimenting with plantation for agriculture sector. Coffee-growing was introduced into the highlands which was in middle of the country, initially it's great success that revolutionized the country's economy. In the beginning, permission was given for farming of royal lands without allowing private ownership. The British crown lands were gradually sold to private buyers. Unfortunately, Coffee economy was destroyed by a leaf disease by spreading throughout the plantations from the 1850 to 1870. This falling reflected form many aspects in Europe market. The plantation owners did not abandon their estates and hopes. Instead of that, Cinnamon was tried out but unfortunately the market was too limited and lack of

diversity. Meanwhile, they found Tea as a suitable substitute crop for Coffee and Cinnamon. The British Tea growers haired permanent workers from the Tamil areas of South India instead of local Sinhalese who were not willing to live on the tea plantation areas due to lack of ability to work. Due to the lack of labors, Tamils were brought from India in large numbers. Whilst Sri Lanka is also known for its Gem deposits.

With more elaborations, in the 19th and 20th centuries Sri Lanka became a famous in exporting of Cinnamon, Rubber and Ceylon Tea which remains a trademark national export and highly impacted commodities. The development under British rule, the country raised the strategic importance and called as a Centre of trade. From 1948 to 1977, socialism strongly was influenced to the government economic policies. These were impacted highly to the country economy. With ending Colonial plantations, industries and welfare state were nationalized. In 1977, the *Free Market Economy* was introduced to the country incorporating privatization with highly promoting of private enterprise and deregulation of economic activities/rule. This is an importance foot step in Sri Lankan economy.

In Free Market Economy, the main strategy and highly focused on the private sector as the engine of growth. Policies/ rules were introduced to accelerate economic growth by private investment through various incentive cases. The concept was also opportunity to increase the foreign earnings by promoting Export oriented economic activities. The liberalization policies were reviewed by International Monetary Fund and the World Bank for successive beginning. The economy was successfully remarking a real growth rate about 6% per year until 1986 by enhancing levels of foreign aid's and investments. An ethnical conflict on economic activities caused during the following years. Because of that there was a marked deceleration economic growth. Gross domestic product was showing at an average of 2.7% per year from 1986 to 1989 and it was increased to an average of 5% per year from 1990 to 2000. The level of income in the economy was growing significantly with per capita gross domestic products more than doubling that mean it was from US$382 in 1975 to US$802 by 2000.

The country is endowed with many natural resources with high level diversity. There is an equal with a high average rainfall. The land is a suitable for growing number of different types of crops. Rivers cascading from the central hill country. This is also helping to provide energy by generating hydropower which is the major source of electricity. The country also has rich fishing resource, mineral resources including Titanium ore, Graphite, Kaolin, unexploited Iron are and Gemstones.

In Sri Lankan economy, Foreign Trade is placed a major role and an important segment. Major Imports expenditure are Petroleum, Consumables items, Machinery parts, Capital equipment's, Motor vehicles and various manufactured goods that mean finished goods. Major Exports include Tea, Rubber, Coconut products, Food stuffs, Garments and Textile, Gems and Jewelry. Sri Lanka is the largest exporter for Black Tea in the world and the 3rd largest producer of natural rubber. The country is getting world famous from variety gemstones. Significant quantities of high-grade graphite which are getting more benefits in Export sectors. The United Kingdom, Germany, Japan, Russia, China, India and the Middle East are major Exports market. In Imports side, Japan is the single and largest exporter to Sri Lanka from Motor vehicles, spare parts and woven fabrics. India is considered as the second largest Importer followed by Singapore, China, Taiwan, South Korea, the United Kingdom, and the United States. While the manufacturing production, Export of Tea, Rubber, Coffee, Sugar and other commodities remain important to the country. Industrialization has help to increase the importance of Food processing, Textiles, Telecommunications/IT, service and Finance sector. The country's main economic sectors are Tourism industry, Tea Export, Garment/ Textile, Rice production and other agricultural products. In additionally that, overseas employment contributes substantially in foreign exchange highlighted in the Middle East.

Since 2010, the service sector was showing 60% of *GDP*, the industrial sector 28% and the agriculture sector 12%. 85% economic activities were accounted to the private sector. United States, China, India, Russia and Middle East Countries are Sri Lanka's largest trading partners. Western province was showing the highest economic activities around

45% of the *GDP* and the Southern Province, the Central Province contributing 11% and 10% respectively. With the ending civil war in the Northern Province, it was reported a record 23% *GDP* growth in 2010. As early described, Ceylon Tea is most famous which has *ISO* with the cleanest tea in the world in terms of pesticide residues. The per capita income of Sri Lanka has approximately twin since 2005. During the same period, poverty has decreasing trend from 15.2% to 7.6%. Unemployment rate has decreased from 7.2% to 4.9%. Colombo Stock Exchange Market capitalization has highly reflected and the budget deficit has doubled. Employee income inequality has also decreased trend in recent years, it was indicated by Gini coefficient of 0.36 in 2010. From 2005 to 2010, Cellular popularity and usages in Sri Lanka has shown a significant growth around 550%. Especially, in Exports sector, Textiles and Garments (52% of total exports) and tea (17%) are showing higher contribution. Our industry, agriculture and services are also benefit for increasing Export opportunities. With increasing Exports and Imports will be benefit our Ports, Steamship lines and Airlines.

Based on World Bank publication (Apr 12, 2020), Sri Lankan economy growth continues to be adversely affected by shocks. The political instability in last year led to a subdued growth of 3.2 percent for 2018. The growth rate of the 1st quarter 2019 is 3.7% with improving agriculture and related industry sectors. Annual average inflation remained low at 4.2 percent by end of June 2019. Favorable inflation expectations were presented by reducing the policy rate corridor by 100 basis points in the first eight months of 2019 from the Central Bank. Nevertheless, the demand for private credit has shown limed responsiveness impacted economic activities. Tourism and its's related sectors have become a crucial source. Income is help for the poor and low skilled workers in rural areas for poverty reduction. However, following key factors are facing country's economic activities like low female labor, low quality of private sectors including government, including high rates of informal employment and remain persistent issues. In 2018, overall unemployment was presenting relatively low at 4.4% but unfortunately young unemployment was recorded as 21.4% indicating difficulties with entering the job markets.

In last decade & after the civil war, following major economic activities happened for both Export and Import sectors mainly. Especially, restriction for *GSP+* plus which was highly affected to the Export sectors. With fluctuation of petroleum prices (raised) in world market, this is also contribution to the economic fallen out from the civil war that peaked inflation 20%. However, by the ending civil war in May 2009, the economy has started to grow at high rate of 8.0% in 2010 year and it gradually reached 9.1% in 2012, due to non-tradable sectors. However, this was not showing continuously, and the *GDP* growth was showing decreasing trend to 3.4% in 2013 and 4.5% in 2014. In 2016, the government has succeeded in lifting of *EU* ban that aimed to help Sri Lankan fish products which resulted in fish Exports to *EU* by increasing 200%. In 2017, improving human rights related functions which are resulted in the European Commission proposing to restore *GSP+* facility to Sri Lanka.

Based on the above several economic facts, history incidents and experienced in Sri Lanka economy, there is a clear picture about Export and Imports which are impotency to country economic. If economic system, political and other organization policies/rules are changing then it is highly impacting country economy. Both Exporting and Importing helps to grow the country economy and it can be helping to expand for the global market directly. Based on the country specific resources and skill, Sri Lanka is rich from natural resources such as Foods, Timber, Fertile soil or precious metals and minerals but the country has facing shortages form seviarl important resources such as Fuel, Gas. Additionally, country infrastructures, proper educational systems and capital markets are engaged in complex manufacturing process and technological innovations.

Import sector is main source for both businesses and individual consumers. Individual consumers are also getting huge benefit from the locally manufactured productions with imported components or raw materials. Meanwhile, imported commodities are provided a favorable price or more choices to consumers by helping their standard of living. If the country wants to focus on net Exporters rather than net Importers, then it will be given huge benefits. Importing is not necessarily a bad thing since these support for accessing

to important resources and products. If Import's are greater than Export, huge money is going out from the country with trade deficit. In the other hand, if more Exports, then more domestic economic activity is occurring with lot of advantages such as higher manufacturing, production, jobs market and revenue. If country is a net Export, it increased gross domestic product.

By studying the total export & total imports, it can be revealed how Sri Lankan economy is going in future, what were the behind & what are the improvements need to identify. This research is trying to investigate how and what are the commodities affect to Sri Lanka export & import sectors. Also, what will be the improvements for future Sri Lanka export and import sector. According to Central Bank, Census & Statistics departments the exports expenditures are belonging to four main categories namely Agriculture, Industrial, Mineral and Unclassified. Other hand, the imports are categorized four main groups such as Consumer good (Food & other), Intermediate, Investment & Unclassified groups.

The study is essential based on secondary and published data by Central Bank of Sri Lanka and Census & Statistic Department Sri Lanka web sites. The data are collected mainly from 2007 to 2017 monthly basis (US/ Rupee). Data selected period is crucial when considering the country economy in many ways like end of civil war, changed in legitimate, policies changes & government changes etc. Since this period is very important for developing country like Sri Lanka. As the mentioned, there are four groups for both exports & imports based on the data source.

1.2: LIMITATION OF STUDY

Research topic of the study is too broad to thoroughly on all aspects of liberalization in all sectors of the country economic. Hence, the scope of the study is narrow down to only total imports & exports commodities relating to statistical reference. The main aim is carried out to study regarding classified groups in advance. There are some assumptions due to inconsistence and unpredictable policies especially currency changes may be affected to the study.

1.3: OBJECTIVES

The general objective of the study is to evaluation of the exports & imports commodities in the country economic. However changing policies of the governments from time to time is also reviewed. Following objectives are mainly categorized,

- To examine the behavior of the Exports and Imports in Sri Lanka.
- To determine which type of commodity is mainly impact to the country economic.
- To understand theoretically link between the total exports and imports commodities groups in Sri Lanka.
- To revisit the total exports and imports groups by investigating hidden factors which are impacting to county economy.

1.4: SUMMARY

Chapter 2 is included main literatures which are related to the research topics. The chapter is contained summarization the importance aspects of the literature, evaluation the current situation of the literature reviewed, identification the significant gaps, outline areas for future study, how to linkage between the main objectives and literature and statistical theories.

CHAPTER 02

LITERATURE REVIEW

Mats Hagnell, Muhammad Shair Ali (2005) was published the thesis focusing on the econometric evaluation of the effects of major Exports and Imports on the Balance of foreign trade in Pakistan. This research paper is mainly focused on the econometric evaluation of Exports and Imports on the Balance of Trade, in order to find which Exports and Import commodities have a significant effect on the Balance of Trade and evaluation of stationary in the Balance of Trade to the country.

Pakistan is an economically developing country and it's economy is mainly based on Agriculture. Globalization and competition of market are challenging to the economy and the gap between Import and Exports has consistently increased. However, the country has achieved a good growth in Exports and Imports. However, the Imports has reached relatively higher than Exports. The contribution of Export sector is mainly coming from the manufacturing industries and raw material. Demanding the world trade market, the exports of the Pakistan has sharply increased after 1977 due to an increasing trend in the world trade market. The country has remarkable progress from primary commodities, that helps to manufactur goods in the Export sector from 1990 to 2000. As the other countries, Pakistan has number of import commodities with lack of resources. As a result of that, the Export sector has being increasing but the Imports has being growing relatively more compared last two decades. Since the trade deficit is showing every year and continuously growing. This impact for an emerging market in Pakistan.

The data source was obtained from the official website of the State Bank of Pakistan from 1972 to 2005. Both Exports and Imports commodities are clustering four groups such as Food, Textile goods, Manufacturing and Miscellaneous. Export and Imports commodities categorization are showing similar to Sri Lanka since statistical applications in this publication is more helping to carried out my research paper. Principal Component Analysis is one of the statistical techniques for transforming correlated variables into a

smaller number of uncorrelated variables (called as principal components) and to reduce the dimensions of the data set. When applying *PCA* for each commodity group, it can be helping to identify relationship among the group and validity of the existing group. This application is more focused on my research paper 1st and 2nd objectives. Initially, Correlation Analysis is carried out with among the group and identified the correlation among the commodities. Also, by applying correlation with total value of group, researcher try to explain the relationship of commodities. And this is helping to carried out *PCA* for each group.

When moving to the analytical view, the first group includes of the Agricultural and Animals' products. The variables of first group are highly correlated and it's showing one principal component. Other three groups include textile goods, manufactured products and miscellaneous. Each group gives one principal component. As described in above paragraphs and using this correlation study and coefficients of each principal component in each group, researcher try to describe the relationship of commodities among the group and reduced the dimension of group. This application is helping to derive the objective of which commodities mainly impacting to Export and Imports sector. Further, using the Multiple Regression Analysis, the researcher tried to evaluate the effect of these four types of 1st principle component from each group into the balance of trade. To improving the results, the Stepwise Regression is used. Finally, Augmented Dickey Fuller (*ADF*) test is used to identify the non-stationarity in the balance of the trade. Before moving to the ADF test, using Simple Time series analysis, the researcher is explained the behavior of the trade balance. This is a good technique for understanding the behavior of the data set and helping to identify the major changing points.

As results, the principal components of the first three groups (Food, Textiles and Manufacturing) have significant and the fourth group is insignificant on effect on Balance of Trade. There is a significant effect food products and live animals (import variables) in the food category. In second (Textile's) category, there are significant effect on cotton fabrics, floor covering, and stripes. In the manufacturing category, the significant lies on

manufactured goods (imports), sports goods (export), leather (export), and fuel and lubricants (import). The Balance of Trade from 1972 to 2005, the gap between Imports and Exports is continuously growing and is not showing stationarity for the long run.

Felix A.A, Adongo J.A, Jr Lewis, James C.C & Martin O (2018) who published the compressive research paper regarding analysis of macroeconomic indicators namely Principle Component and Factor Analysis for Macroeconomic Indicators. Multivariate statistical methods are importance when data set is going large i.e numbers of variable are increased as example Principal Component Analysis, Factor Analysis, Grouping, Classification, Clustering and so on. Fairly, there are some difficulties to identify a complete number of random variables or features explaining existing phenomenon at a given period of time. For this, most of the researcher includes all random variables at his disposal to explain the phenomenon as best as possible where different random variables have different impacts on the study or relating to objective. It becomes computationally burdensome and time consuming analyzing multivariate data with a countless of random variables. Since if one multivariate statistical method can be applied to data set for reduce the number of random variables without losing a substantial amount of information captured by the original data. This is getting huge benefits. However, the paper resorted to the factor analysis and principal component analysis methods for dimension reduction. Also classify random variables into factors representing the entire data without a significant loss of information. Factor analysis lessens the level of redundancy existing in the data by grouping random variables with very high similarities into the same factors with their corresponding loadings. Also, relying on the fact that no substantial amount of information is lost after reduction or factoring, the principal component and factor analysis remain the motivating tools to adopt in shrinking big data. The paper employed the maximum likelihood and the principal component methods of estimating the factor loadings in the factor analysis. Results from the maximum likelihood were quite striking since it fails to provide extreme loading on Inflation given the method's popularity in estimating factor loadings. The principal component approach was then used to rightly

factor Inflation among the factors. This is very helpful discussion for 3rd and 4th objectives in my research.

The data set is included nine macroeconomic variables in Liberia from January 2006 to December 2014 namely Inflation Rate, Government Expenditures, Real Exchange Rate, Interest Rate, Inflow, Outflow, Imports, Exports and GDP. The motivation for employing the principal component and factor analysis. Most of these indicators are highly related. The need thus to group these variables with the purported high similarities into common factors is vital. First the principal component then the factor analysis of these macroeconomic indicators adopting the two conventional methods of estimation.

The rotated loadings of the principal component method of estimation are shown a greater output. Comparing these two estimation methods, extreme loadings is relatively grater compared to the maximum likelihood estimation method. Using the principal component method and it is showing, Real Exchange Rate, Interest Rate, Inflow, Outflow, Export and Import can be classified into one group namely Factor 1. Government Expenditure and GDP can also be classified into a different group namely Factor 2 while the rate of Inflation in its own uniqueness constitutes as Factor 3. Factor 1 tends to focus more on the Open Economy because Real Exchange Rate, Interest Rate, Inflow, Outflow, Exports and Imports cannot be possible when the economy is a closed one except for the case of Inflation in some sense. The indicators, Imports and Exports adequately define the openness of an economy. Assuming, Government Expenditure is solely domestic, then the factor 2 is more to the closed economy than to the open economy if net exports/imports are not factored into *GDP*. Inflation in its own uniqueness is a factor. Consequently, factor one can be interpreted as the Open Economy, the Closed Economy Factor and the Inflation Factor.

Furthermore, the Factor Analysis was carried out to identify the variables which are likely to be classified together as one factor. Three factor model was used with evidences from the scree plots of principal components. It was seen that those three components roughly

explain 80.2% of the total variation. That means the six of these indicators; Exchange Rate, Interest Rate, Inflow, Outflow, Exports and Imports are presenting a very high relationship which were classified into one factor called Open Economy Factor. Government Expenditure and *GDP* exhibited great similarities and were classified into another factor called Closed Economy Factor. But Inflation on its own uniqueness from the others was classified as Inflation Factor. In effect, these methods can be used as tools for reducing number of variables and reclassified variables into fewer factors with lower loss of valuable information. Since Factor Analysis is helping to reclassify the number of variables and to identify the relationship among the group.

2.1: SUMMARY

Chapter 03 is the research methodology. Main objective of the chapter is referring research objectives and how statistical theories linked to the research. Moreover, the way how research systematically carring out a study to ensure validity and reliability of results that address the main research objectives such as data collection plan, main statistical theories and its application.

CHAPTER 03

RESEARCH METHODOLOGY

3.1: INTRODUCTION

This chapter gives an outline and analysis based on the research methods. It provides more details of the selection of the mythology, the criteria for inclusion in the study and sample data collection planned. The researcher described the research design that was selected for this study and main point for chosen. Following chapter try to give, main advance statistical theories which are used in analysis chapter. Also, how these were aligning with the objectives.

3.1.1: DATA COLLECTION

Data for this study were collected from secondary publish data official web site in Central Bank and Census and Statistics Department Sri Lanka. The data set is expanding from 2007 to 2017. Data set mainly include two categories such as Total Exports and Total Imports. Each category (Exports and Imports) divided into four main sub groups (Table 4.1) with respective commodities. Exports category is included 33 commodities and Imports category is included 47 commodities. Both sub categories included Total values. When consider the entire data set, there are 90 variables identified (Table 4.2).

3.2: STATISTICAL METHODOLOGY

3.2.1: DESCRIPTIVE ANALYSIS

Identifying the behavior and distribution of each variables are well support to develop for advance statistical theories. Using basic statics such as Mean, Standard deviation, Min-Max and Range and graphical charts such as Box Plots and Histogram with Normal Curve, try to describe the 90 variables. The Coefficients of Variation (*CV*) is a measurement of the dispersion of the data set which represent the ratio of the standard deviation and mean. C*V* is a useful for comparing the degree of variation form one variable to another even

different scale/range data sets. Furthermore, in Finance and Economic the *CV* allows to determine degree of volatility and risk. Low coefficient of variation is showing low volatility with high return. This is another good indicator to find the impact of commodities to each group, to determine how much volatility/ risk in comparison to the amount of return expected from investment. Time series plot is best displaying the graphical method to examine the behavior of data sets. By applying time series plot for Exports and Imports, it could be tried to illustrate the behavior of the variables since 2007.

When analysis large data sets (90 commodities) and to finding relationship between each commodity group and its commodities Scatter plot and Correlation Coefficients are important. To identify the relationship commodity group and its commodities since 2007, Scatter plot is used to graphically represent the two variables as example Exports and Agriculture Exports then Agriculture Exports and Tea like wise. With examining the liner relationship graphically, further analysis Correlation Coefficient (say ρ) is used which is a measure of strength and direction of a relationship in numerically. For the study, between 0 to 2.5 as weekly, 2.6 to 6.5 as moderately and 6.7 to 1.0 as strongly correlated based on magnitude value.

- $\rho = 1$, positive linear correlation that mean if one variable increased, then other variable is also increased.
- $\rho = 0$, no linear correlation.
- $\rho = -1$, negative linear correlation that mean if one variable increased, then other variable is decreased.

3.2.2: PRINCIPAL COMPONENT ANALYSIS

Principle Component Analysis (*PCA*) is one of the multivariate data analyses. PCA is a dimensional reduction method of large data sets by the large set of variables into a smaller one without losing information in the data set. Also, this is very flexible tool and allows to analyze dataset which contains multicollinearity, clustering and reduced the dimension. The main goal is to extract all information into another few variables without losing

information which is called Principle Components. By applying the *PCA* method for each commodities group, it can be revealed the validity of the existing group and how much number of different groups will be existed in the group based on the Scree Plots and Total Variations. Also, the correlation between the principle component and the original commodity in the group, which is showing correlation with magnitude. After applying *PCA* for 8 groups (basically 6) in Exports and Imports, *PCA* is applied for all commodities without considering groups for re clustering or re grouping. This is much important for factor analysis. Basis formulas are showing in following.

Suppose that X_1, X_2, …, X_p be the random variables and it defines as a (p*1) random vector $\mathbf{X'}$=[X_1, X_2, …, X_p] and let μ, Σ be a mean vector and covariance matrix of **X** respectively . The eigen values, eigen vectors pairs $(\lambda_1,e_1),(\lambda_2,e_2),\dots ,(\lambda_p ,e_p)$ with $\lambda_1 \geq \lambda_2 \geq \dots \lambda_p \geq 0$ for Σ. Then i^{th} *PC* is given by,

$$Y_i = e_{i1}X_1 + e_{i2}X_2 + \dots + e_{ip}X_p = \boldsymbol{e_i'X}\,; i = 1,2,\dots,p$$

And

$$Var(Y_i) = Var(\boldsymbol{e}'_i\boldsymbol{X}) = \lambda_i\,; i = 1,2,\dots,p$$
$$Cov(Y_i, Y_k) = \boldsymbol{e}'_i\Sigma\boldsymbol{e}_i = 0\,; i \neq k$$

Then the total variance,

$$\sum_{i=0}^{P} Var(X_i) = \sum_{i=0}^{P} Var(Y_i) = \lambda_1 + \lambda_2 + \dots + \lambda_P$$

and the proportion of total variance due to the k^{th} *PC* is equal to

$$\frac{\lambda_k}{\sum_{i=0}^{P}\lambda_i}; k = 1,2,\dots,P$$

The correlation coefficient between the Y_i and X_k is defined by ,

$$\rho_{Y_i,X_k} = \frac{e_{ki}\sqrt{\lambda_i}}{\sqrt{Var(x_{kk})}}; k\,, i = 1,2,\dots,P$$

Let ρ be a correlation matrix of random vector **X**. Then,

$$\Sigma = V^{\frac{1}{2}}\rho V^{\frac{1}{2}}$$

Where, $\mathbf{Z}'$=[Z_1, Z_2, …, Z_p] be the standardization variables of X_1, X_2, …, X_p such that

$$Z = (Z_1, Z_2, \ldots, Z_p) = (V^{-1/2})(X - \mu)$$

and

$$V^{-1/2} = (diag(\Sigma))^{1/2}.$$

Also,

$$E(Z) = 0$$

and

$$Cov(Z) = \rho$$

The eigen values, eigen vector pairs (λ_1,e_1),(λ_2,e_2),… ,(λ_p ,e_p) with $\lambda_1 \geq \lambda_2 \geq \ldots \lambda_p \geq 0$ for ρ. Then i^{th} PC is given by,

$$Y_i = e_{i1}Z_1 + e_{i2}Z_2 + \ldots + e'_{ip}Z_p = e_i Z\,; i = 1,2,\ldots,p,$$

Then the total variance,

$$\sum_{i=0}^{P} Var(Y_i) = \sum_{i=0}^{P} Var(Z_i) = P$$

and the correlation between correlation coefficient the Y_i and Z_k is defined by

$$\rho_{Y_i,X_k} = e_{ki}\sqrt{\lambda_i}\,; k\,, i = 1,2,\ldots,P.$$

3.2.3: FACTOR ANALYSIS

The main objective of Factorial Analysis (*FA*) is that multiple number of variables have similar patterns and find out all associated with a latent variable. These interrelationships can be categorized into multiple components. One of the main research objectives is that reclassification of Exports and Imports commodities without losing information. This is focused on the variance and covariance rather than mean. One of the important points is selected new factor which is explained total variance for the commodities. Total variance is summation of Common and Unique (Specific and Error) variances.

- Common Variance (Communality) is variance that ranges between 0 to 1. If value is closer to 1 that mean extracted factor is explained more of the variance of original variables or commodities.
- Unique variance is combination of Specific and Error variance.

Before moving to the Factor Analysis for Exports and Imports commodities, it is important to identify the numbers of components based on *PCA* methods for Export and Imports commodities. Based on the idea of the components, the *FA* is carried for Exports and Imports separately. To getting more accurate results and improving the results, *VARIMAX* rotation is carried out for two group separately. As a result, new factor is included similarity of commodities which can be called as new factors. If Specific variance is showing higher or lesser community value that means, there is impacting other economic or commodities into the factor. Following is showing basic terminologies for Factor Analysis.

Suppose that observable random vector **X** with p components i.e $\mathbf{X'}$= [X_1, X_2, …, X_p] with **μ** mean vector & **Σ** covariance matrix. **X** is linearly dependent upon a few unobservable random variables **F** vector which is called common factor i.e $\mathbf{F'}$= [f_1, f_2, …, f_m]. **ε** is vector of errors or specific factors i.e $\boldsymbol{\varepsilon}'$= [ε_1, ε_2, …, ε_p].

Then, following model can be defined,

$$X_1 - \mu_1 = l_{11}f_1 + l_{12}f_2 + \cdots + l_{1m}f_1 + \varepsilon_1$$

$$X_2 - \mu_2 = l_{21}f_1 + l_{22}f_2 + \cdots + l_{2m}f_2 + \varepsilon_2$$

$$\vdots$$

$$X_p - \mu_p = l_{p1}f_1 + l_{p2}f_2 + \cdots + l_{pm}f_m + \varepsilon_p$$

Or matrix notations,

$$\boldsymbol{X} - \mu = \boldsymbol{LF} + \boldsymbol{\varepsilon}$$

Where

l_{ij} is called the loading of the i^{th} variable on j^{th} factor, m<p, f_i i=1…m & ε_i i=1…p is unobservable. Following assumption are made,

$$E(\mathbf{F}) = \mathbf{0} \text{ and}$$

$$\text{Cov}(\boldsymbol{\varepsilon}) = E(\boldsymbol{\varepsilon}\,\boldsymbol{\varepsilon}') = \Psi = \begin{bmatrix} \Psi_1 & 0 & 0 \\ 0 & \Psi & 0 \\ 0 & 0 & \Psi_p \end{bmatrix}$$

F and ε are independent that implies,

$$\text{Cov}(\mathbf{F}, \boldsymbol{\varepsilon}) = E(\boldsymbol{\varepsilon}\mathbf{F}') = \mathbf{0}$$

$$\boldsymbol{\Sigma} = \mathbf{L}\mathbf{L}' + \boldsymbol{\Psi}$$

$$\sigma_{ii} = l_{i1}^2 + l_{i2}^2 + \cdots + l_{im}^2 + \Psi_i = h_i^2 + \Psi_i$$

σ_{ii} = Var(X_i)

$l_{i1}^2 + l_{i2}^2 + \cdots + l_{im}^2 = h_i^2$ = community

Ψ_i = specific variance

Cov(X_i, f_j) = l_{ij}

Let **T** be any m*m orthogonal matrix so that $\mathbf{T}\mathbf{T}' = \mathbf{T}'\mathbf{T} = \mathbf{I}$

$$\boldsymbol{X} - \mu = \boldsymbol{L}\boldsymbol{T}\boldsymbol{T}'\boldsymbol{F} + \boldsymbol{\varepsilon} = \boldsymbol{L}^*\boldsymbol{T}^* + \boldsymbol{\varepsilon}$$

$$\boldsymbol{\Sigma} = \boldsymbol{L}^*(\boldsymbol{L}^*)' + \boldsymbol{\Psi}$$

3.3: SUMMARY

Chapter 04 is contained the all statistical analysis and main conclusions based on the outputs. Firstly, describe the behavior of the data set using basic statistics and graphical charts then applied the correlation test, *PCA* and finally *FA*. Each output is described relating to the main objectives.

CHAPTER 04

ANALYSIS

4.1: INTRODUCTION

The analysis is based on number of different methodologies and data sources. Basically, the chapter describes two segments such as preliminary and confirmatory analysis respectively. Under the preliminary sections, all the descriptive statistics such as mean, standard deviation, 1st quartiles, 3rd quartiles, median, maximum and minimum are used for all variables / commodities. Also, graphical methods were used to detect and identify for numbers of outliers and behaviors of the distribution. All the variables were fluctuated around the mean value but when those are the economical variable i.e this is tending to be a time series data, so the time series plots were used for identifying basic variations which are Total Exports & Total Imports including subcategories.

Confirmatory analysis section is included important statistical analysis tools for many aspects of economic data analysis such as statistical modeling, significant testing, clustering, hidden factor identification and identifying relationships etc. Those type of advance statistical techniques are included. All the decisions and the ideas have been made based on the preliminary analysis (Chapter 04) then the conclusions and decisions are generalized.

Table 4.1: Summary Table for Total Exports & Imports Commodities

Group	Category	Number of Commodities
Export	Agriculture	10
	Industrial	19
	Mineral	3
	Unclassified	1
Import	Consumer	22
	Intermediate	20
	Investment	4
	Unclassified	1

Following variables names are used for further analysis. All data is collected from 2007-Jan to 2017-Oct (Rs. Million). During the period, some of the month data are missing, since data mining technique is used to fill the missing data.

Table 4.2: Variable Names for Export Commodity

Category	Commodity Type	Variable Name
Agriculture		AX1
	Tea	X1
	Rubber	X2
	Coconut	X3
	Kernel Products	X4
	Other	X5
	Spices	X6
	Vegetable	X7
	Unmanufactured Tobacco	X8
	Minor agricultural products	X9
	Sea food	X10
Industrial		IX2
	Food beverages & tobacco	X11
	Animal fodder	X12
	Textiles and garments	X13
	Garments	X14
	Textiles	X15
	Other made up textile articles	X16
	Rubber products	X17
	Gem diamonds and Jewelry	X18
	Machinery and mechanical appliances	X19
	Transport equipment	X20
	Petroleum products	X21
	Chemical products	X22
	Wood and paper products	X23
	Printing Industry products	X24
	Leather, travel goods and footwear	X25
	Plastic and articles thereof	X26
	Base metals and articles	X27
	Ceramics products	X28
	Other industrial	X29
Mineral		MX3
	Earths and stones	X30
	Ores, slag and ash	X31

	Precious Mental	X32
Unclassified		UX4
Total Exports		TE

Table 4.3: Variable Names for Import Commodity

Category	**Commodity Type**	**Variable Name**
Consumer goods		CY1
	Food and Beverages	Y1
	Vegetables	Y2
	Sugar and confectionery	Y3
	Cereals and milling industry products	Y4
	Dairy Products	Y5
	Seafood	Y6
	Oils and Fats	Y7
	Spices	Y8
	Fruits	Y9
	Beverages	Y10
	Other Food and beverage	Y11
	Other Consumer Goods	Y12
	Medical and Pharmaceuticals	Y13
	Vehicles	Y14
	Household and furniture items	Y15
	Home appliances	Y16
	Clothing and accessories	Y17
	Cosmetics and toiletries	Y18
	Rubber products	Y19
	Printed materials and stationary	Y20
	Telecommunication devices	Y21
	Other nonfood consumables	Y22
Intermediate goods		IY2
	Fuel	Y23
	Petroleum and Crude oil	Y24
	Refined Petroleum	Y25
	Coal	Y26
	Textile and textile articles	Y27
	Chemical products	Y28
	Plastic and articles thereof	Y29
	Wheat and Maize	Y30
	Diamonds and precious or semi stones	Y31
	Gold	Y32
	Paper and paperboard and articles thereof	Y33

	Base metals	Y34
	Fertilizers	Y35
	Vehicle and machinery parts	Y36
	Agricultural Inputs	Y37
	Food preparations	Y38
	Rubber and articles thereof	Y39
	Mineral products	Y40
	Unmanufactured tobacco	Y41
	Other intermediate goods	Y42
Investment goods		IY3
	Machinery and equipment	Y43
	Building materials	Y44
	Transport equipment's	Y45
	Other investment Goods	Y46
Unclassified		UY4
Total Imports		TI

4.2: SUMMARY STATISTICS

Before the making confirmatory analysis or advance statistical techniques, it is needing to understand the behavior of the data sets. Since using several statistical tools such as five statistics & graphical methods, try to describe each variable starting.

4.2.1: DISTRIBUTION OF TOTAL EXPORTS & IMPORTS

By using basic statistical tools describe the main two variables of *TE* & *TI* such as mean, Std deviation, min/max, quartiles, Histogram, Box plots & simple time series plots.

Table 4.4: Summary Statistics for Total Export & Imports

Variable	N	Mean	Std. Dev	Min	Q1	Median	Q3	Max
TE	130	100,667	26,088	76,215	101,694	120,602	51,363	157,760
TI	130	**176,643**	54,482	12,4164	188,209	218,769	69,070	284,464

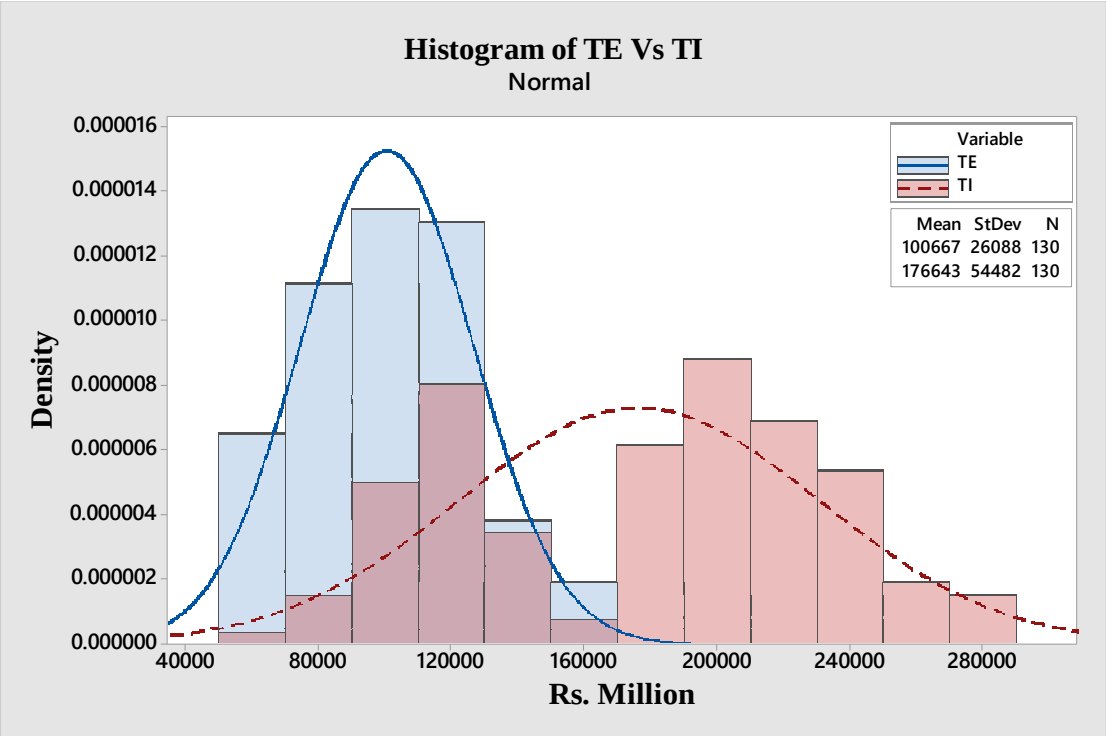

Figure 4.1: Histogram of Total Export & Imports

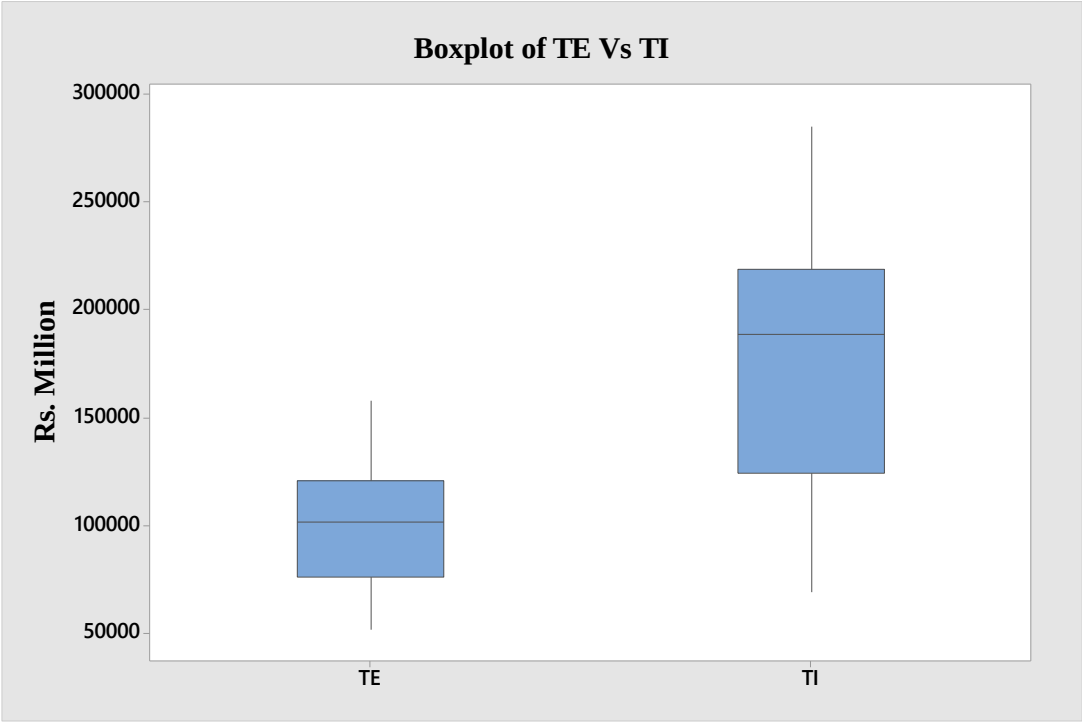

Figure 4.2: Box Plots of Total Export & Imports

According to above table 4.4, there are 130 observations from 2007-Jan to 2017-Oct. Mean value (Rs. 176,643 Mn) of *TI* is the highest compared to *TE* (Rs. 100,667 Mn). The lowest standard deviation is presented for *TE* (Rs. 26,088 Mn). Also, standard deviation *TI* is twice than *TE*. Similarly, mean values of *TI* is approximately twice than *TE* during the period. Based on the figure 4.1 & 4.2, range value of *TI* is higher than *TE* during the period. mean & median values of *TE* are approximately equal numerically & Box plot. So, it can be concluded that *TE* is normally distributed in graphically. When consider *TI*, mean & median values of *TI* are not approximately equal numerically. Box plot is showing it as right Skewed distribution (i.e Mean<Median). So, it can be concluded that *TI* is not normally distributed in graphically. Furthermore, Histogram (Figure 4.1) is clearly show that *TI* is showing higher variation compared to *TE*.

According to time series plot (Appendix Figure a), it is clearly show that *TI* is showing a slightly increasing trend during the 10-year period, there are no any specific variations during that period. But, *TE* is showing a slightly increasing trend compared to *TI* but this is lower compared to *TI*. And *TE* and *IT* values are fluctuated around the mean values. 2007-2011, there was no trend for *TI* after 2011-217 there was increasing trend. When consider *TE*, 2007-2013 there was no variation, 2013 it was jumped to higher point later 2014-2017 data was fluctuated around the mean value.

4.2.2: DISTRIBUTION OF TOTAL EXPORTS COMMODITIES

Table 4.5: Summary Statistics for Total Export of Categories

Variable	N	Mean	Std. Dev	Min	Q1	Median	Q3	Max
AX1	130	24,400	6,514	11,426	19,379	24,184	29,714	40,168
IX2	130	**75,587**	19,908	39,727	58,365	76,138	91,209	117,993
MX3	130	344	261	84	209	271	376	1,676
UX4	130	144	127	8	77	120	164	815

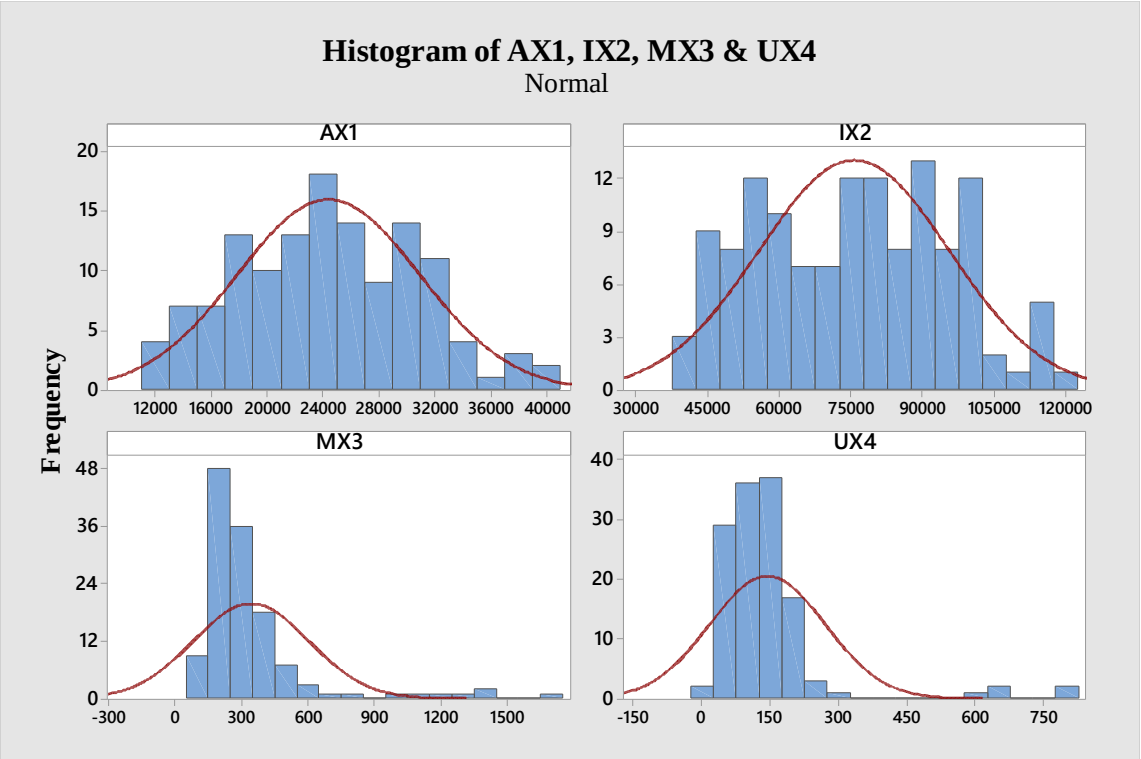

Figure 4.3: Histograms for Total Export of Categories

According to table 4.5 & figure 4.4, it is show that highest mean value is Industrial Export (*IX2*, Rs.75,587 Mn) and *IX2* standard deviation is highest. That means, *IX2* is showing highest variation during the 10-year period. *IX2* is also showing maximum range compared to other four groups. *MX3* & *UX4* were showing minimum variations. For all the main exports categories are graphically normal since mean value is approximately equal to median value.

Table 4.6: Summary Statistics for Agriculture Export Commodities

Variable	Mean	St.Dev	Coef. Var	Min	Median	Max	Skewness	Kurtosis
X1	**14,375**	**3,347**	**23.28**	6,748	14,350	21,975	-0.05	-0.31
X2	950	618	65.00	229	838	2,918	1.16	0.91
X3	2643	1,321	49.97	632	2,251	5,528	0.47	-1.09
X4	1,388	909	**65.47**	261	1,014	3,333	0.55	-1.23
X5	1,254	488	38.93	345	1241.2	2,419	0.14	-0.62

X6	2,760	1,533	55.52	549	2,386	7,695	0.94	0.47
X7	234	131	56.03	52	188	649	0.81	-0.08
X8	**390**	**126**	32.30	119	375	805	0.62	0.85
X9	1,026	612	59.64	288	847	2,771	0.70	-0.44
X10	2,021	599	**29.64**	971	1,885	4,387	0.80	0.70

Based on the table 4.6, *X1-X10* commodities are belong to *AX1* (Agriculture Exports). *X1*(Tea) is showing a highest mean value (Rs.14,375Mn) & standard deviation (Rs.3,347Mn). Mean (Rs.390Mn) & standard deviation (Rs.126Mn) values are minimum for *X8*(Unmanufactured Tabaco). Lowest coefficient of variation is showing for *X1* (23%) that mean, it is a most optimal risk-to-reward ratio i.e low volatility with high returns. Similarly, 2nd (30%) & 3rd (32%) are *X10* (See food) & *X8* (Unmanufactured Tobacco) which are given low volatility with high returns respectively. Whilst the highest coefficient values are showing *X2*(65%, Rubber) & *X4* (66%, Kernel Products) that mean those products consider as a high volatility with low return i.r risk agriculture products. Most of the agriculture exports products are graphically normally distributed due to mean value is approximately equal to median value, Skewness is approximately zero & Kurtosis is approximately zero except Rubber (*X2*) product.

Table 4.7: Summary Statistics for Industrial Export Commodities

Variable	Mean	St.Dev	Coef. Var	Min	Median	Max	Skewness	Kurtosis
X11	3,025	1,132	37.41	1,216	2,939	8997	1.44	5.19
X12	712	276	38.69	146.9	710	1,751	0.74	2.01
X13	**43,804**	**12,550**	**28.65**	22290	41,670	71,702	0.25	-1.10
X14	**41,455**	**11,835**	**28.55**	20984	39,661	67,776	0.24	-1.11
X15	1,681	629	37.39	693.6	1,565	4075	0.78	0.68
X16	668	231	34.56	271.1	612	1,700	1.12	2.12
X17	7,525	2,591	34.43	2059	8,234	12,383	-0.24	-1.06
X18	4,284	1,120	26.13	2203.0	4164	7,592	0.75	0.31
X19	3,216	931	28.95	1139.8	3,134	5,795	0.40	0.28
X20	1,676	2,251	**134.27**	371	912	20,310	5.15	36.94
X21	3,485	1,621	46.52	1010	3,414	9,478	0.63	0.56
X22	1,149	410	35.72	445.2	1,196	2,202	0.16	-0.74

X23	1,091	355	32.59	374	1128	2,021	0.12	-0.52
X24	793	856	**108.01**	13	525	4,262	1.91	3.64
X25	998	635	63.63	245	696	2,849	0.94	-0.11
X26	600	175	29.29	253	554	1,159	0.63	0.11
X27	696	347	49.96	181	625	2,000	1.46	2.65
X28	**405**	**73**	**18.20**	262	401	607	0.31	-0.74
X29	2,127	711	33.43	979	1,961	4,119	0.48	-0.63

Based on the table 4.7, *X11-X29* commodities are belong to *IX2* (Industrial Exports). *X13*(Textiles and garments) & *X14*(Garments) are showing highest mean values (Rs.43,804Mn, Rs.41,455Mn) & standard deviations (Rs.12,550Mn, Rs.11,835Mn). Mean (Rs.405Mn) & standard deviation (Rs.73Mn) values is minimum for *X28*(Ceramics products). Lowest coefficient of variation values (26%, 28%) are showing for *X18*(Gem diamonds and jewelry), *X13* & *X14*) that mean, these three products are a most optimal risk-to-reward ratio i.e low volatility with high returns. Whilst the highest coefficient values are showing *X20*(134%, Transport equipment) & *X24* (108%, Printing industry products) that mean those products consider as a high volatility with low return i.e risk industrial exports products. Most of the industrial exports products are graphically normally distributed due to mean value is approximately equal to median value, Skewness is approximately zero & Kurtosis is approximately zero except X11, X12, X13 X16, X20, X24 & X27 products which are not normally distributed i.e Skewed distribution (right).

Table 4.8: Summary Statistics for Mineral Export Commodities

Variable	Mean	St.Dev	Coef. Var	Min	Median	Max	Skewness	Kurtosis
X30	**164**	**57**	**34.69**	55	159	357	0.84	1.06
X31	127	103	80.97	11	103	746	2.59	10.41
X32	**82**	**409**	**500.08**	0.0	0.0	4,062	7.79	70.87

Based on the table 4.8, *X30-X32* commodities are belong to *MX3* (Mineral Exports). *X30*(Earths and stone) is showing highest mean value (Rs.164Mn) with lowest standard deviation (Rs.57Mn). *X32*(Precious Metals) is showing the lowest mean value (Rs.82Mn) with highest standard deviation (Rs.410Mn). Lowest coefficient of variation value (35%)

is showing for *X30* that mean, this product is a most optimal risk-to-reward ratio i.e low volatility with high returns. Whilst the highest coefficient value is showing *X32*(500%) that mean this product is considered as a high volatility with low return i.e risk industrial exports product. Most of the mineral exports products are not graphically normally distributed due to mean value is approximately equal to median value, Skewness is approximately zero & Kurtosis is approximately zero i.e Skewed distribution (right).

4.2.3: DISTRIBUTION OF TOTAL IMPORTS COMMODITIES

Table 4.9: Summary Statistics for Total Imports of Categories

Variable	Mean	St. Dev	Coef. Var	Min	Median	Max	Skewness	Kurtosis
CY1	33,742	15,058	44.63	11,156	32,217	70,942	0.30	-1.10
IY2	**101,480**	**28,171**	27.76	37,909	107,980	156,385	-0.29	-0.85
IY3	40,412	15,111	37.39	13,947	42,359	68,078	0.07	-1.20
UY4	1,010	1,784	176.66	34	309	9,472	3.21	10.72

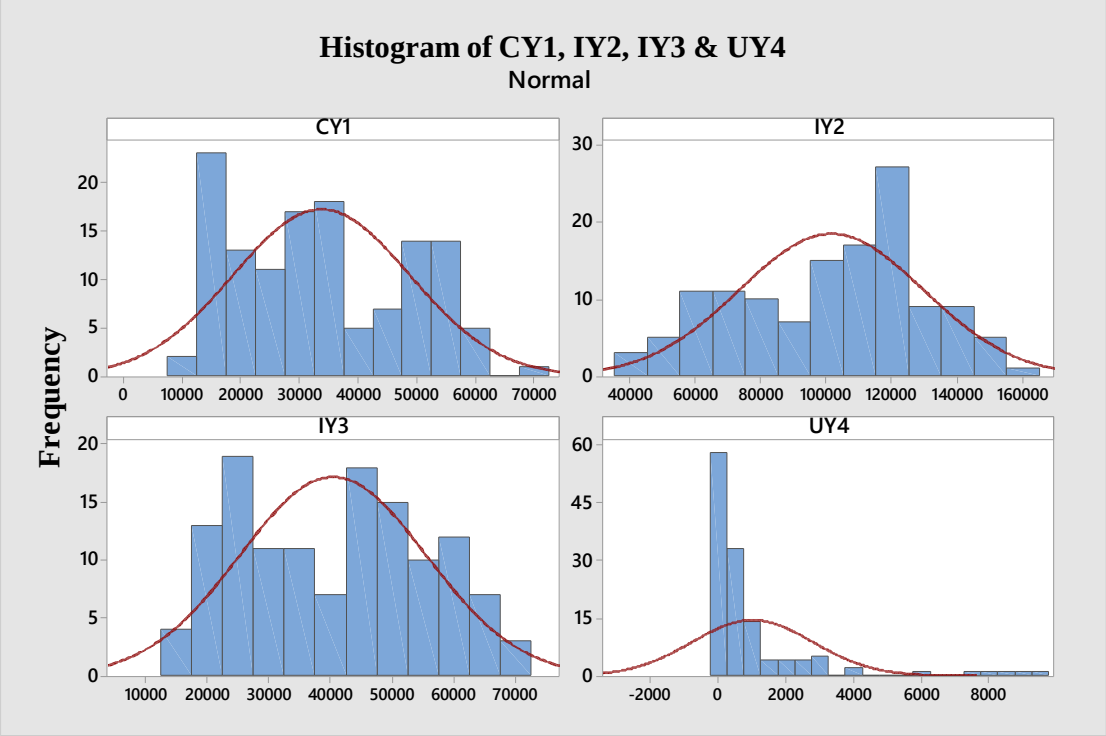

Figure 4.4: Histograms for Total Import of Categories

According to table 4.9 & figure 4.5, it is show that highest mean value & standard deviation is showing for industrial import (*IY2*, Rs.101,480 Mn, Rs.28,171 Mn). That means, *IY2* is showing highest variation during the 10-year period. *IY2* is also showing maximum range compared to other four groups. *UY4* was showing minimum variations (Rs.1,784 Mn). For three main imports categories are graphically normal except UY4 since mean value is approximately equal to median value.

Table 4.10: Summary Statistics for Consumer good Import Commodities

Variable	Mean	St. Dev	Coef. Var	Min	Median	Max	Skewness	Kurtosis
Y1	14,432	4,964	34.39	5,721	14,236	32,329	0.40	0.07
Y2	3,046	1,257	41.27	1,038	2,704	6,889	0.67	-0.17
Y3	2,965	1,274	42.98	644	2,922	8,420	0.89	1.76
Y4	1,062	1,710	160.96	94	350	8,122	2.65	6.61
Y5	2,827	934	33.05	798	2,824	5,637	0.27	0.28
Y6	1,692	727	42.98	473	1,442	3,888	1.02	0.22
Y7	312	197	63.48	76	245	1,134	1.23	1.53
Y8	912	385	42.28	333	837	2,037	0.85	0.09
Y9	489	289	59.09	129	426	1,419	0.94	0.23
Y10	629	356	56.60	122	625	1,998	0.68	0.48
Y11	497	292	58.76	102	465	1,512	1.10	1.62
Y12	**19,310**	**10,583**	54.81	4,637	18,320	41,279	0.36	-1.11
Y13	3,681	1,715	46.59	596	3,586	7,705	0.39	-0.87
Y14	6,623	4,658	70.32	456	6,704	21,459	0.85	0.58
Y15	1,274	609	47.86	419	1,162	3,168	0.76	-0.04
Y16	1,842	1,013	55.02	215	1,803	4,576	0.47	-0.44
Y17	2,238	1718	76.75	425	1,631	8,610	1.10	0.72
Y18	612	257	42.06	206	602	1,357	0.57	-0.10
Y19	845	363	42.99	303	806	2,407	0.75	1.22
Y20	406	182	44.99	154	372	1,153	1.60	3.36
Y21	1,352	1,145	84.74	1	1,026	5,610	1.15	0.99
Y22	436	220	50.38	102	417	1,043	0.56	-0.62

Based on the table 4.10, *Y1-Y22* commodities are belong to *CY1* (Consumer goods Imports). *Y12*(Other Consumer Goods) is showing a highest mean value (Rs.19,310Mn) & standard deviation (Rs.10,583Mn). Mean (Rs.312Mn) & standard deviation (Rs.198Mn) values are minimum for *Y7*(Oil and fats). Lowest coefficient of variation is showing for *Y5* (33%) that mean, it is a most optimal risk-to-reward ratio i.e low volatility with high returns. Similarly, 2nd (34%) & 3rd (41%) are *Y1* (Food and Beverages) & *Y2* (Vegetables) which are given low volatility with high returns respectively. Whilst the highest coefficient values are showing *Y4*(161%, Cereals and milling industry products) that mean this product is considered as a high volatility with low return i.e risk consumer good products. Most of the consumer goods imports products are graphically normally distributed due to mean value is approximately equal to median value, Skewness is approximately zero & Kurtosis is approximately zero except *Y4*, *Y11*, *Y7*, *Y11*, *Y17*, *Y20* & *Y21* product.

Table 4.11: Summary Statistics for Intermediate Goods Import Commodities

Variable	Mean	St. Dev	Coef. Var	Min	Median	Max	Skewness	Kurtosis
Y23	36,186	14,005	38.70	8,443	34,781	75,769	0.44	-0.34
Y24	11,268	6,811	60.45	0	10,373	31,249	0.72	0.68
Y25	23,738	10,130	42.67	4,318	22,902	51,881	0.51	-0.20
Y26	1,180	1,689	143.13	0	236	8,543	1.75	3.09
Y27	22,510	6,780	30.12	11,283	22,199	38,177	0.47	-0.60
Y28	7,074	2,577	36.43	2,431	6,808	12,299	0.11	-1.20
Y29	5,233	1,777	33.97	1,722	4,986	8,973	0.18	-1.09
Y30	3,466	1,915	55.24	26	3,358	10,305	0.53	0.60
Y31	4,851	3,315	68.34	511	3,939	15,008	0.95	0.16
Y32	2,142	2,852	133.15	0	669	10,014	1.33	0.67
Y33	4,159	1,370	32.93	1,860	3,989	7,074	0.38	-0.87
Y34	3,965	2,088	52.67	712	3,589	10,250	0.87	0.30
Y35	2,732	1,996	73.05	76	2,276	11,814	1.74	4.13
Y36	2,218	853	38.50	880	2107	4,305	0.45	-0.85

Y37	1,473	654	44.45	429	1,356	3,128	0.42	-0.74
Y38	2,408	876	36.38	713	2,313	5,116	0.59	0.35
Y39	1,967	1,196	60.77	344	1,562	6,351	1.09	1.29
Y40	1,702	1,324	77.81	318	1,406	8,031	2.07	5.40
Y41	610	341	55.89	106	534	1,710.	1.12	1.16
Y42	925	336	36.35	381	861	2,028	0.58	-0.29

Based on the table 4.11, *Y23-Y42* commodities are belong to *IY2* (Intermediate Good Imports). *Y23*(Fuel) is showing highest mean values (Rs.36,186Mn) & standard deviations (Rs.14,005Mn). Mean (Rs.610Mn) & standard deviation (Rs.341Mn) values are minimum for *Y41*(Unmanufactured Tobacco). Lowest coefficient of variation value (30%) is showing for *Y27*(Textile & Textile articles) that mean, *Y21* product is a most optimal risk-to-reward ratio i.e low volatility with high returns. Whilst the highest coefficient values are showing *Y32*(133%, Gold) i.e the product is considered as a high volatility with low return. Most of the intermediate goods imports products are graphically normally distributed due to mean value is approximately equal to median value, Skewness is approximately zero & Kurtosis is approximately zero except *Y26, Y35, Y39, Y40* & *Y41* products which are not normally distributed i.e Skewed distribution (right).

Table 4.12: Summary Statistics for Investment Goods Imports Commodities

Variable	Mean	St. Dev	Coef. Var	Min	Median	Max	Skewness	Kurtosis
Y43	**20,997**	**8,380**	**39.91**	7,930	20,918	42,713	0.33	-0.87
Y44	12,172	4,836	**39.73**	4,403	12,077	23,575	0.33	-0.94
Y45	7,187	3,500	48.70	1,511	6,999	18,248	0.86	0.86
Y46	**55**	**46**	**84.00**	11	42	387	3.50	19.59

Based on the table 4.12, *Y43-X46* commodities are belong to *IY3* (Investment Goods Imports). *Y43*(Machinery and equipment) is showing highest mean value (Rs.20997Mn) with highest standard deviation (Rs.8340Mn). *Y46*(Other investment Goods) is showing the lowest mean value (Rs.56Mn) with lowest standard deviation (Rs.47Mn). Lowest

coefficient of variation value (40%) is showing for *Y43 & Y44* that mean, this product is a most optimal risk-to-reward ratio i.e low volatility with high returns. Whilst the highest coefficient value is showing *Y46* (84%, Other investment Goods) that mean this product is considered as a high volatility with low return. Most of the investment goods imports products are graphically normally distributed due to mean value is approximately equal to median value, Skewness is approximately zero & Kurtosis is approximately zero except *Y46* i.e Skewed distribution (right).

When considering from Tables 4.5 to 4.8 (Total Exports Commodities), *X13* is showing the highest mean (Rs.43,804Mn) & standard deviation (Rs.12,550Mn, Textiles and garments) values. Lowest mean value (Rs.82Mn, Precious Metals) is presented *X32* whilst *X31* is showed the lowest standard deviation (Rs.57Mn, Ores, slag and ash). Lowest coefficient of variation value (18%, Ceramics products) is showing for *X28* that mean, this product is a most optimal risk-to-reward ratio i.e low volatility with high returns. Whilst the highest coefficient value is showed *X32* (500%, Precious Metals) that mean this product is considered as a high volatility with low return.

Similarly, from Tables 4.10 to 4.12 (Total Imports Commodities), *Y23* is showing the highest mean (Rs.36,186Mn) & standard deviation (Rs.14,005Mn, Fuel) values. *Y46* is showing the lowest mean (Rs.56Mn) & standard deviation (Rs.47Mn, Other investment Goods) values. Lowest coefficient of variation value (30%, Textile and textile articles) is showing for *Y27* that mean, this product is a most optimal risk-to-reward ratio i.e low volatility with high returns. Whilst the highest coefficient value is showed *Y4* (161%, Cereals and milling industry products) that mean this product is considered as a high volatility with low return.

It is clearly categories entire eight groups into major two groups by looking the scale (Appendix Figures b.1 & b.2) i.e one group is belonging to Rs. 10,000Mn - Rs. 160,000Mn (*AX1, IX2, CY1, IY2* & *IY3*) which is called Major 1 and other is Rs. 0Mn - Rs. 20,000Mn (*MX3, UX4* & *UY4*) which is called Major 2. When consider Major 2 group, it is clearly

showing that there are sharply increasing trend. But, it is compared with Major 1 group, it is negligible. Also, there are no any seasonal or cyclic variations. *UY4* was showing four periods like 2007-2008 (sharply increasing), 2008-2010 (cyclic pattern), 2010-2016 (down word trend) & 2016-2017 (significant up & down spikes). Similarly, *MX3* () is showing a sharply increasing trend and 2011-2013, there are high variations i.e up & down movement. And there is no significant variation for *UX4*.

Similarly, when considering Major 2 group, all five categories were showing increasing trend during the period. By looking the time series plots, there are four seasons. First one is 2007-2011 period (no trend). Second one is 2011-2012 (increasing trend). Third one was 20120-2015 (sharply decreasing trend thereafter no trend). Finally, 2015-2017 there was sharply increasing trend. Except *IY2*, other categories were showing increasing trend furthermore.

4.3: CORRELATION ANALYSIS

The correlation analysis is a statistical method used to exam the strength of linear relationship between two variables. A high correlation means that two variables have a strong relationship, a week correlation means that two variables have a week relationship and approximately zero value is indicated no correlation. The aim of the study is to evaluate a general overview of the relationship in each category as well as major groups.

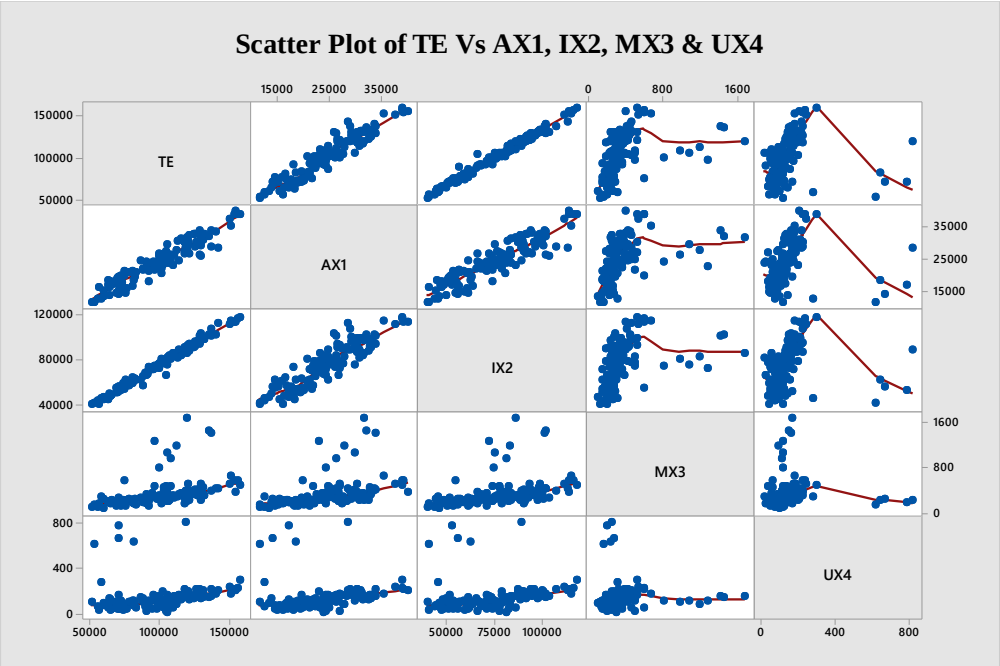

Figure 4.5: Correlation Matrix of Total Exports

Table 4.13: Correlation Coefficient for Total Exports

	TE	AX1	IX2	MX3
AX1	0.950***			
	0.000			
IX2	**0.992*** **	0.909***		
	0.000	0.000		
MX3	0.427***	0.446***	0.402***	
	0.000	0.000	0.000	
UX4	**0.163***	0.122	0.170**	0.011
	0.063	0.167	0.053	0.901

Sig Level: .1 *, .05**, .01***

According to the above scatter plots matrix (Figure 4.7) and Spearmen's correlation matrix (Table 4.13), it is clearly indicated that most of the variables are positively correlated with *TE* (Total Exports). Among the main four categories, *IX2* & *TE* is showing the highest strong positive correlation (0.992) & second highest strong positive relationship is *AX1* (0.950). *MX3* & *TE* is presented moderate positive relationship

(0.427). Minimum or week positive correlation (0.163) is showing *UX4* & *TE*. Pair of (*IX2*, *TE*), (*AX1*, *TE*) & (*MX3*, *TE*) are statistically significant at 5% S.L. That's mean H_0 is rejected at 5% S.L (P-value < 0.05). It can be concluded that these pairs are statistically positive significant relationship. Similarly, (*UX4*, *TE*) is not statistically significant at 5% S.L but it is at 1% (P-value < 0.1) S.L i.e the pair is statistically positive relationship at 1% S.L.

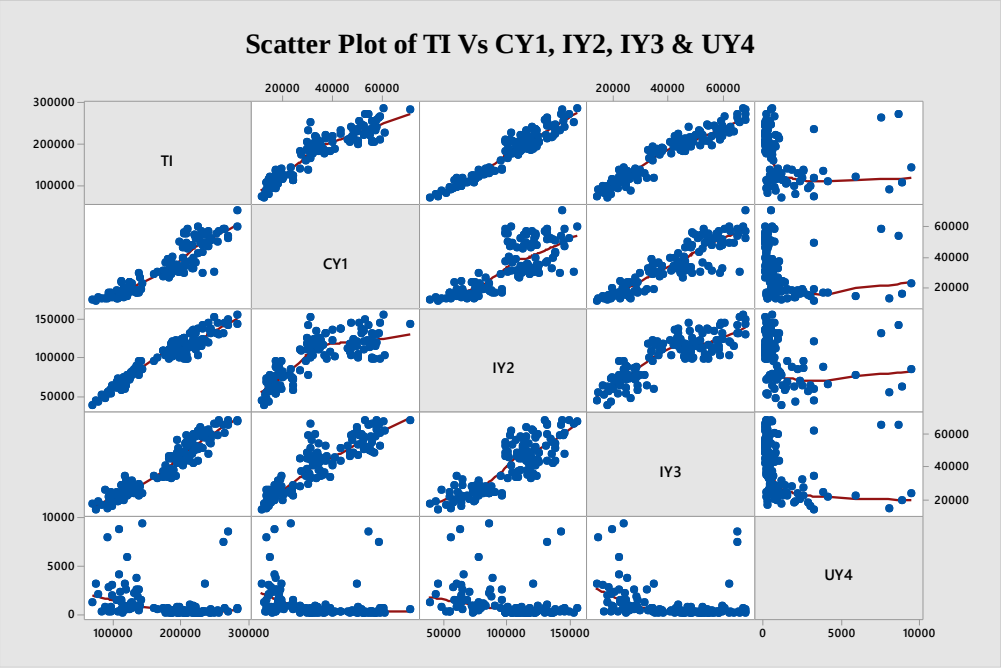

Figure 4.6: Scatter Plot Matrix of Total Imports

4.14: Correlation Coefficient for Total Imports

	TI	CY1	IY2	IY3
CY1	0.911***			
	0.000			
IY2	**0.954*** **	0.767		
	0.000	0.000		
IY3	0.951***	0.893	0.845	
	0.000	0.000	0.000	
UY4	**-0.277****	-0.278	-0.293	-0.296
	0.001	0.001	0.001	0.001

Sig Level: .1 *, .05**, .01***

According to the above scatter plots matrix (Figure 4.8) and Spearmen's correlation matrix (Table 4.14), it is clearly indicated that most of the variables are positively correlated with *TI* (Total Exports) except *UY4*. Among the main four categories, *IY2* & *TI* is showing the highest strong positive correlation (0.954) & second highest strong positive relationship is *IY3* (0.951). *CY1* & *TI* is also presented strong positive relationship (0.911). Moderate negative correlation (-0.277) is showing *UY4* & *TI*. Pair of (*IY3, TI*), (*IY2, TI*) & (*CY1, TI*) are statistically significant at 5% S.L. That's mean H_0 is rejected at 5% S.L (P-value < 0.05). It can be concluded that these pairs are statistically positive significant relationship. Similarly, (*UY4, TI*) is statistically significant at 5% S.L (P-value < 0.05) i.e the pair is statistically negative relationship at 5% S.L.

4.3.1: CORRELATION ANALYSIS EXPORTS COMMODITIES GROUP

4.15: Correlation Coefficient for *AX1* & *AX1* Commodities

	AX1	***X1***	***X2***	***X3***	***X4***	***X5***	***X6***	***X7***	***X8***	***X9***
X1	**0.964****									
X2	-0.381**	-0.314								
X3	0.843**	0.722	-0.543							
X4	0.762**	0.631	-0.576	0.971						
X5	**0.860****	0.779	-0.396	0.897	0.765					
X6	0.858**	0.753	-0.473	0.748	0.688	0.742				
X7	0.774**	0.710	-0.456	0.736	0.724	0.643	0.603			
X8	0.341**	0.357	-0.152	0.150	0.110	0.201	0.275	0.198		
X9	0.846**	0.754	-0.524	0.835	0.823	0.726	0.715	0.837	0.221	
X10	0.718**	0.704	-0.348	0.523	0.437	0.601	0.487	0.637	0.355	0.608

Sig Level: .1 *, .05**, .01***

According to the above Spearmen's correlation matrix (Table 4.15), it is clearly showed that most of the variables are strongly positive correlation with *AX1* (Agriculture Exports, Correlation > 0.75) except *X2 & X8*. Among the main category, *X1* is showing the highest strong positive correlation (0.964) & second highest strong positive relationship is *X5*

(0.860). Only *X2* is presented moderate negative relationship (-0.381). Lowest correlation is showing for X8 (Moderate, -0.341). All pair of *AX1* & it's commodities (*X1-X10*) are statistically significant at 5% S.L. That's mean H_0 is rejected at 5% S.L (P-value < 0.05). It can be concluded that these pairs are statistically positive significant relationship except *X2*. *X2* is statistically negative relationship with *AX1*. Three groups can be identified in *AX1* main category such as highly positive correlated (1.0 - 0.7), moderately positive correlated (0.6 - 0.3) and moderately negative correlated.

	IX2	X11	X12	X13	X14	X15	X16	X17	X18	X19	X20	X21	X22	X23	X24	X25	X26	X27
X11	0.684																	
X12	0.470	0.325																
X13	0.971	0.622	0.429															
X14	0.969	0.617	0.429	0.999														
X15	0.848	0.550	0.412	0.856	0.840													
X16	0.769	0.652	0.221	0.790	0.780	0.732												
X17	0.928	0.577	0.410	0.860	0.860	0.757	0.616											
X18	-0.086	-0.078	0.033	-0.196	-0.192	-0.182	-0.300	0.105										
X19	0.728	0.564	0.299	0.680	0.672	0.656	0.698	0.677	-0.072									
X20	0.283	0.201	0.240	0.166	0.165	0.168	0.113	0.183	-0.094	0.128								
X21	0.607	0.352	0.301	0.496	0.495	0.460	0.326	0.706	0.187	0.393	0.037							
X22	0.919	0.604	0.462	0.900	0.897	0.816	0.718	0.877	-0.132	0.633	0.140	0.611						
X23	0.933	0.651	0.439	0.890	0.885	0.847	0.749	0.902	-0.096	0.754	0.167	0.648	0.930					
X24	-0.083	-0.051	-0.022	-0.160	-0.156	-0.178	-0.188	-0.043	-0.044	-0.194	0.066	0.066	-0.057	-0.099				
X25	0.840	0.621	0.309	0.873	0.870	0.759	0.828	0.682	-0.340	0.655	0.169	0.319	0.778	0.780	-0.156			
X26	0.855	0.698	0.343	0.845	0.840	0.777	0.800	0.744	-0.210	0.751	0.198	0.411	0.804	0.848	-0.206	0.817		
X27	0.586	0.562	0.193	0.559	0.550	0.547	0.692	0.497	-0.283	0.717	0.059	0.275	0.574	0.667	-0.084	0.633	0.674	
X28	0.368	0.324	0.079	0.341	0.340	0.321	0.246	0.354	0.156	0.517	0.101	0.023	0.251	0.316	-0.126	0.293	0.400	0.304
X29	0.933	0.647	0.382	0.931	0.927	0.834	0.802	0.855	-0.165	0.709	0.160	0.498	0.892	0.900	-0.166	0.853	0.853	0.634

Sig Level: .1 *, .05**, .01***

4.16: Correlation Coefficient for *IX2* & *IX2* Commodities

According to the above Spearmen's correlation matrix (Table 4.16), it is clearly showed that *X13-X17, X19, X22-X23, X25-X26 & X29* variables are strongly positive correlation with *IX2* (Industrial Exports, Correlation > 0.75). Among the main category, *X12, X20, X21 & X27-X28* variables are showing the moderate positive correlation (0.3 – 0.75). Only *X18 & X24* are presented week negative relationship. Highest correlation is showing for *X23 & X29* (0.933) variables. Lowest correlation is showing for *X24* (Week, -0.083). Most pair of *IX2* & it's commodities (*X11-X29*) are statistically significant at 5% S.L. That's mean H_0 is rejected at 5% S.L (P-value < 0.05). It can be concluded that these pairs are statistically positive significant relationship except *X18 & X24*. *X18 & X24* are statistically insignificant relationship with *IX2*. Three groups can be identified in *IX2* main category such as highly positive correlated (1.0 - 0.7), moderately positive correlated (0.7 - 0.3) and week negative correlated.

4.17: Correlation Coefficient for *MX3* & *MX3's* Commodities

	MX3	**X30**	**X31**
X30	0.349**		
X31	0.561**	0.219	
X32	0.474**	0.031	0.076

Sig Level: .1 *, .05**, .01***

According to the above Spearmen's correlation matrix (Table 4.17), it is clearly showed that all variables are moderately positive correlation with *MX3* (Mineral Exports, Correlation between 0.3 - 0.75). *X31* is showing the highest moderate positive correlation (0.561). Lowest correlation is showing for *X30* (Moderate, 0.349). All pair of *MX3* & it's commodities (*X30-X32*) are statistically significant at 5% S.L. That's mean H_0 is rejected at 5% S.L (P-value < 0.05). It can be concluded that these pairs are statistically positive significant relationship. Only one group can be identified in *MX3* main category such as moderately positive correlated.

4.3.2: CORRELATION ANALYSIS IMPORTS COMMODITIES GROUP

	CY1	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8	Y9	Y10	Y11	Y12	Y13	Y14	Y15	Y16	Y17	Y18	Y19	Y20	Y21
Y1	0.932**																					
Y2	0.712**	0.764																				
Y3	0.433**	0.527	0.296																			
Y4	0.455**	0.573	0.263	-0.091																		
Y5	0.595**	0.654	0.384	0.333	0.252																	
Y6	0.858**	0.784	0.704	0.331	0.221	0.391																
Y7	0.541**	0.549	0.466	0.189	0.200	0.327	0.564															
Y8	0.847**	0.806	0.648	0.448	0.296	0.402	0.795	0.483														
Y9	0.880**	0.856	0.644	0.384	0.391	0.515	0.861	0.587	0.734													
Y10	0.834**	0.767	0.467	0.528	0.224	0.501	0.753	0.464	0.717	0.789												
Y11	0.816**	0.789	0.488	0.223	0.599	0.487	0.614	0.423	0.714	0.700	0.675											
Y12	0.986**	0.858	0.654	0.368	0.379	0.541	0.852	0.512	0.827	0.850	0.826	0.791										
Y13	0.923**	0.853	0.661	0.411	0.329	0.527	0.875	0.539	0.783	0.899	0.850	0.736	0.914									
Y14	0.866**	0.693	0.516	0.270	0.342	0.462	0.658	0.359	0.695	0.616	0.640	0.701	0.907	0.700								
Y15	0.905**	0.828	0.630	0.367	0.348	0.510	0.841	0.536	0.749	0.889	0.837	0.748	0.900	0.907	0.685							
Y16	0.860**	0.793	0.558	0.448	0.267	0.551	0.774	0.539	0.757	0.841	0.831	0.651	0.852	0.852	0.638	0.855						
Y17	0.896**	0.805	0.664	0.311	0.364	0.458	0.822	0.516	0.778	0.828	0.744	0.727	0.898	0.859	0.705	0.883	0.782					
Y18	0.821**	0.814	0.604	0.531	0.223	0.562	0.808	0.514	0.750	0.822	0.834	0.628	0.786	0.864	0.556	0.822	0.833	0.730				
Y19	0.879**	0.766	0.575	0.345	0.298	0.473	0.784	0.474	0.752	0.768	0.852	0.724	0.891	0.834	0.788	0.843	0.744	0.793	0.743			
Y20	0.543**	0.439	0.275	0.275	0.144	0.277	0.440	0.207	0.476	0.438	0.509	0.428	0.567	0.510	0.521	0.494	0.500	0.429	0.443	0.518		
Y21	0.891**	0.826	0.651	0.296	0.416	0.461	0.860	0.528	0.784	0.873	0.761	0.703	0.881	0.862	0.683	0.843	0.821	0.826	0.746	0.754	0.495	
Y22	0.911**	0.819	0.623	0.335	0.336	0.516	0.850	0.528	0.749	0.892	0.849	0.771	0.912	0.900	0.711	0.938	0.847	0.888	0.818	0.858	0.494	0.877

Sig Level: .1 *, .05**, .01***

4.18: Correlation Coefficient for *CY1* & *CY1's* Commodities

According to the above Spearmen's correlation matrix (Table 5.6), it is clearly showed that all variables are positively correlated with *CY1*. Out of the variables, *Y1, Y2, Y6, Y8-Y19 & Y21-Y22* variables are strongly positive correlation with *CY1* (Consumer Imports, Correlation > 0.75). Others are moderately positive correlated such as *Y3-Y5, Y7 & Y19.* The highest correlation is showing for *Y1* (0.932) variable. Lowest correlation is showing for *Y3* (0.433). All pair of *CY1* & it's commodities (*Y1-Y22*) are statistically significant at 5% S.L. That's mean H_0 is rejected at 5% S.L (P-value < 0.05). It can be concluded that these pairs are statistically positive significant relationship. Two groups can be identified in *CY1* main category such as highly positive correlated (1.0 - 0.7) & moderately positive correlated (0.7 - 0.3).

	IY2	Y23	Y24	Y25	Y26	Y27	Y28	Y29	Y30	Y31	Y32	Y33	Y34	Y35	Y36	Y37	Y38	Y39	Y40	Y41
Y23	0.761**																			
Y24	0.321**	0.679																		
Y25	0.754**	0.879	0.266																	
Y26	0.491**	0.280	0.002	0.219																
Y27	0.796**	0.272	-0.109	0.365	0.511															
Y28	0.818**	0.347	-0.040	0.417	0.536	0.890														
Y29	0.819**	0.327	-0.056	0.404	0.515	0.913	0.954													
Y30	0.359**	0.214	0.095	0.212	0.120	0.227	0.231	0.265												
Y31	0.419**	0.224	0.043	0.258	0.136	0.326	0.203	0.202	0.130											
Y32	0.509**	0.189	-0.013	0.226	0.265	0.508	0.402	0.405	0.126	0.910										
Y33	0.766**	0.248	-0.080	0.328	0.408	0.897	0.911	0.946	0.230	0.204	0.390									
Y34	0.769**	0.430	0.037	0.487	0.489	0.721	0.749	0.768	0.213	0.198	0.359	0.723								
Y35	0.124**	0.175	0.201	0.116	-0.061	-0.104	-0.088	-0.074	0.072	0.057	-0.069	-0.004	0.033							
Y36	0.786**	0.273	-0.081	0.344	0.530	0.921	0.934	0.932	0.186	0.295	0.514	0.894	0.737	-0.097						
Y37	0.768**	0.340	-0.039	0.426	0.419	0.842	0.880	0.880	0.242	0.164	0.363	0.859	0.726	-0.086	0.881					
Y38	0.530**	0.186	-0.054	0.245	0.295	0.542	0.538	0.586	0.366	0.270	0.394	0.554	0.435	-0.024	0.541	0.474				
Y39	0.673**	0.190	-0.105	0.277	0.340	0.783	0.837	0.818	0.155	0.283	0.464	0.821	0.620	-0.067	0.859	0.707	0.537			
Y40	0.560**	0.298	0.082	0.306	0.306	0.476	0.600	0.590	0.191	0.130	0.231	0.550	0.470	-0.024	0.537	0.533	0.358	0.467		
Y41	0.453**	0.138	-0.096	0.226	0.175	0.533	0.540	0.525	0.264	0.093	0.171	0.533	0.491	0.037	0.480	0.521	0.183	0.396	0.289	
Y42	0.729**	0.231	-0.099	0.302	0.506	0.882	0.872	0.893	0.260	0.189	0.396	0.886	0.664	-0.067	0.883	0.813	0.530	0.745	0.563	0.457

Sig Level: .1 *, .05**, .01***

4.19: Correlation Coefficient for *IY2* & *IY2's* Commodities

According to the above Spearmen's correlation matrix (Table 5.7), it is clearly showed that all variables are positively correlated with *IY2*. Out of the variables, *Y23, Y25, Y27-Y29, Y33, Y34, Y36, Y37 & Y42* variables are strongly positive correlation with *IY2* (Intermediate Goods, Correlation > 0.75). *Y24, Y30-Y32, Y35 & Y38-Y41* are moderately positive correlated with *IY2*. Only *Y35* is presented week positive correlation among the all variables. The highest correlation is showing for *Y29* (0.819) variable. Lowest correlation is showing for *Y3* (0.124). All pair of *IY2* & it's commodities (*Y23-Y42*) are statistically significant at 5% S.L. That's mean H_0 is rejected at 5% S.L (P-value < 0.05). It can be concluded that these pairs are statistically positive significant relationship. Three groups can be identified in *IY2* main category such as highly positive correlated (1.0 - 0.7), moderately positive correlated (0.7 - 0.3) & weekly positive correlated.

4.20: Correlation Coefficient for *IY3* & *IY3's* Commodities

	IY3	Y43	Y44	Y45
Y43	0.971**			
Y44	0.943**	0.915		
Y45	0.682**	0.528	0.490	
Y46	0.541**	0.556	0.569	0.206

Sig Level: .1 *, .05**, .01***

According to the above Spearmen's correlation matrix (Table 5.8), it is clearly showed that all variables are positive correlation with *IY3* (Investment Goods Imports). *Y43* & *Y44* are strong positive correlation with *IY3. Y45 & Y46* are showing the moderate positive correlation with *IY3*. Highest correlation is presented *Y45* (0.943). Lowest correlation is showing for *Y46* (Moderate, 0.541). All pair of *IY3* & it's commodities (*Y43-Y46*) are statistically significant at 5% S.L. That's mean H_0 is rejected at 5% S.L (P-value < 0.05). It can be concluded that these pairs are statistically positive significant relationship. Only two groups can be identified in *IY3* main category such as highly positive correlated (1.0 - 0.7) & moderately positive correlated (0.7 - 0.3).

4.4: PRINCIPLE COMPONENT ANALYSIS

4.4.1: INTRODUCTION

In this section, Principle Component Analysis (*PCA*) technique is used to describe the Total Exports (*TE*) and Total Imports (*TI*). Correlation studies are carried out (section 4.3) before applied the PCA. Also, it can be only applied *PCA* techniques for mainly 3 categories from each group. That means, *PCA* is applied for *AX1*, *IX2 & MX3* in *TE*. Similarly, PCA is applied for *CY1, IY2 & IY3* in *TE*. Other both groups (*UX4 & UY4*) are contained one variable. PCA is a dimension reduction tool that can be used to reduce a large set of variables to a small set that still contains most of the information in the large set. Also, it is a mathematical procedure that transform several possible correlated variables into a smaller number of uncorrelated variables called Principle Component (*PC*). Based on those facts, we tried to investigate numbers of *PC*'s for each group commodities separately using the advance statistical method.

4.4.2: *PCA* for Total Exports (*TE*)

According to the original data set there are four main categories for *TE* such as *AX1, IX2, MX3* & *UX4*. But, more than two variables are included only first three groups (*AX1, IX2 & MX3*). Under the *PCA* methodology, only consider these three categories.

4.4.2.1: *PCA* for Agriculture Exports (*AX1*) in *TE*

Table 4.21: Eigen Values for *AX1*

PC	**PC1**	**PC2**
Eigen Value (λ_i)	**6.3770**	**1.1224**
Probability (P_i)	0.6380	0.1120
Cumulative Probability (C. P_i)	0.6380	0.7500

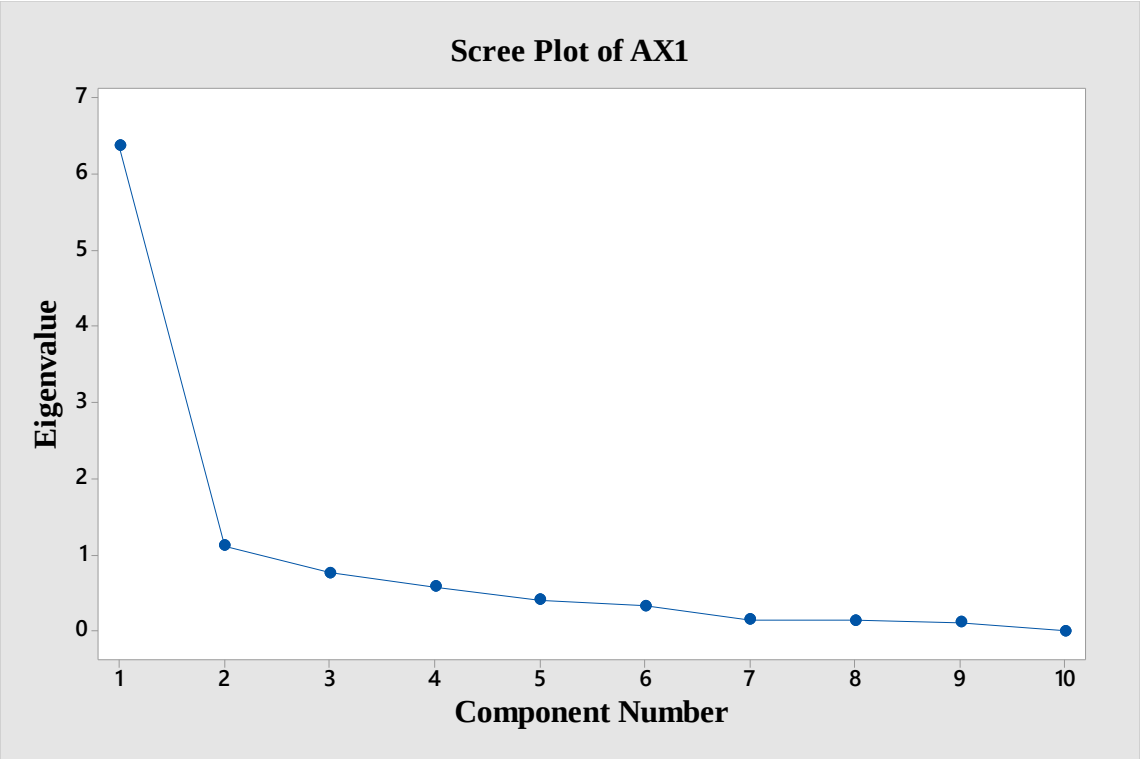

Figure 4.7: Scree Plot for *AX1*

According to the above table 4.21 & figure 4.9 for *AX1*, the point where the slope of the curve is clearly leveling off (elbow) indicates after 2nd components. Also, eigen values are greater than "1" for 1st and 2nd (λ_1 = 6.3770>1, λ_2 = 1.1224>1) components. Since, there are two components (namely PC1 & PC2) which can be selected for further analysis. Furthermore, these ten commodities can be grouped into two factors without losing much information. PC1 is explained 64% of the total variance & PC2 is explained 11% of the total variance. The cumulative proportion of variance explained by the first two components is roughly 75% of the total variance.

Table 4.22: Coefficient/ Eigen Vector for *AX1*

Variable	PC1	PC2
X1	**0.341**	0.242
X2	-0.235	0.224
X3	**0.370**	-0.226
X4	**0.350**	**-0.305**
X5	**0.349**	-0.041
X6	**0.330**	0.016
X7	**0.336**	-0.016
X8	0.122	**0.775**
X9	**0.362**	-0.070
X10	**0.282**	**0.374**

Based on the above table 4.22, the *PC1* is moderately correlated with 9 variables and one variable is week positive correlation (*X8*, 0.122). Out of 9 variables, 8 variables are showing positive magnitude and *X2* is showing negative magnitude with *PC1*, but all 8 variables are approximately equal coefficient value. This suggests that these 8 commodities vary together (Tea, Coconut, Kernel Products, Other Spices, Vegetable, Minor agriculture & Sea food). If one increases, then the remaining ones tend to increase as well. This component can be viewed as measure of the general needed foods in human life.

Similarly, the *PC2* is showing both negative/positive correlation & no correlation with commodities. Out of all 10 commodities, *X8* is highly correlated with the second component (0.775). Three commodities (*X1, X2* & *X10*) are moderately positive correlated. Two variables are moderately negative correlated (*X3* & *X4*). And others are not correlated with second principle component. Furthermore, PC2 is most correlated with *X4, X8 & X10* both negative & positive direction (Coconut, Unmanufactured Tabaco & Sea Food). *X8* (Unmanufactured Tabaco) is strongly correlated with *PC2*. This component can be viewed as secondary agriculture foods.

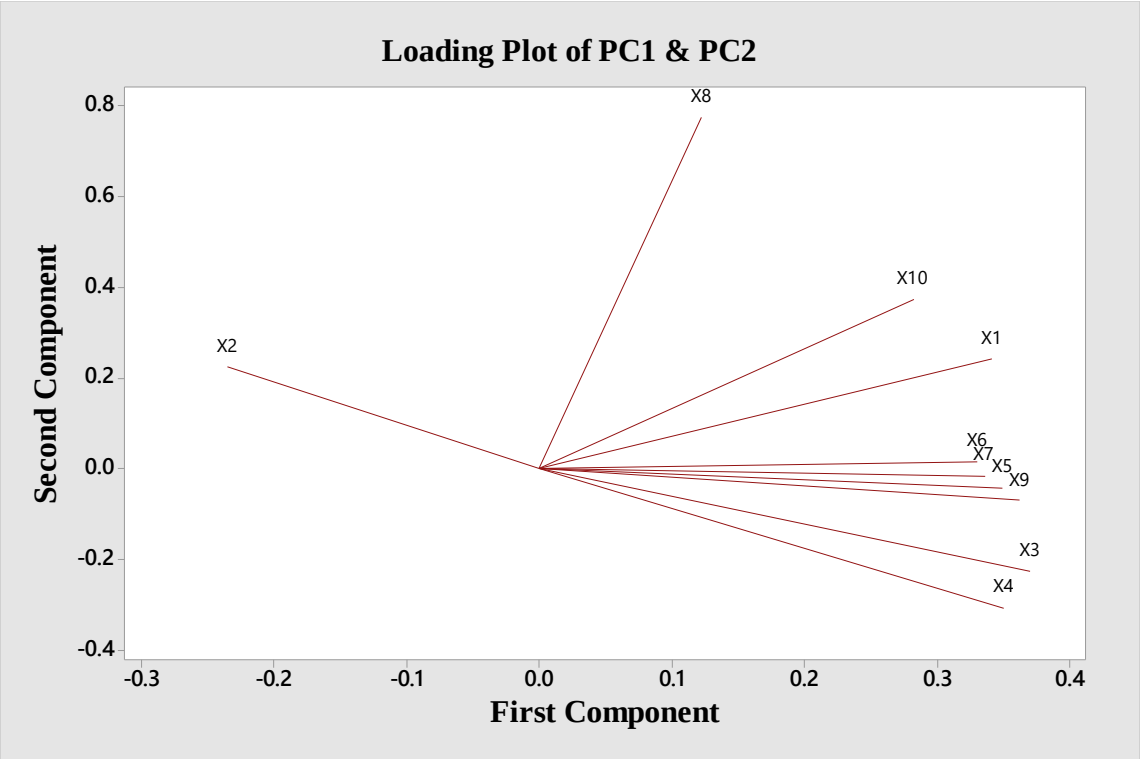

Figure 4.8: Loading Plot for *PC1 & PC2 in AX1*

In this loading plot (figure 4.10) is show that same results as discussed above numerical figures. Seven commodities *X1, X3-X7 & X9* are same direction with positively correlated with *PC1*. *X2, X8 & X10* commodities are related to *PC2*. Similar result is also showing for *X2* that mean it is not showing clear direction for *PC1* & *PC2*.

$$PC1 = 0.341X1 - 0.235X2 + 0.370X3 + 0.350X4 + 0.349X5 + 0.330X6 + 0.336X7 + 0.122X8 + 0.362X9 + 0.282X10$$

$$PC2 = 0.241X1 + 0.224X2 - 0.226X3 - 0.305X4 - 0.041X5 - 0.016X6 - 0.016X7 + 0.775X8 - 0.070X9 + 0.344X10$$

4.4.2.2: *PCA* for Industrial Exports (*IX2*) in *TE*

Table 4.23: Eigen Values for *IX2*

PC	PC1	PC2	PC3	PC4	PC5
Eigen Value (λ_i)	**10.781**	**1.563**	**1.287**	**1.094**	**0.953**
Probability (P_i)	0.567	0.082	0.068	0.058	0.050
Cumulative Probability (C. P_i)	0.567	0.650	0.717	0.775	0.825

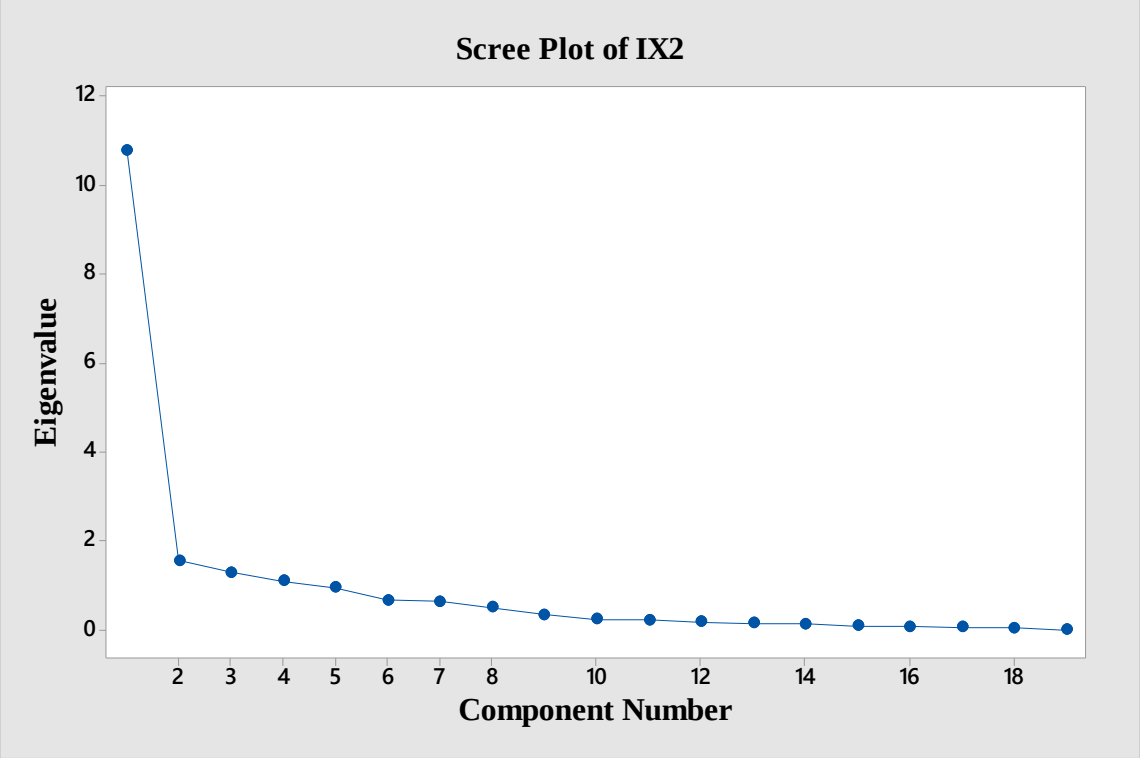

Figure 4.9: Scree Plot for *IX2*

According to the above table 4.23 & figure 4.11 for *IX2*, the point where the slope of the curve is clearly leveling off (elbow) indicates after 2nd components but the thumb of rule of eigen value table, first five components λi's are greater than one ($\lambda 1$ = 10.781>1, $\lambda 2$ = 1.563>1, $\lambda 3$ = 1.287>1, $\lambda 4$ = 1.094>1, $\lambda 5$ = 0.953=1). Since, there are five components (namely PC1, PC2, PC3, PC4 & PC5) which can be selected for further analysis. Furthermore, these 18 industrial exports commodities can be grouped into five factors without losing much information. PC1 is explained 57% of the total variance, PC2 is

explained 8% of the total variance, PC3 is explained 7% of the total variance, PC4 is explained 6% of the total variance, PC5 is explained 5% of the total variance. The cumulative proportion of variance explained by the first five components is roughly 83% of the total variance. Comparatively, total variance of PC1 is higher than other four components (approximately 7 times). Since it can be concluded that most of the commodities are influence by PC1 that other four components.

Table 4.24: Coefficient/ Eigen Vector for *IX2*

Variable	PC1	PC2	PC3	PC4	PC5
X11	**0.221**	-0.032	-0.029	-0.161	0.179
X12	0.136	**0.285**	**0.211**	**-0.282**	**-0.369**
X13	**0.290**	0.006	0.054	0.049	-0.114
X14	**0.288**	0.011	0.056	0.048	-0.114
X15	**0.268**	-0.002	0.031	0.031	-0.133
X16	**0.258**	**-0.246**	0.012	0.091	0.030
X17	**0.269**	**0.290**	-0.015	0.043	0.043
X18	-0.053	**0.592**	**-0.454**	-0.036	0.013
X19	**0.244**	-0.064	**-0.260**	-0.081	0.169
X20	0.061	0.032	**0.259**	**-0.785**	-0.138
X21	0.169	**0.480**	0.125	**0.271**	0.098
X22	**0.281**	0.124	0.127	0.107	-0.029
X23	**0.291**	0.114	0.038	0.070	0.030
X24	-0.048	0.193	**0.478**	-0.120	**0.744**
X25	**0.268**	**-0.208**	0.076	0.023	-0.044
X26	**0.278**	-0.109	-0.057	-0.043	0.001
X27	**0.215**	**-0.256**	-0.066	0.032	**0.311**
X28	0.122	-0.016	**-0.576**	**-0.381**	**0.270**
X29	**0.290**	-0.008	-0.009	0.040	-0.031

Based on the above table 4.24, the *PC1* is moderately correlated with most of the variables (13 commodities, +/-0.3) and other variables are week correlation. Out of 18 variables, 13 variables are showing positive magnitude (*X11, X13-X17, X19, X22, X23, X25-X27 & X29*). This suggests that these 13 commodities vary together (Food beverages & tobacco, Animal Fodder, Textile and Garments, Garments, Textile, Other make up textile, Rubber Products, Gem Diamond and Jewelry, Machinery and mechanical appliances, Wood and Paper Products, Printing Industry Products, Leather travel goods and Foot ware, Plastics and articles thereof, Base metals and articles & Other industrial). *X13* & *X23* are highest correlated with PC1 i.e highly influenced commodities into PC1. If one increases, then the remaining ones tend to increase as well. This component can be viewed as measure of the general well manufactured products.

Similarly, the *PC2* is showing both negative/positive correlation & no correlation with commodities. Out of all 18 commodities, *X18* is highly correlated with the second component (0.592) & 7 commodities (*X12, X26-X18, X21, X25* & *X27*) are moderately positively/ negatively correlated with PC2. Furthermore, PC2 is most correlated both negative & positive direction (Animal Fodder, Other made up textile articles, Rubber products, Gem diamonds and Jewelry, Petroleum products, Leather, travel goods and footwear & Base metals and articles). *X18* (Gem diamonds and Jewelry) is strongly correlated with *PC2*. This component can be viewed as hard raw material exports.

The *PC3* is showing both negative/positive correlation & no correlation with commodities. Out of all 18 commodities, 6 commodities (*X12, X18-X20, X24* & *X28*) are moderately positively/ negatively correlated with PC3. Furthermore, PC3 is most correlated both negative & positive direction (Animal Fodder, Gem diamonds and Jewelry, Machinery and mechanical, Transport equipment, Printing industry products & Ceramics products). *X28* (Ceramics products, -0.676) is strongly negative correlated with *PC3*. This component can be viewed as soft raw material exports.

The *PC4* is showing both negative/positive correlation & no correlation with commodities. Out of all 18 commodities, 4 commodities (*X12, X20, X21* & *X28*) are positively/ negatively correlated with *PC4*. Furthermore, *PC4* is most correlated both negative & positive direction (Animal Fodder, Transport equipment, Petroleum products, & Ceramics products). *X20* (Transport equipment, -0.785) is strongly negative correlated with *PC4*. This component can be viewed as re exports products.

Finally, the *PC5* is showing both negative/positive correlation & no correlation with commodities. Out of all 18 commodities, 4 commodities (*X12, X24, X27* & *X28*) are positively/ negatively correlated with PC4. Furthermore, PC4 is most correlated both negative & positive direction (Animal Fodder, Printing industry products, Base metals and articles & Ceramics products). *X24* (Printing industry products, 0.744) is strongly positive correlated with *PC5*. This component can be viewed as printing exports products.

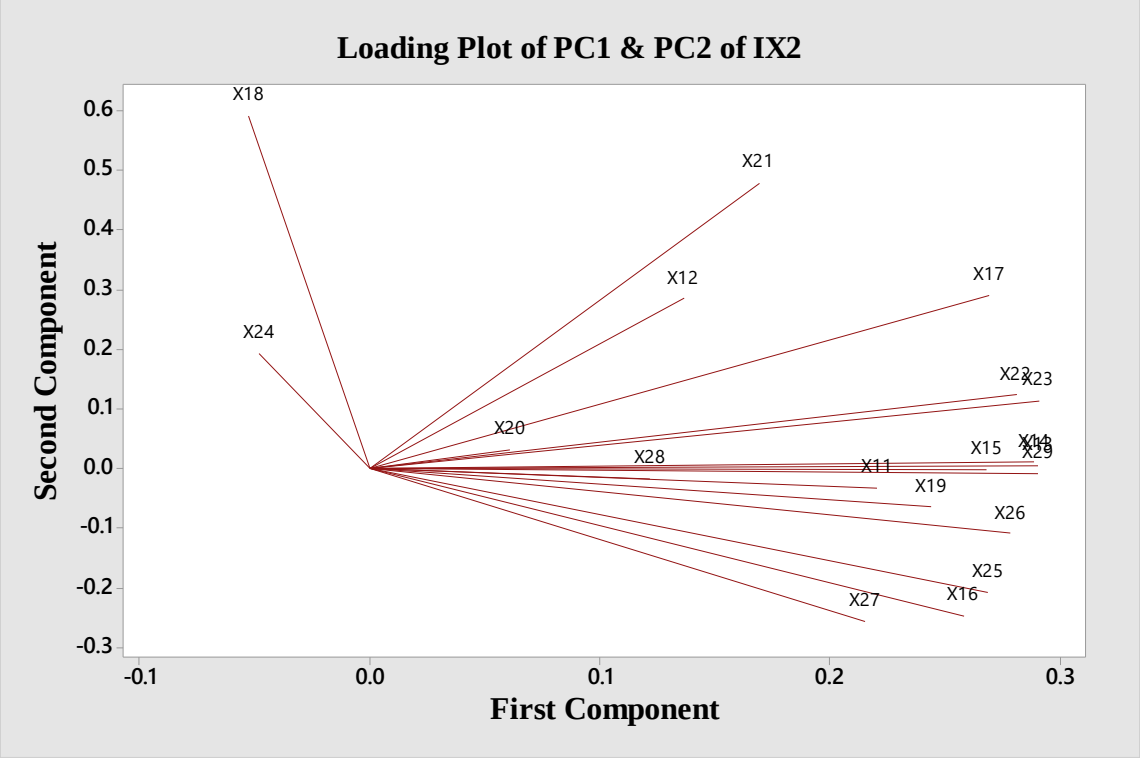

Figure 4.10: Loading Plot for *PC1 & PC2 in IX2*

Based on the above loading plot (figure 4.12), it is like the above two interpretations of *PC1 & PC2*.

$$PC1 = 0.221X11 + 0.136X12 + 0.290X13 + 0.288X14 + 0.268X15 + 0.258X16 + 0.269X17 - 0.053X18 + 0.244X9 + 0.061X20 + 0.169X21 + 0.281X22 + 0.291X23 - 0.048X24 + 0.268X25 + 0.278X26 + 0.215X27 + 0.122X28 + 0.290X29$$

$$PC2 = -0.032X11 + 0.285X12 + 0.006X13 + 0.011X14 - 0.002X15 - 0.246X16 + 0.290X17 + 0.592X18 - 0.064X9 + 0.032X20 + 0.480X21 + 0.124X22 + 0.114X23 + 0.193X24 - 0.208X25 - 0.109X26 - 0.256X27 - 0.016X28 - 0.008X29$$

$$PC3 = -0.029X11 + 0.211X12 + 0.054X13 + 0.056X14 + 0.031X15 + 0.012X16 - 0.015X17 - 0.454X18 - 0.260X9 + 0.259X20 + 0.125X21 + 0.127X22 + 0.038X23 + 0.478X24 + 0.076X25 - 0.057X26 - 0.066X27 - 0.576X28 - 0.009X29$$

$$PC4 = -0.161X11 - 0.282X12 + 0.049X13 + 0.048X14 + 0.031X15 + 0.091X16 + 0.043X17 - 0.036X18 - 0.081X9 - 0.785X20 + 0.271X21 + 0.107X22 + 0.070X23 - 0.120X24 + 0.023X25 - 0.043X26 + 0.032X27 - 0.381X28 + 0.040X29$$

$$PC5 = 0.179X11 - 0.369X12 - 0.114X13 - 0.114X14 - 0.133X15 + 0.030X16 + 0.043X17 + 0.013X18 + 0.169X9 - 0.138X20 + 0.098X21 - 0.029X22 + 0.030X23 + 0.744X24 - 0.044X25 + 0.001X26 + 0.311X27 + 0.270X28 - 0.031X29$$

4.4.2.3: *PCA* for Minor Exports (*MX3*) in *TE*

Table 4.25: Eigen Values for *MX3*

PC	PC1	PC2
Eigen Value (λi)	**1.2432**	**0.9808**
Probability (Pi)	0.414	0.327
Cumulative Probability (C. Pi)	0.414	0.741

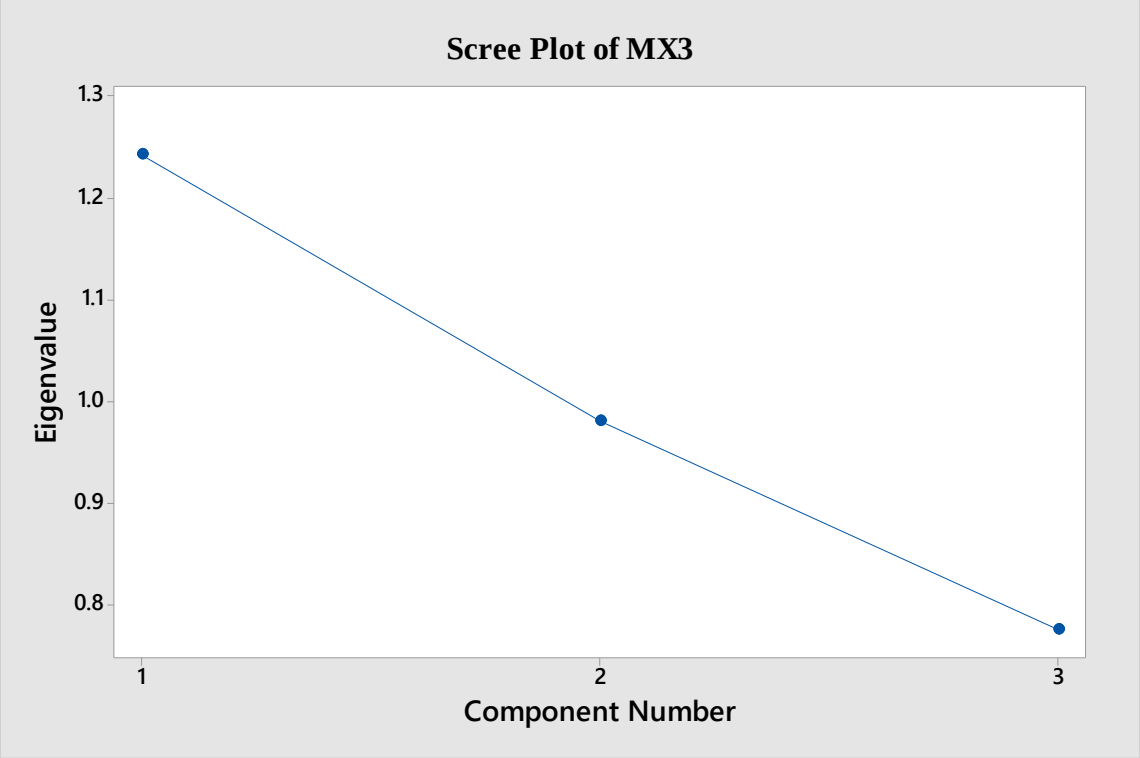

Figure 4.11: Scree Plot for *MX3*

According to the above table 4.25 & figure 4.13 for *MX3*, the point where the slope of the curve is not clearly leveling off (elbow) indicates the components. Since only considering, eigen values are greater than "1" for 1st and 2nd ($\lambda_1 = 1.2432>1$, $\lambda_2 = 0.9808=1$) components. Since, there are two components (namely PC1 & PC2) which can be selected for further analysis. Furthermore, these three commodities of *MX3* can be grouped into two factors without losing much information. PC1 is explained 41% of the total variance & PC2 is explained 32% of the total variance. The cumulative proportion of variance explained by the first two components is roughly 74% of the total variance.

Table 4.26: Coefficient/ Eigen Vector for *MX3*

Variable	PC1
X30	**0.660**
X31	**0.689**
X32	0.300

Based on the above table 4.26, the *PC1* is moderately correlated with one variable (*X32*) and other two variables are strong positive correlation (*X30*, *X31*, approximately 0.7). This suggests that these two commodities vary together (Earths and stone & Ores, slag and ash). If one increases, then the remaining ones tend to increase as well. This component can be viewed as measure of the fertilizer.

The *PC2* is showing both negative/positive correlation & no correlation with commodities. Out of all 3 commodities, *X32* is strong correlated with the second component (0.942). *X30* commodity is moderately positive correlated. *X32* variable is strong positively correlated (*X32*). Furthermore, *PC2* is most correlated with *X30 & X32* both negative & positive direction (Earths and stone & Precious Metals). *X32* (Precious Metals) is strongly correlated with *PC2*. This component can be viewed as Metal.

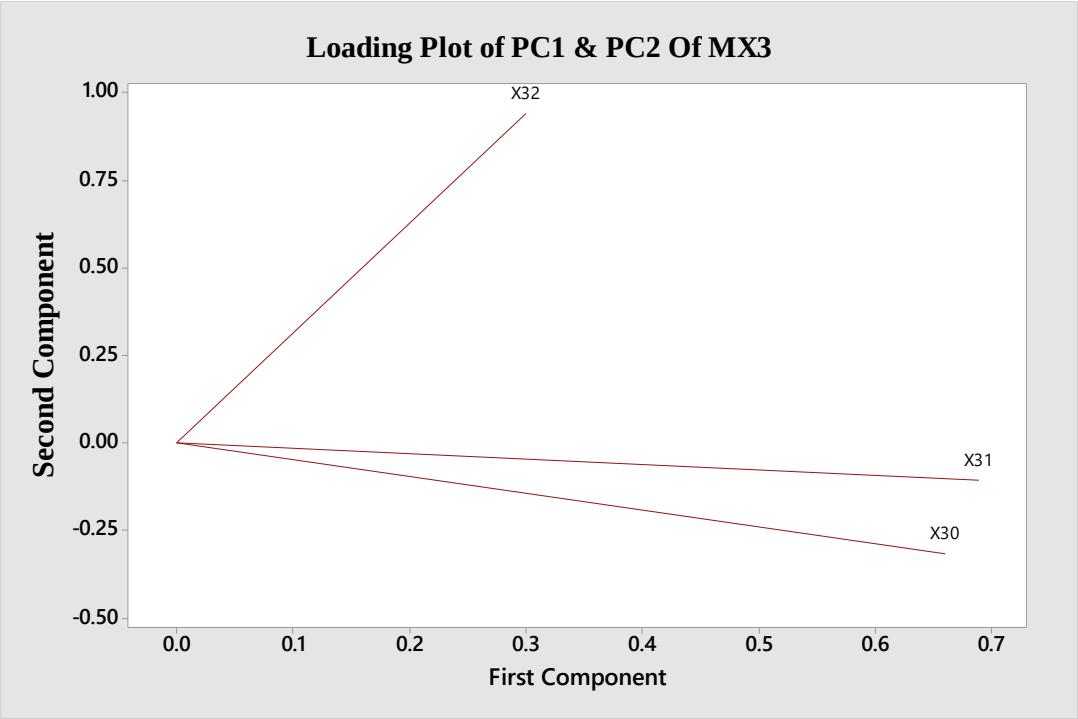

Figure 4.12: Loading Plot for *PC1 & PC2 in MX3*

In this loading plot (figure 4.14) is show that same results as discussed above numerical figures. Two commodities *X31 & X30* are same direction with positively correlated with *PC1*. *X32* commodity is related to *PC2*.

$$PC1 = 0.660X1 + 0.689X2 + 0.300X3$$

$$PC2 = -0.317X1 - 0.107X2 + 0.942X3$$

4.4.2.4: *PCA* for Total Exports (*TE*)

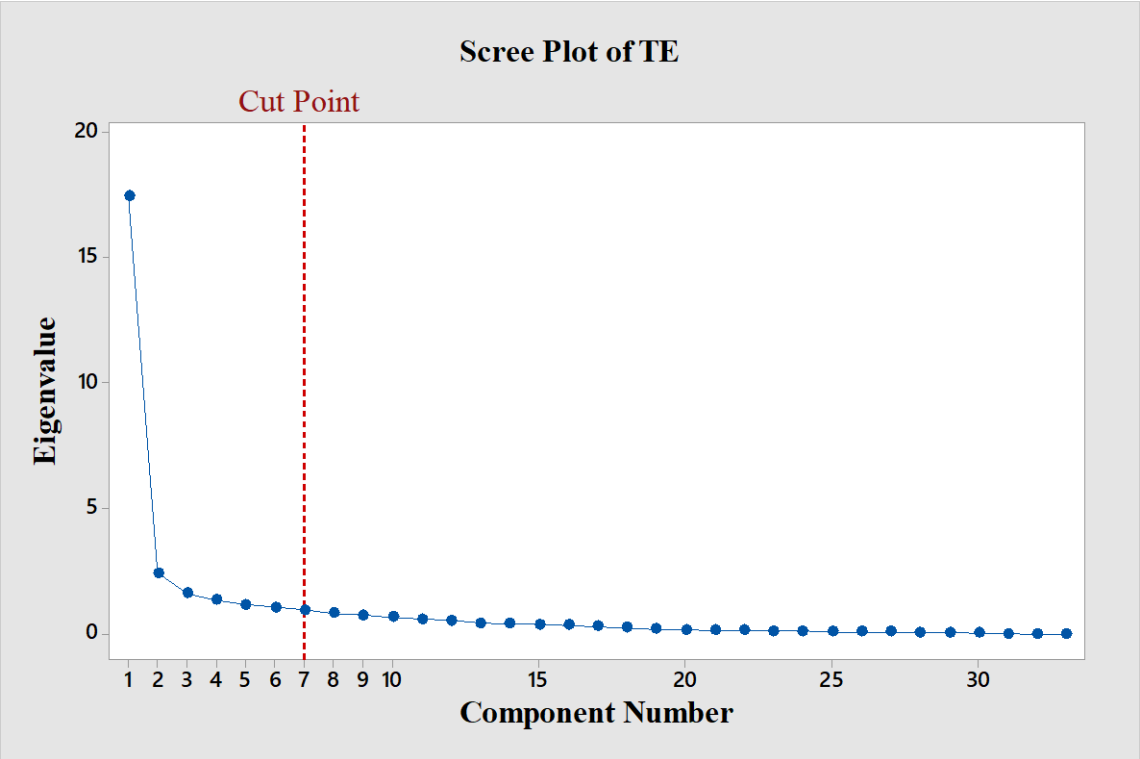

Figure 4.13: Scree Plot for *TX*

Table 4.27: Eigen Values for *TX (Elected PC's)*

PC	**PC1**	**PC2**	**PC3**	**PC4**	**PC5**	**PC6**	**PC7**
Eigen Value (λi)	**17.452**	**2.430**	**1.621**	**1.355**	**1.169**	**1.064**	**0.967**
Probability (Pi)	0.529	0.074	0.049	0.041	0.035	0.032	0.029
Cumulative Probability (C. Pi)	0.529	0.602	0.652	0.693	0.728	0.760	0.790

Based on the above table 4.27 (33 *PC*'s), when considering entire total exports commodities (*TE,* 33 commodities). The point where the slope of the curve is not clearly leveling off (elbow) indicates the components. After 2nd component there is elbow i.e there are two components based on Scree plot namely (*PC1* & *PC2*). But when looking eigen values of from *PC1* to *PC7* are greater than one. Since, there are seven components (namely PC1, PC2, … & PC7) which can be selected for further analysis. Furthermore, these three commodities of *TX3* can be grouped into two or seven factors without losing much information. Each component explained total variance from *PC1* to *PC7* is 53%, 7%, 5%, 4%, 4%, 3% & 3% respectively. The cumulative proportion of variance explained

by the first two components is roughly 60% of the total variance. The cumulative proportion of variance explained by the seven components is roughly 79% of the total variance. Based on another rule of selecting the components, at least 80% of total variance should be selected for factoring. Since, seven *PC*'s are selected for further analysis.

Table 4.28: Coefficient/ Eigen Vector for *TE*

Variable	PC1	PC2	PC3	PC4	PC5	PC6	PC7
X1	**0.201**	**-0.201**	-0.011	-0.126	0.028	0.136	-0.136
X2	-0.129	**-0.356**	-0.184	**0.245**	0.148	**0.211**	0.062
X3	**0.220**	0.078	-0.153	-0.024	-0.060	-0.094	-0.033
X4	**0.207**	0.153	-0.146	-0.016	-0.059	-0.108	-0.053
X5	**0.209**	-0.074	-0.142	-0.033	-0.053	-0.053	0.008
X6	**0.200**	-0.040	0.019	0.034	-0.134	0.030	-0.099
X7	0.186	0.074	-0.091	**-0.245**	0.010	0.140	-0.070
X8	0.074	-0.192	**0.422**	-0.149	0.029	0.142	**0.277**
X9	**0.209**	0.036	-0.097	-0.151	-0.025	-0.018	-0.006
X10	0.167	-0.099	0.095	**-0.244**	0.074	**0.243**	0.048
X11	0.167	-0.019	-0.012	**0.322**	0.135	-0.089	0.030
X12	0.106	-0.180	-0.164	-0.073	0.135	**-0.432**	0.063
X13	**0.228**	0.018	-0.026	-0.089	-0.045	-0.045	-0.024
X14	**0.227**	0.014	-0.029	-0.096	-0.046	-0.046	-0.028
X15	**0.206**	0.033	0.030	-0.030	-0.018	-0.055	0.016
X16	0.198	0.175	-0.016	0.167	-0.032	0.045	0.084
X17	**0.212**	**-0.219**	0.039	-0.025	-0.055	0.003	-0.058
X18	-0.043	**-0.401**	**0.309**	0.088	-0.171	**-0.255**	**-0.296**
X19	0.183	0.021	**0.238**	**0.252**	0.126	0.112	-0.024
X20	0.046	-0.050	-0.095	-0.040	**0.692**	**-0.389**	0.194
X21	0.131	**-0.370**	-0.046	0.055	**-0.259**	0.077	0.156
X22	**0.224**	-0.078	-0.090	-0.050	-0.086	0.019	0.027
X23	**0.227**	-0.089	0.011	0.030	-0.031	0.057	0.041

X24	-0.035	-0.223	**-0.460**	0.089	**0.289**	**0.459**	**-0.236**
X25	**0.213**	0.174	-0.101	0.011	-0.015	-0.043	-0.029
X26	**0.214**	0.085	0.057	0.084	0.085	0.003	0.011
X27	0.163	0.112	0.060	**0.343**	0.090	**0.262**	0.091
X28	0.092	0.008	**0.410**	0.151	**0.293**	-0.025	**-0.566**
X29	**0.229**	0.017	0.016	-0.014	-0.039	-0.020	-0.042
X30	**0.203**	-0.058	-0.011	0.131	0.120	-0.005	-0.067
X31	0.063	**-0.322**	-0.003	**0.316**	-0.107	-0.158	**0.386**
X32	0.035	-0.153	**0.225**	**-0.461**	**0.286**	0.185	**0.208**
UX4	0.060	**0.291**	**0.215**	0.189	0.070	0.173	**0.357**

Based on the above table 4.28, the *PC1* is moderately correlated with most of the variables (16 commodities, approximately +/-0.2) and other variables are week correlation (below 0.2). Out of 33 variables, all weekly correlated variables are showing positive magnitude (*X1, X3-X6, X9, X13-X15, X17, X22-X23, X25-X26 & X29-X30*). This suggests that these 16 commodities vary together (Plantation industries, Spices, Textile, Garments, Chemical Products, Wood Products, Rubber Products & Stone). Most of the *PC1* influence products manufactured raw materials are in Sri Lanka. *X29* is highest correlated with *PC1* i.e highly influenced commodities into *PC1* (Other Industrial). If one increases, then the remaining ones tend to increase as well. This component can be viewed as measure of the general well purely country production.

Similarly, the *PC2* is showing both negative/positive correlation & no correlation with commodities. Out of all 33 commodities, 7 commodities (*X1, X2, X17, X18, X21, X31* & *X33*) are moderately positively/ negatively correlated with *PC2*. Furthermore, PC2 is most correlated both negative & positive direction (Raw materials & Petroleum Products). *X18* (Gem diamonds and Jewelry) is strongly correlated with *PC2*. This component can be viewed as raw material exports.

The *PC3* is showing both negative/positive correlation & no correlation with commodities. Out of all 33 commodities, 7 commodities (*X8, X18, X19, X24, X28 & X32-*

X33) are moderately positively/ negatively correlated with *PC3*. Out of seven commodities *X24* is showing a negative correlation and it is highest (-0.460). Furthermore, *PC3* is most correlated both negative & positive direction (Unmanufactured exports products & printing products). This component can be viewed as unmanufactured material exports.

The *PC4* is showing both negative/positive correlation & no correlation with commodities. Out of all 33 commodities, 8 commodities (*X2, X3, X10, X11, X21, X19, X27* & *X31-32*) are positively/ negatively correlated with *PC4*. Furthermore, *PC4* is most correlated both negative & positive direction (Food Products & Metal). *X32* (Precious Metals, -0.460) is strongly negative correlated with *PC4*. This component can be viewed as food & metal products.

The *PC5* is showing both negative/positive correlation & no correlation with commodities. Out of all 33 commodities, 5 commodities (*X20, X21, X24, X28* & *X32*) are positively/ negatively correlated with *PC5*. Furthermore, *PC5* is most correlated both negative & positive direction (Transport products, Ceramics products & Metal). *X20* (Transport equipment, 0.692) is strongly positive correlated with *PC5*. This component can be viewed as re exports products.

The *PC6* is showing both negative/positive correlation & no correlation with commodities. Out of all 33 commodities, 7 commodities (*X2, X10, X12, X18, X20, X24* & *X27*) are positively/ negatively correlated with *PC6*. Furthermore, *PC6* is most correlated both negative & positive direction (Mix production). *X24* (Printing industry products, 0.459) is strongly positive correlated with *PC6*.

The *PC7* is showing both negative/positive correlation & no correlation with commodities. Out of all 33 commodities, 7 commodities (*X8, X18, X24, X28* & *X31-X33*) are positively/ negatively correlated with *PC7*. Furthermore, *PC7* is most correlated both negative & positive direction (Unclassified Products). *X28* (Ceramics products, -0.566) is

strongly positive correlated with *PC7*. This component can be viewed as Ceramics products.

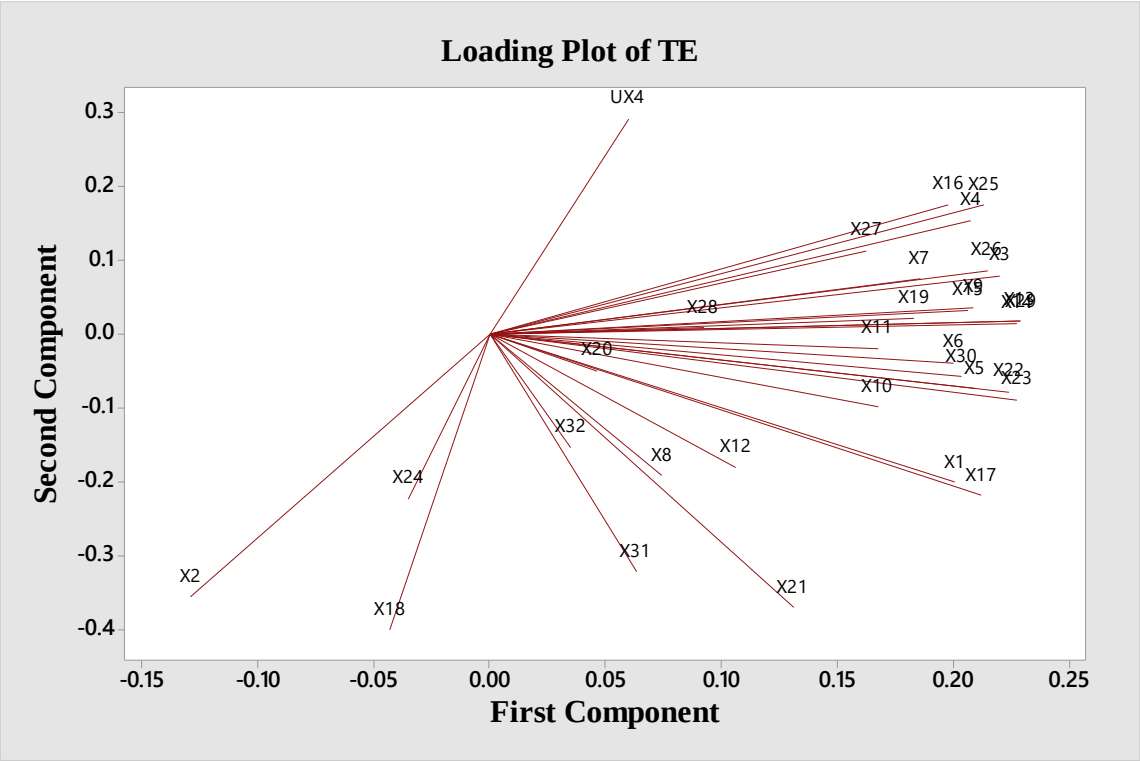

Figure 4.14: Loading Plot for *TE*

Based on the above loading plot (figure 4.16), it is clearly shown that numerical interpretation is well proof by loading plot of *PC1* & *PC2*. *X2, X24* & *X18* are negative correlations with *PC2*. *UX4* is positive correlation with *PC2*. Other most of the commodities are week/ moderate positive correlation with *PC1*.

4.4.3: PCA for Total Imports (*TI*)

According to the original data set (as discussed) there are four main categories for *TI* such as *CY1, IY2, IY3* & *UY4*. But, more than two variables are included only first three groups (*CY1, IY2 & IY3*). Under the *PCA* methodology, only consider these three categories for *PCA* analysis.

4.4.3.1: *PCA* for Consumer Imports (*CY1*) in *TI*

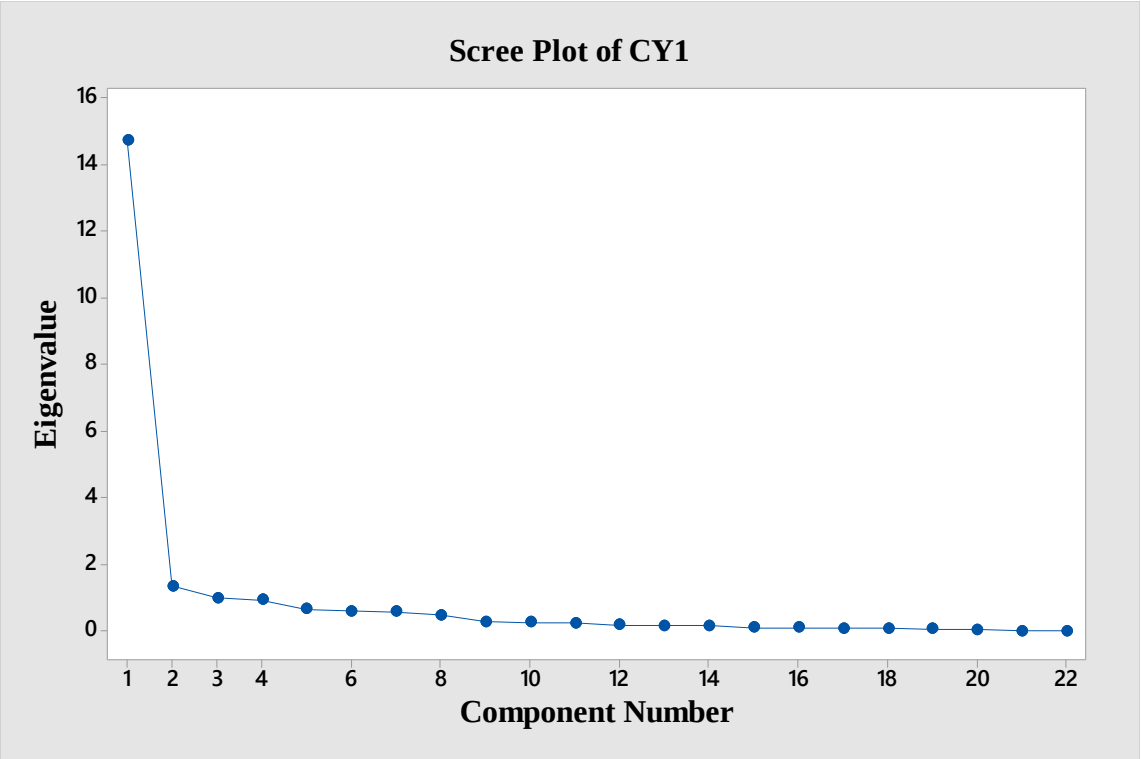

Figure 4.15: Scree Plot for *CY1*

Table 4.29: Eigen Values for *CY1*

PC	**PC1**	**PC2**	**PC3**
Eigen Value (λi)	**14.748**	**1.352**	**0.988**
Probability (Pi)	0.670	0.061	0.045
Cumulative Probability (C. Pi)	0.670	0.732	0.777

According to the above table 4.17 for *CY1*, the point where the slope of the curve is clearly leveling off (elbow) indicates after 1st component. But looking table 4.29, eigen values are greater than "1" for 1st, 2nd and 3rd (λ_1 = 14.789>1, λ_2 = 1.352>1 & λ_3 = 0.988=1) components. Since, there are three components (namely *PC1*, *PC2* & *PC3*) which can be selected for further analysis. Furthermore, these 22 imports commodities can be grouped into three factors without losing much information. *PC1* is explained 67% of the total variance, *PC2* is explained 6% of the total variance & *PC3* is explained 5% of total variance. The cumulative proportion of variance explained by the first three components is roughly 78% of the total variance.

Table 4.30: Coefficient/ Eigen Vector for *CY1*

Variable	PC1	PC2	PC3
Y1	**0.242**	-0.079	0.092
Y2	0.185	-0.030	**0.350**
Y3	0.116	**0.559**	-0.058
Y4	0.104	**-0.664**	-0.033
Y5	0.153	0.031	-0.022
Y6	**0.233**	0.066	0.167
Y7	0.154	-0.010	**0.502**
Y8	**0.224**	0.044	-0.012
Y9	**0.240**	-0.009	0.156
Y10	**0.229**	0.189	-0.127
Y11	**0.210**	**-0.306**	-0.159
Y12	**0.251**	-0.051	-0.137
Y13	**0.247**	0.042	0.028
Y14	**0.204**	-0.125	-0.331
Y15	**0.245**	0.000	0.019
Y16	**0.233**	0.123	0.012
Y17	**0.235**	-0.074	0.057
Y18	**0.228**	**0.210**	0.098
Y19	**0.231**	0.006	-0.158
Y20	0.143	0.105	**-0.590**
Y21	**0.237**	-0.084	0.052
Y22	**0.246**	-0.017	-0.002

Based on the above table 4.30 (only showing first 10 PC's out of 22 PC's), the *PC1* is moderately positive correlated with 16 variables out of 22 commodities (*Y1, Y6, Y8-Y19* & *Y21-Y22*) and other variables are week positive correlation. Highest positive correlation is showing for *Y12* (0.250). This suggests that these 16 commodities vary together (Food and Beverages, Seafood, Spices, Fruits, Consumer Goods, Pharmaceuticals, Vehicles,

Furnitures, Telecommunication & nonfood consumables). If one increases, then the remaining ones tend to increase as well. This component can be viewed as measure of the general needed foods in human life.

Similarly, the *PC2* is showing both negative/positive correlation & no correlation with commodities. Four commodities are correlated with out of all 22 commodities, *Y3* is highly positive correlated with the second component (0.559). At the same time, *Y4* is highly negative correlated with the second component (-0.664). Other two imports commodities are negative & positive moderately correlated. And others are not correlated with second principle component. Furthermore, *PC2* is most correlated with *Y3, Y4, Y11 & Y18* both negative & positive direction (Sugar, Milking, Beverage & Cosmetics). Sugar & Milking is strongly correlated with *PC2*. This component can be viewed as sweet foods.

When looking 3rd component (*PC3*), there are three components correlated with PC3 in both negative & positive direction (*Y2, Y7* & *Y20*). it is clearly showing a strong negative correlation (-0.590) with *Y20* (Stationary) and *Y7*(Oils & fats) is moderately positive correlation. This component can be viewed as stationary items.

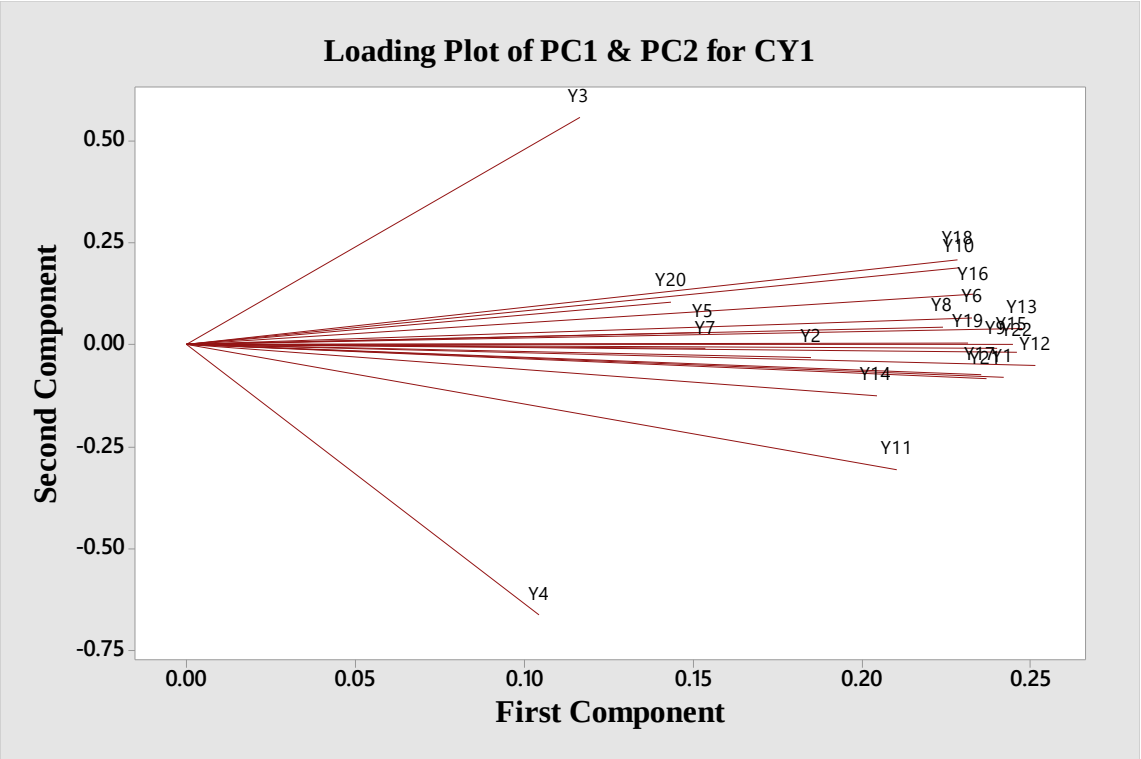

Figure 4.16: Loading Plot for *PC1 & PC2 in CY1*

In this loading plot (figure 5.12) is show that same results as discussed above numerical figures. *Y4* & *Y3* is highly correlated with *PC2*. Other all commodities are moderately positive correlated with *PC1*.

$$PC1 = 0.242Y1 + 0.185Y2 + 0.116Y3 + 0.104Y4 + 0.153Y5 + 0.233Y6 + 0.154Y7 + 0.224Y8 + 0.240Y9 + 0.210Y10 + 0.210Y11 + 0.251Y12 + 0.247Y13 + 0.204Y14 + 0.245Y15 + 0.233Y16 + 0.235Y17 + 0.228Y18 + 0.231Y19 + 0.143Y20 + 0.237Y21 + 0.246Y22$$

$$PC2 = -0.079Y1 - 0.030Y2 + 0.559Y3 - 0.664Y4 + 0.031Y5 + 0.066Y6 - 0.010Y7 + 0.044Y8 - 0.009Y9 + 0.189Y10 - 0.306Y11 - 0.051Y12 + 0.042Y13 - 0.125Y14 + 0.000Y15 + 0.123Y16 - 0.074Y17 + 0.210Y18 + 0.006Y19 + 0.105Y20 - 0.084Y21 - 0.017Y22$$

$$PC3 = 0.092Y1 + 0.350Y2 - 0.058Y3 - 0.033Y4 - 0.022Y5 + 0.167Y6 + 0.502Y7 - 0.012Y8 + 0.156Y9 - 0.127Y10 - 0.159Y11 - 0.137Y12 + 0.028Y13 - 0.331Y14 + 0.019Y15 + 0.012Y16 + 0.057Y17 + 0.098Y18 - 0.158Y19 - 0.590Y20 + 0.052Y21 - 0.002Y22$$

4.4.3.2: *PCA* for Intermediate Imports (*IY2*) in *TI*

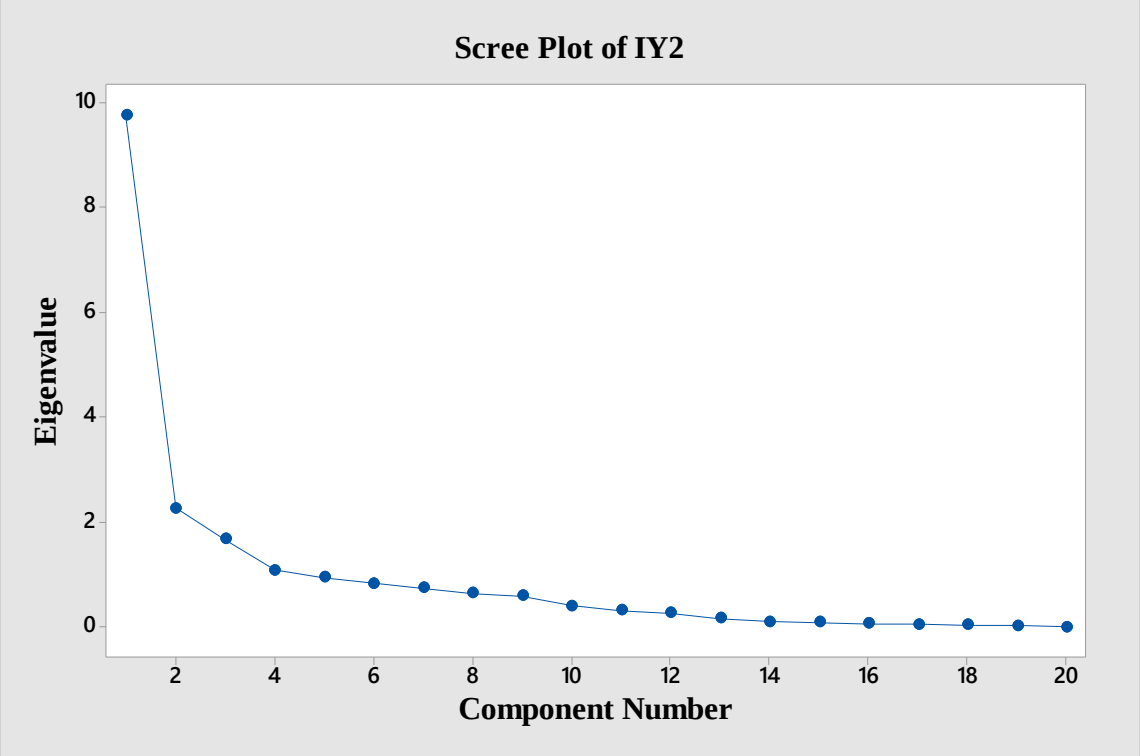

Figure 4.17: Scree Plot for *IY2*

Table 4.31: Eigen Values for *IY2*

PC	**PC1**	**PC2**	**PC3**	**PC4**
Eigen Value (λ_i)	**9.752**	**2.261**	**1.669**	**1.081**
Probability (P_i)	0.488	0.113	0.083	0.054
Cumulative Probability (C. P_i)	0.488	0.601	0.684	0.738

According to the above table 4.19 & figure 4.31 for *IY2*, the point where the slope of the curve is clearly leveling off (elbow) indicates after 4th components. And the thumb of rule

of eigen value table, first four components λi's are greater than one (λ_1 = 9.752>1, λ_2 = 2.261>1, λ_3 = 1.169>1, λ_4 = 1.081>1). Since, there are four components (namely PC1, PC2, PC3 & PC4) which can be selected for further analysis. Furthermore, these 20 intermediate imports commodities can be grouped into four factors without losing much information. PC1 is explained 49% of the total variance, PC2 is explained 11% of the total variance, PC3 is explained 8% of the total variance & PC4 is explained 5% of the total variance. The cumulative proportion of variance explained by the first four components is roughly 74% of the total variance. Comparatively, total variance of PC1 is higher than other three components (approximately 4 times). Since it can be concluded that most of the commodities are influence by PC1 other than three components.

Table 4.32: Coefficient/ Eigen Vector for *IY2*

Variable	PC1	PC2	PC3	PC4
Y23	0.132	**-0.580**	-0.106	0.159
Y24	-0.005	**-0.520**	-0.110	0.114
Y25	0.156	**-0.450**	-0.067	0.096
Y26	0.176	-0.016	-0.030	**0.287**
Y27	**0.300**	0.091	0.032	0.033
Y28	**0.307**	0.056	-0.094	0.062
Y29	**0.309**	0.066	-0.088	0.013
Y30	0.098	-0.137	-0.016	**-0.676**
Y31	0.109	-0.165	**0.678**	-0.036
Y32	0.170	-0.065	**0.630**	0.043
Y33	**0.298**	0.102	-0.078	-0.053
Y34	**0.260**	-0.075	-0.099	0.039
Y35	-0.016	-0.253	-0.061	**-0.468**
Y36	**0.305**	0.096	0.015	0.091
Y37	**0.287**	0.042	-0.119	0.030
Y38	0.198	0.017	0.140	**-0.252**
Y39	**0.269**	0.118	0.056	0.023

Y40	0.198	-0.049	-0.119	0.037
Y41	0.177	0.063	-0.151	**-0.326**
Y42	**0.289**	0.112	-0.064	0.002

Based on the above table of 4.32, the *PC1* is moderately correlated with most of the variables (9 commodities, +/-0.3) and other variables are week correlation. Out of 20 variables, 9 variables are showing positive magnitude (*Y27-Y29, Y33, Y34, Y36, Y37, Y39 & Y42*). This suggests that these 9 commodities vary together (Textiles, Chemical, Plastic, Paper, Metal, Fertilizer, Food Preparations & Rubber). *Y29* is highest correlated with *PC1* i.e highly influenced commodities into *PC1*. If one increases, then the remaining ones tend to increase as well. This component can be viewed as measure of the raw materials.

Similarly, the *PC2* is showing both negative/positive correlation & no correlation with commodities. Out of all 20 commodities, *Y23* is highly negative correlated with the second component (-0.589) & 4 commodities (*Y23-Y25 & Y35*) are moderately negatively correlated with *PC2*. Furthermore, PC2 is most correlated negative direction (Fuel, Crude oil & Fertilizer). *Y23* (Fuel) is strongly correlated with *PC2*. This component can be viewed as fuel imports.

The *PC3* is showing both negative/positive correlation & no correlation with commodities. Out of all 20 commodities, only 2 commodities (Y31 & *Y32*) are strongly positively correlated with *PC3*. Furthermore, *PC3* is most correlated with positive direction (Diamonds & Gold). *Y31* (Diamonds, 0.678) is strongly positive correlated with *PC3*. This component can be viewed as gold imports.

The *PC4* is showing both negative/positive correlation & no correlation with commodities. Out of all 20 commodities, 5 commodities (*Y26, Y30, Y35, Y38 & Y41*) are positively/ negatively correlated with *PC4*. Furthermore, *PC4* is correlated both negative & positive direction (Coal, Wheat, Fertilizer, Food Preparation & Unmanufactured Tobacco). *Y30* (Wheat, -0.676) is strongly negative correlated with *PC4*. This component can be viewed as Cereals Imports.

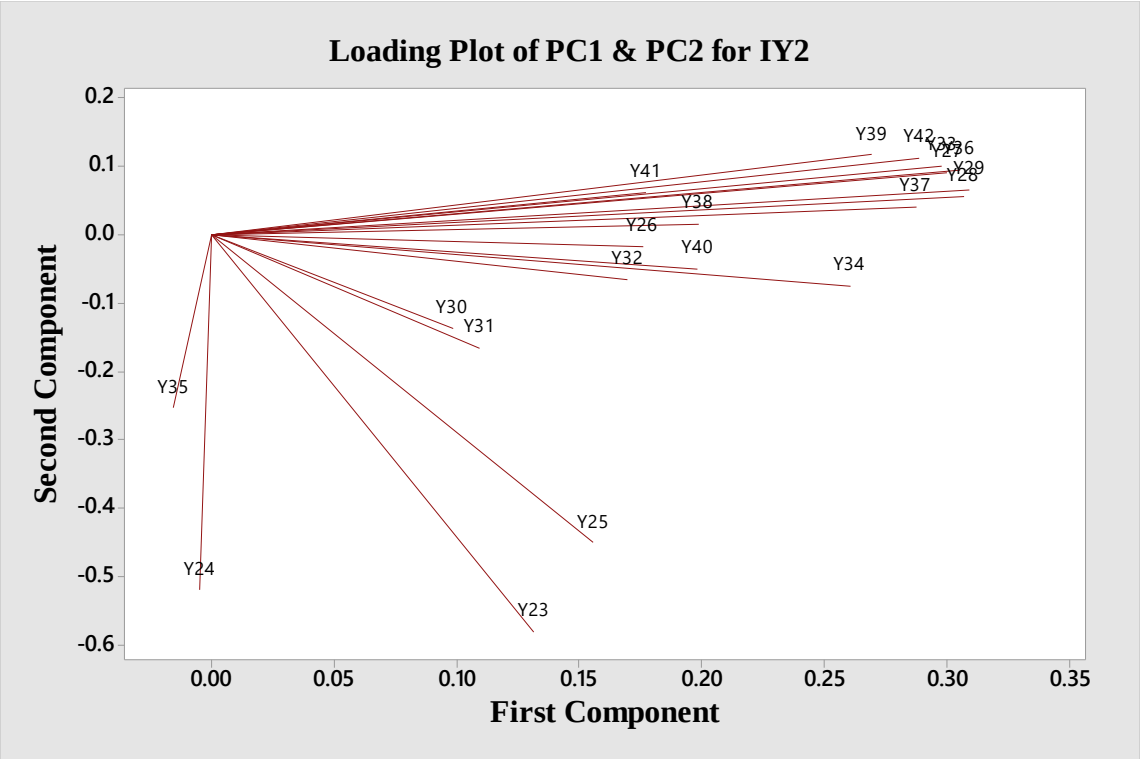

Figure 4.18: Loading Plot for *PC1 & PC2 in IY2*

Based on the above loading plot (figure 4.20), it is clearly verified about numerical interpretations of *PC1 & PC2*.

$$PC1 = 0.132Y23 - 0.005Y24 + 0.156Y25 + 0.176Y26 + 0.300Y27 + 0.307Y28 + 0.309Y29 + 0.098Y30 + 0.109Y31 + 0.170Y32 + 0.298Y33 + 0.260Y34 - 0.016Y35 + 0.305Y36 + 0.287Y37 + 0.198Y38 + 0.269Y39 + 0.198Y40 + 0.177Y41 + 0.289Y42$$

$$PC2 = -0.580Y23 - 0.520Y24 - 0.450Y25 - 0.016Y26 + 0.091Y27 + 0.056Y28 + 0.066Y29 - 0.137Y30 - 0.165Y31 - 0.065Y32 + 0.102Y33 - 0.075Y34 - 0.253Y35 + 0.096Y36 + 0.042Y37 + 0.017Y38 + 0.118Y39 - 0.049Y40 + 0.063Y41 + 0.112Y42$$

$$PC3 = -0.106Y23 - 0.110Y24 - 0.067Y25 - 0.030Y26 + 0.032Y27 - 0.094Y28 - 0.088Y29 - 0.016Y30 + 0.678Y31 + 0.630Y32 - 0.078Y33 - 0.099Y34 - 0.061Y35 + 0.015Y36 - 0.119Y37 + 0.140Y38 + 0.056Y39 - 0.119Y40 - 0.151Y41 - 0.064Y42$$

$$PC4 = 0.159Y23 + 0.114Y24 + 0.096Y25 + 0.287Y26 + 0.033Y27 + 0.062Y28 + 0.013Y29 - 0.679Y30 - 0.036Y31 + 0.043Y32 - 0.053Y33 + 0.039Y34 - 0.468Y35 + 0.091Y36 + 0.030Y37 - 0.252Y38 + 0.023Y39 + 0.037Y40 - 0.326Y41 + 0.002Y42$$

4.4.3.3: *PCA* for Investment Imports (*IY3*) in *TI*

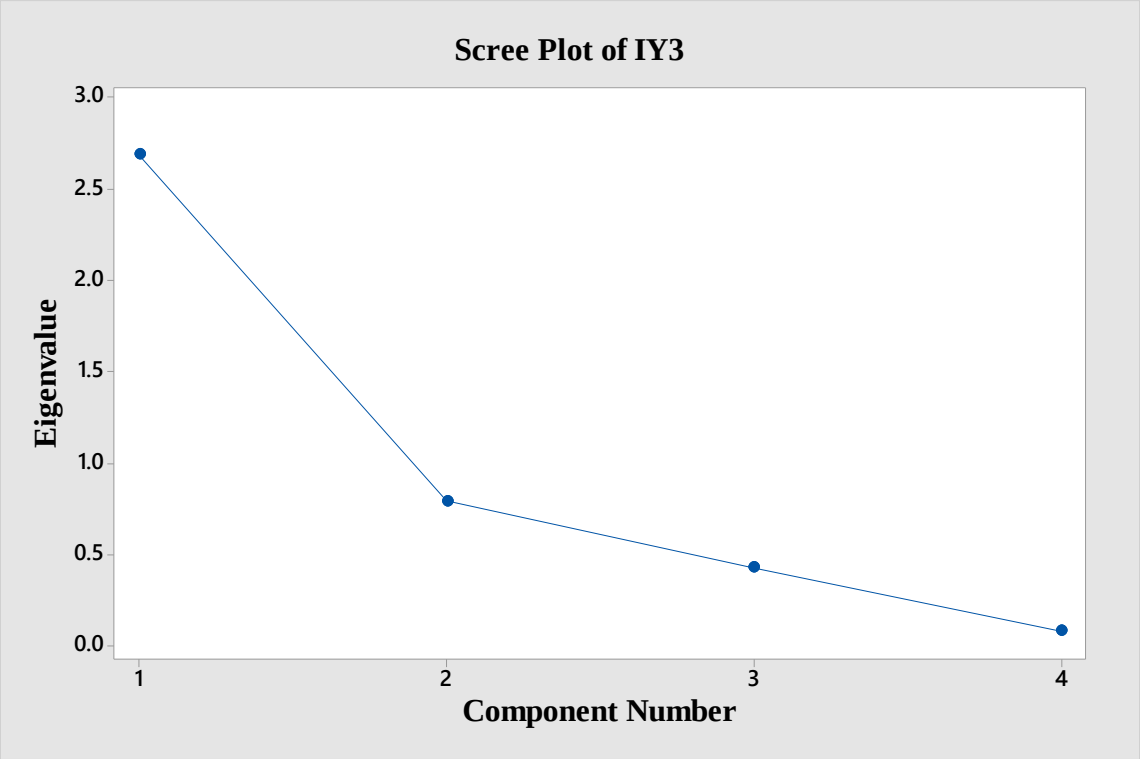

Figure 4.19: Scree Plot for *IY3*

Table 4.32: Eigen Values for *IY3*

PC	**PC1**
Eigen Value (λ_i)	**2.690**
Probability (P_i)	0.673
Cumulative Probability (C. P_i)	0.673

According to the above table 4.32 & figure 4.21 for *IY3*, the point where the slope of the curve is not clearly leveling off (elbow) indicates the components. Since only considering, eigen values are greater than "1" for 1st (λ_1 = 2.690>1) component. Since, there is only component (namely *PC1*) which can be selected for further analysis. Furthermore, these four commodities of *IY3* can be grouped into one factor without losing much information. *PC1* is explained 67% of the total variance. The cumulative proportion of variance explained by the first components is roughly 67% of the total variance.

Table 4.33: Coefficient/ Eigen Vector for *IY3*

Variable	**PC1**
Y43	**0.575**
Y44	**0.571**
Y45	**0.398**
Y46	**0.430**

Based on the above table 4.33, the *PC1* is moderately positive correlated with all variables. This suggests that existing investment commodity group is correct, and it can't be grouped further. This component can be viewed as measure of the investment imports.

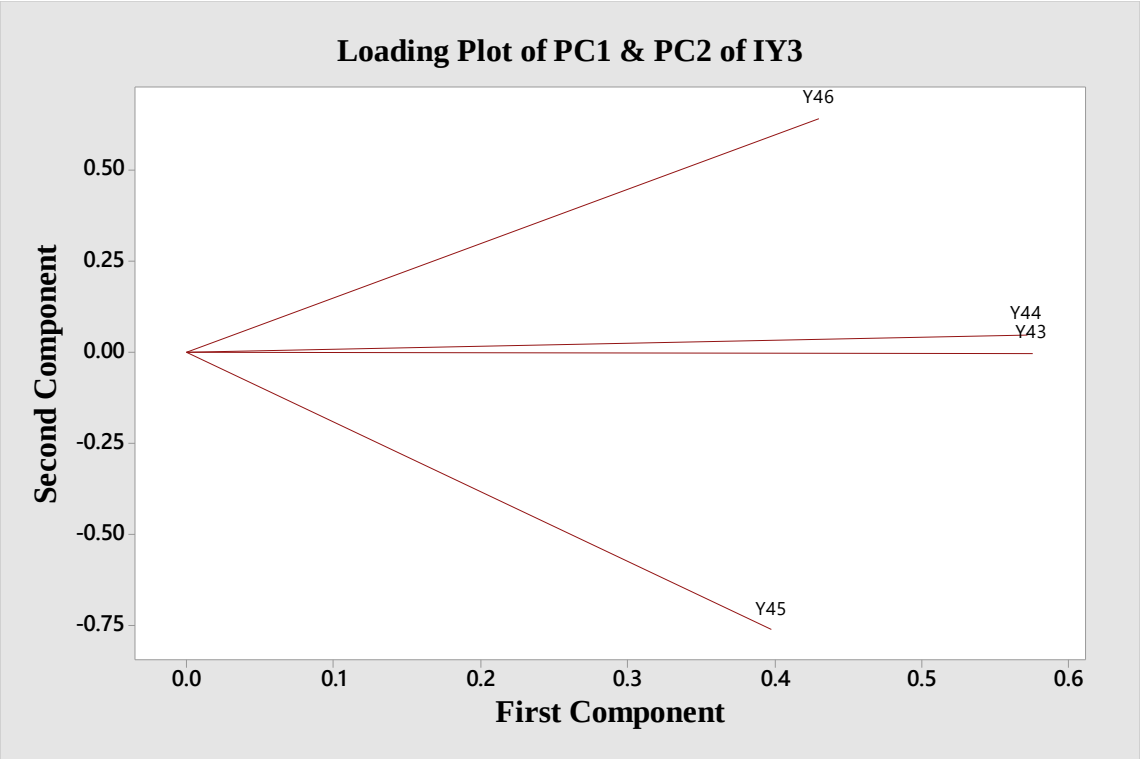

Figure 4.20: Loading Plot for *PC1 & PC2 in IY3*

In this loading plot (figure 4.22) is show that same results as discussed above numerical figure. There is only one *PC1* and *PC1* is positively correlated with other commodities.

$$PC1 = 0.575Y43 + 0.571Y44 + 0.398Y45 + 0.430Y46$$

4.4.3.4: *PCA* for Total Imports (*TI*)

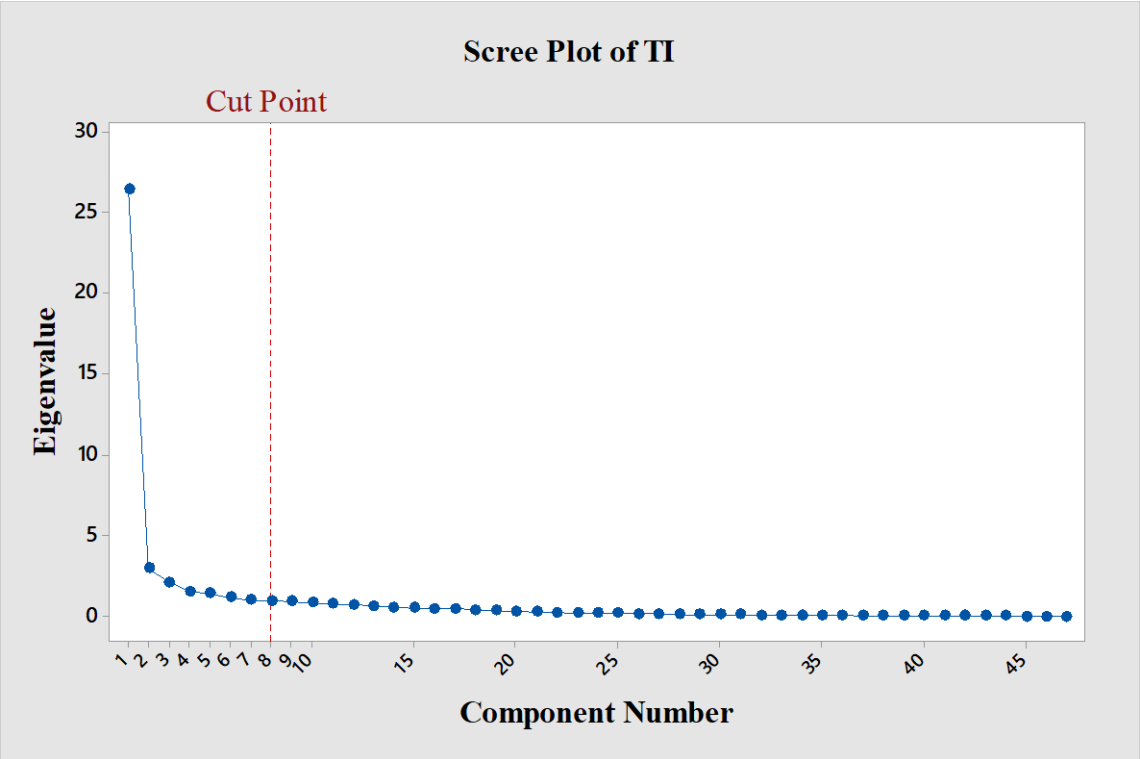

Figure 4.21: Scree Plot for *TI*

Table 4.34: Eigen Values for *TI (Selected PC's)*

PC	**PC1**	**PC2**	**PC3**	**PC4**	**PC5**	**PC6**	**PC7**	**PC8**
Eigen Value (λi)	**26.438**	**2.954**	**2.104**	**1.542**	**1.398**	**1.178**	**1.025**	**0.969**
Probability (Pi)	0.563	0.063	0.045	0.033	0.030	0.025	0.022	0.021
Cumulative Probability (C. Pi)	0.563	0.625	0.670	0.703	0.733	0.758	0.780	0.800

Based on the above table 4.34 (47 *PC*'s), when considering entire total imports commodities (*TI*, 47 commodities). The point where the slope of the curve is not clearly leveling off (elbow) indicates the components. After 2nd component there is elbow i.e there are two components based on Scree plot namely (*PC1* & *PC2*). But when looking eigen values of from *PC1* to *PC8* which are greater than one. Since, there are 8 components (namely PC1, PC2, … & PC8) which can be selected for further analysis. Furthermore, these 43 commodities of *TI* can be grouped into two or eight factors without losing much information. Each component explained total variance from *PC1* to *PC8* are 56%, 6%, 5%, 3%, 3%, 3%, 3% & 2% respectively. The cumulative proportion of variance explained

by the first two components is roughly 63% of the total variance. The cumulative proportion of variance explained by the eight components is roughly 80% of the total variance. Based on another rule of selecting the components, at least 80% of total variance should be selected for factoring. Since, eight *PC*'s are selected for further analysis.

Table 4.35: Coefficient/ Eigen Vector for *TI*

Variable	PC1	PC2	PC3	PC4	PC5	PC6	PC7	PC8
Y1	0.178	0.011	0.010	-0.116	-0.068	**-0.221**	-0.036	0.051
Y2	0.132	0.165	0.015	-0.165	0.062	-0.185	-0.195	-0.078
Y3	0.083	-0.153	**0.295**	0.163	**0.233**	**-0.357**	-0.048	0.028
Y4	0.079	0.045	**-0.227**	**-0.305**	**-0.444**	-0.078	0.098	**0.218**
Y5	0.118	**-0.236**	-0.023	-0.111	-0.046	**-0.217**	0.005	0.110
Y6	0.169	0.168	0.065	0.050	0.105	0.028	-0.126	-0.110
Y7	0.112	0.077	0.068	-0.178	0.074	-0.190	0.011	-0.188
Y8	0.161	0.123	0.036	0.120	-0.033	-0.177	0.044	**-0.215**
Y9	0.177	0.074	0.052	-0.110	0.055	0.001	-0.053	0.089
Y10	0.171	-0.060	0.094	0.132	0.118	0.035	0.066	0.031
Y11	0.159	0.001	**-0.204**	-0.037	-0.154	0.003	0.069	0.009
Y12	0.186	0.047	-0.074	0.113	-0.029	-0.050	0.047	-0.050
Y13	0.185	0.028	0.030	0.005	0.091	0.033	-0.053	0.025
Y14	0.151	0.027	-0.185	**0.237**	-0.128	-0.145	0.099	-0.120
Y15	0.184	0.038	0.043	-0.007	0.045	0.084	-0.022	0.041
Y16	0.174	-0.044	0.089	0.017	0.045	-0.024	0.179	0.006
Y17	0.173	0.110	-0.077	0.005	0.051	-0.010	-0.044	-0.006
Y18	0.169	-0.018	0.174	-0.009	0.107	-0.058	-0.014	0.012
Y19	0.172	0.037	-0.052	0.141	0.068	0.052	0.054	-0.097
Y20	0.108	-0.089	0.059	**0.311**	**-0.212**	0.137	0.005	0.040
Y21	0.174	0.129	0.007	-0.034	-0.041	0.024	0.021	-0.013
Y22	0.184	0.049	0.000	-0.022	0.041	0.125	-0.012	0.015
Y23	0.064	**-0.497**	-0.129	-0.183	0.151	0.005	-0.078	-0.032
Y24	-0.014	**-0.381**	-0.133	-0.117	0.144	-0.022	-0.122	**-0.381**
Y25	0.079	**-0.430**	-0.077	-0.114	0.133	0.027	-0.081	**0.222**
Y26	0.112	-0.006	-0.066	-0.366	-0.119	-0.034	0.332	-0.060

Y27	0.181	0.025	0.043	-0.020	0.005	0.112	-0.057	0.073
Y28	0.187	0.002	-0.069	-0.004	0.059	0.001	-0.019	-0.004
Y29	0.188	0.003	-0.077	0.037	0.020	-0.007	-0.021	0.020
Y30	0.052	-0.129	-0.104	0.118	**-0.359**	-0.156	-0.569	0.085
Y31	0.059	**-0.228**	0.523	0.013	**-0.246**	0.132	0.057	0.028
Y32	0.099	-0.128	0.496	-0.050	**-0.209**	0.125	0.044	0.028
Y33	0.180	0.036	-0.086	0.090	-0.042	0.074	-0.048	-0.016
Y34	0.151	-0.097	-0.116	-0.117	-0.008	**0.225**	-0.001	0.178
Y35	-0.017	**-0.201**	-0.147	0.192	**-0.223**	**0.373**	0.018	-0.460
Y36	0.187	0.038	0.029	-0.028	0.033	0.063	-0.007	-0.041
Y37	0.174	0.002	-0.064	-0.014	0.100	0.036	-0.161	0.021
Y38	0.117	-0.045	0.034	-0.001	**-0.315**	**-0.313**	-0.085	-0.041
Y39	0.161	0.036	0.038	0.118	-0.027	0.051	0.030	-0.051
Y40	0.117	-0.059	-0.093	0.013	0.099	-0.021	-0.014	**-0.275**
Y41	0.106	0.009	-0.117	**0.234**	0.014	**0.255**	**-0.204**	**0.369**
Y42	0.177	0.055	-0.053	0.035	0.011	0.049	-0.014	-0.062
Y43	0.178	-0.049	0.017	-0.068	0.115	0.116	0.025	0.013
Y44	0.183	0.001	-0.000	-0.077	0.106	0.072	-0.024	-0.009
Y45	0.115	-0.173	-0.024	0.183	**-0.214**	-0.165	**0.324**	-0.104
Y46	0.103	0.095	0.073	**-0.353**	-0.081	**0.316**	0.039	-0.103
UY4	-0.055	0.140	0.189	**-0.222**	-0.149	0.082	**-0.457**	**-0.311**

Based on the above table 4.35, the *PC1* is moderately correlated with most of the variables (47 commodities, approximately +/-0.2) and other variables are week correlation (below 0.2). Out of 47 variables, all weekly correlated variables are *Y2-Y5, Y7, Y20, Y23-Y26, Y30-Y32, Y35, Y40, Y41, Y45, Y46 & UY4*. This suggests that these 18 commodities are not vary together. Except those variables, other commodities in total exports are vary together (Food, Beverages, Seafood, Fruits, Medical, Clothing, Vehicles, Telecommunication, Chemicals, Plastics, Plastics & Metal). Most of the *PC1* influence products manufactured raw materials are in Sri Lanka. *Y29* is highest correlated with *PC1* i.e highly influenced commodities into *PC1* (Plastic). If one increases, then the remaining

ones tend to increase as well. This component can be viewed as measure of the general consumable goods.

Similarly, the *PC2* is showing both negative/positive correlation & no correlation with commodities. Out of all 47 commodities, 7 commodities (*Y5, Y23-Y25, Y31* & *Y35*) are moderately negatively correlated with *PC2*. Furthermore, *PC2* is most correlated negative direction (Dairy Products, Fuel, Petroleum Products, Diamonds & Fertilizer). *Y23* (Fuel) is strongly correlated with *PC2*. This component can be viewed as Fuel Imports Commodities.

The *PC3* is showing both negative/positive correlation & no correlation with commodities. Out of all 47 commodities, 3 commodities (*Y3, Y4 & Y11*) are moderately positively/ negatively correlated with *PC3*. Out of three commodities *Y3* is showing a negative correlation and other two are showing negative correlation. PC3 is highly positive correlated with *Y3* (Sugar and Confectionery,0.295). Furthermore, *PC3* is most correlated both negative & positive direction (Sugar and Confectionery, Cereals, Food & beverage). This component can be viewed as Food & Beverage exports.

The *PC4* is showing both negative/positive correlation & no correlation with commodities. Out of all 47 commodities, 6 commodities (Y4, *Y14, Y20, Y41, Y46 & UY4*) are positively/ negatively correlated with *PC4*. Furthermore, *PC4* is most correlated both negative & positive direction (Cereals, Vehicles, Telecommunication, Unmanufactured Tabaco, Other investments & unclassified). *Y46* (Other investments, -0.353) is strongly negative correlated with *PC4*. This component can be viewed as other investments.

The *PC5* is showing both negative/positive correlation & no correlation with commodities. Out of all 47 commodities, 9 commodities (*Y3, Y4, Y20, Y30-Y32, Y35, Y38 & Y45*) are positively/ negatively correlated with *PC5*. Furthermore, *PC5* is most correlated both negative & positive direction (Sugar, Cereals, Printed, Wheat, Diamonds, Gold, Fertilizer, Food Preparation & Transports). *Y4* (Cereal, -0.444) is strongly negative correlated with *PC5*. This component can be viewed as Cereal products.

The *PC6* is showing both negative/positive correlation & no correlation with commodities. Out of all 47 commodities, 8 commodities (*Y1, Y3, Y5, Y34, Y35, Y38, Y41 & Y46*) are positively/ negatively correlated with *PC6*. Furthermore, *PC6* is most correlated both negative & positive direction (Food, Sugar, Dairy products, Base Metal, Fertilizer, Food, Tobacco & other investment). *Y35* (Fertilizer, 0.373) is strongly positive correlated with *PC6*. This component can be viewed as secondary foods.

The *PC7* is showing both negative/positive correlation & no correlation with commodities. Out of all 47 commodities, 3 commodities (*Y41, Y45 & UY4*) are positively/ negatively correlated with *PC7*. Furthermore, *PC7* is most correlated both negative & positive direction (Tabaco, Transport & Unclassified Products). *UY4* (Unclassified products, -0.457) is strongly negative correlated with *PC7*. This component can be viewed as unclassified products.

The *PC8* is showing both negative/positive correlation & no correlation with commodities. Out of all 47 commodities, 7 commodities (*Y4, Y8, Y24, Y25, Y40, Y41 & UY4*) are positively/ negatively correlated with *PC8*. Furthermore, *PC8* is most correlated both negative & positive direction (Cereals, Spices, Petroleum, Coal, Mineral, Other intermediate goods & unclassified products). *Y24* (Petroleum and Crud Oil, -0.381) is strongly negative correlated with *PC8*. This component can be viewed as petroleum products.

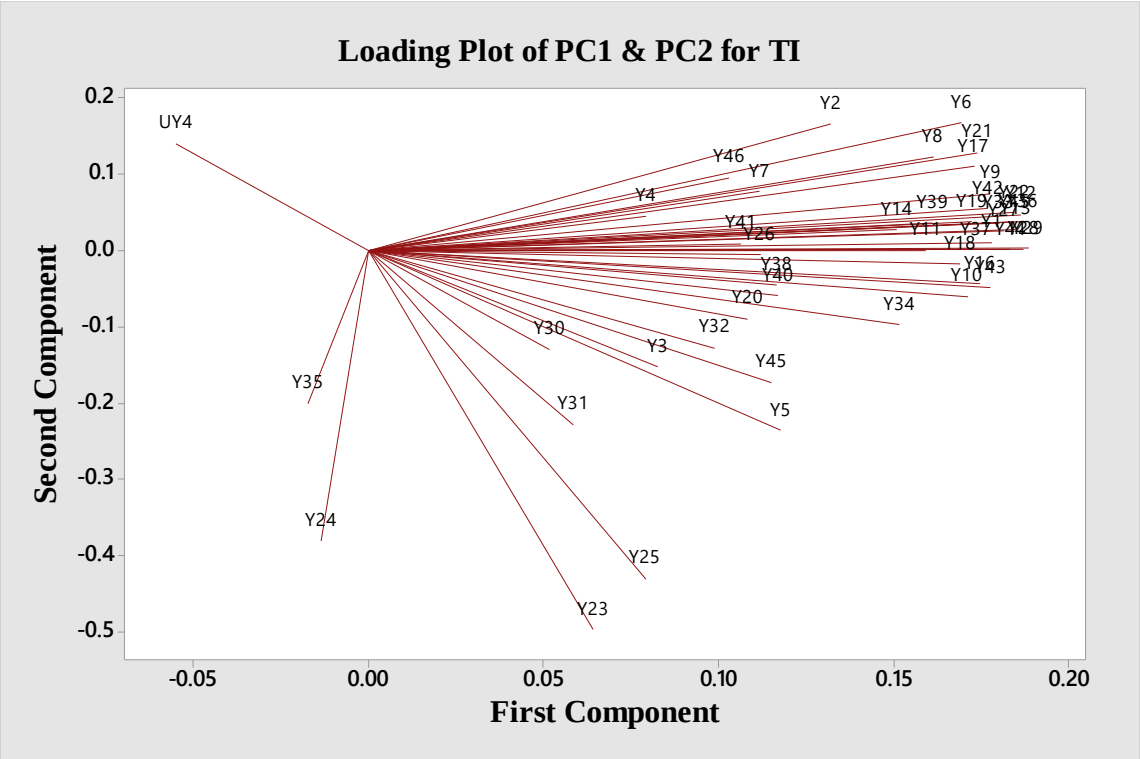

Figure 4.22: Loading Plot for *TI*

Based on the above loading plot (figure 4.24), it is clearly shown that numerical interpretation is well proof by loading plot of *PC1* & *PC2*. Most of the commodities are negative correlations with *PC2* compared to *PC1*. Other commodities are week/ moderate positive correlation with *PC1*.

4.5: FACTOR ANALYSIS

4.5.1: INTRODUCTION

Factor Analysis (*FA*) is an exploratory technique applied to as set of observed variables that seeks to find underlying factors from which the observed variables were generated. Also, *FA* is a method for investigating number of unobservable factors. Using the *PCA* method can be identified the components without losing information's. But it is difficult to interpret the results due to hidden factors & interrelating each component. Based on *PCA* results of *TE* & *TI*, there is a similar problem. The problem is with *PCA* analysis is

that some of the commodities are highlighted in more than one component. Since this does not provide a very clean, simple interpretation of the data. Ideally, each commodity would appear as a significant contributor in one component/factor. Based on the *PCA* results of *TE* & *TI*, *FA* analysis is carried out for *TE* & *TI* to identify the factors clearly. Initially applied the FA analysis (unrotated) then carried out factor rotation (VARIMAX, rotated) method for more simplifications.

4.5.2: *FA* for Total Exports (*TE*)

According to the *PCA* outputs for *TE* (Figure 4.15 & Table 4.27), 7 components are identified. 79% of total variance are explained from these components.

Table 4.36: Unrotated Factor Loading and Communalities for *TE*

Variable	Factor1	Factor2	Factor3	Factor4	Factor5	Factor6	Factor7	Communality
X1	**0.838**	-0.313	-0.013	-0.147	0.030	0.141	-0.134	0.860
X2	**-0.539**	**-0.555**	-0.234	0.285	0.160	0.218	0.061	0.811
X3	**0.919**	0.122	-0.194	-0.027	-0.065	-0.097	-0.033	**0.913**
X4	**0.867**	0.239	-0.185	-0.019	-0.064	-0.111	-0.052	0.862
X5	**0.873**	-0.115	-0.181	-0.039	-0.057	-0.055	0.008	0.816
X6	**0.836**	-0.062	0.024	0.040	-0.145	0.031	-0.097	0.736
X7	**0.775**	0.115	-0.116	-0.286	0.011	0.145	-0.069	0.735
X8	0.311	-0.299	**0.538**	-0.173	0.031	0.146	0.272	0.601
X9	**0.872**	0.056	-0.123	-0.176	-0.027	-0.019	-0.006	0.810
X10	**0.699**	-0.155	0.121	-0.284	0.080	0.251	0.047	0.680
X11	**0.699**	-0.030	-0.015	0.375	0.146	-0.092	0.030	0.661
X12	**0.442**	-0.281	-0.209	-0.085	0.146	**-0.446**	0.062	0.549
X13	**0.954**	0.028	-0.033	-0.103	-0.049	-0.047	-0.023	0.929
X14	**0.950**	0.022	-0.037	-0.112	-0.050	-0.048	-0.027	0.923
X15	**0.862**	0.051	0.038	-0.035	-0.020	-0.057	0.016	0.753
X16	**0.826**	0.272	-0.021	0.194	-0.034	0.047	0.083	0.805
X17	**0.885**	-0.341	0.049	-0.029	-0.059	0.003	-0.057	0.910
X18	-0.180	**-0.624**	0.393	0.102	-0.185	-0.263	-0.291	0.776
X19	**0.765**	0.033	0.303	0.294	0.136	0.115	-0.024	0.796

X20	0.193	-0.078	-0.121	-0.046	**0.748**	**-0.401**	0.190	0.816
X21	0.547	**-0.577**	-0.059	0.064	-0.280	0.079	0.153	0.748
X22	**0.936**	-0.122	-0.114	-0.058	-0.093	0.020	0.027	0.917
X23	**0.950**	-0.138	0.014	0.035	-0.034	0.059	0.040	0.929
X24	-0.146	-0.347	**-0.586**	0.104	0.312	**0.474**	-0.232	0.871
X25	**0.890**	0.271	-0.128	0.013	-0.017	-0.044	-0.029	0.885
X26	**0.896**	0.133	0.073	0.097	0.091	0.003	0.011	0.844
X27	**0.679**	0.175	0.077	**0.400**	0.097	0.270	0.089	0.748
X28	0.385	0.012	**0.521**	0.176	0.316	-0.026	**-0.556**	0.861
X29	**0.957**	0.026	0.021	-0.016	-0.042	-0.020	-0.042	0.922
X30	**0.850**	-0.090	-0.013	0.153	0.130	-0.005	-0.066	0.775
X31	0.264	**-0.502**	-0.004	0.368	-0.115	-0.163	0.380	0.641
X32	0.145	-0.238	0.287	**-0.537**	0.309	0.191	0.205	0.622
UX4	0.250	**0.454**	0.274	0.220	0.076	0.179	0.351	0.553
Variance	17.452	2.430	1.621	1.355	1.169	1.064	0.967	26.057
% Var	0.529	0.074	0.049	0.041	0.035	0.032	0.029	0.790

It is clearly seen the *PCA* analysis of *TE* (Table 4.36) there are more commodities highlighted into one *PC*. With selection of 7 PC's, unrotated factor analysis is carried out for *TE*. There are significant improvement results compared to *PCA* method. That mean there are few commodities highlighted into one factor such as *X2, X12, X20, X27 & X28*. Furthermore, *X2* is overlapped both F1 & F2. According to the table 4.36 in values of unrotated factor loadings & considering most influence commodities into each factor (above +/- 0.4, close to +/-1), 23 commodities are highly correlated with *F1* such as *X1-X7, X9-X17, X19, X22-X23, X25-X27 & X29-X30. F1* is explained 53% of the variations. Similarly, 5 variables are correlated with *F2* (moderately) which is explained 7% of the variations such as *X2, X18, X21, X31* & *UX4*. 3 variables are correlated with *F3* (moderately) which is explained 5% of the variations such as *X8, X24 & X28.* 2 variables are correlated with *F4* (moderately) which is explained 4% of the variations such as *X27 & X32.* one variable is correlated with *F5* (moderately) which is explained 4% of the variations such as *X20.* 3 variables are correlated with *F6* (moderately) which is explained

3% of the variations such as *X12, X20 & X24.* Only one variable is correlated with *F7* (moderately) which is explained 3% of the variations such as *X28.* All 7 factors are explained 79% of the variations. According to the community values, most of the variable communities are above 0.8 except *X10-X12, X31, X32 & UX4*. As exampled, community value of X3 is 0.913 (1-0.913=0.017) i.e 91% total of variations is explained by the 7 factors & specific variance is minimum. But, *X10-X12, X31, X32 & UX4* variable is showing high specific variance (below 40%).

Table 4.37: Rotated Factor Loading, Varimax and Communalities for *TE*

Variable	Factor1	Factor2	Factor3	Factor4	Factor5	Factor6	Factor7	Communality
X1	**0.820**	-0.167	-0.083	0.307	-0.180	-0.164	0.010	0.860
X2	-0.543	-0.377	-0.136	-0.026	0.043	**-0.594**	0.030	0.811
X3	**0.937**	-0.023	0.106	-0.066	0.013	0.084	0.112	0.913
X4	**0.890**	0.065	0.147	-0.123	0.013	0.131	0.104	0.862
X5	**0.876**	-0.183	0.012	0.050	0.011	-0.017	0.108	0.816
X6	**0.815**	-0.167	0.075	0.056	-0.164	0.055	-0.078	0.736
X7	**0.808**	0.185	0.063	0.205	0.037	-0.023	0.003	0.735
X8	0.150	-0.294	0.122	**0.643**	-0.163	0.186	-0.058	0.601
X9	**0.883**	0.016	0.058	0.119	0.029	0.065	0.091	0.810
X10	**0.651**	-0.028	0.074	0.490	-0.069	-0.066	-0.018	0.680
X11	**0.602**	-0.284	0.303	-0.124	-0.242	-0.027	0.227	0.661
X12	0.438	-0.249	-0.257	-0.005	0.042	0.059	**0.474**	0.549
X13	**0.938**	-0.062	0.089	0.117	-0.068	0.118	0.076	0.929
X14	**0.936**	-0.060	0.077	0.120	-0.066	0.114	0.076	0.923
X15	**0.819**	-0.085	0.152	0.107	-0.103	0.150	0.088	0.753
X16	**0.772**	-0.048	0.427	-0.084	-0.065	0.115	0.024	0.805
X17	**0.838**	-0.333	-0.057	0.233	-0.196	-0.026	0.027	0.910
X18	-0.230	**-0.469**	-0.505	0.087	-0.462	0.115	-0.118	0.776
X19	**0.616**	-0.189	0.425	0.120	-0.427	0.052	0.034	0.796
X20	0.092	0.005	0.058	0.120	-0.058	-0.062	**0.885**	0.816
X21	0.521	**-0.615**	-0.138	0.199	0.054	-0.132	-0.139	0.748
X22	**0.926**	-0.198	0.054	0.127	-0.005	-0.004	0.036	0.917

X23	**0.891**	-0.253	0.155	0.173	-0.124	0.001	0.037	0.929
X24	-0.045	0.039	-0.121	-0.067	0.061	**-0.919**	0.034	0.871
X25	**0.888**	0.078	0.244	-0.080	-0.028	0.117	0.096	0.885
X26	**0.818**	-0.061	0.319	0.069	-0.197	0.100	0.127	0.844
X27	0.567	-0.140	**0.592**	-0.030	-0.212	-0.096	-0.033	0.748
X28	0.266	0.121	0.069	0.090	-0.868	0.064	0.065	0.861
X29	**0.920**	-0.098	0.145	0.098	-0.144	0.109	0.050	0.922
X30	**0.783**	-0.188	0.176	0.047	-0.248	-0.066	0.166	0.775
X31	0.156	**-0.771**	0.059	0.006	0.052	-0.013	0.127	0.641
X32	0.065	0.080	-0.053	**0.765**	0.016	-0.017	0.153	0.622
UX4	0.115	0.051	**0.692**	0.067	-0.005	0.231	-0.027	0.553
Variance	15.939	2.059	2.024	1.694	1.562	1.506	1.273	26.057
% Var	0.483	0.062	0.061	0.051	0.047	0.046	0.039	0.790

To examine more precise results, rotated factor analysis (Varimax) is carried out for *TE*. There are significant improvement results compared to *PCA* method & unrotated factor analysis. According to the table 4.37 in values of rotated factor loadings & considering most influence commodities into each factor (above +/- 0.5, close to +/-1), 21 commodities are highly correlated with *F1* such as *X1, X3-X7, X9-X11, X13-X17, X19, X22-X23, X25-X26 & X29-X30* (Tea, Coconut, Kernel Products, Spices, Vegetables, Agriculture Products, Sea food, Beverage, Textiles, Garments, Rubber Products, Machinery, Chemical Products, Wood products, Leather Footwear, Plastics, Other industrial & Erath stones). *F1* is explained 48% of the variations & it is primarily measure Textile/ Garment with increasing scores of country own manufacturing products. Similarly, 3 variables are correlated with *F2* which is explained 6% of the variations such as *X18, X21 & X31* (Gems Diamonds and Jewelry, Petroleum Products & Ore) & it is primarily measure Ore with increasing other hard raw material products. 2 variables are correlated with *F3* which is explained 6% of the variations such as *X27 & UX4* (Base metals & Unclassified) & it is primarily measure unclassified products. Only one variable is correlated with *F4* which is explained 5% of the variations such as *X8* (Unmanufactured Tobacco). Only one variable

is correlated with *F5* which is explained 5% of the variations such as *X32* (Precious Metal). 2 variables are correlated with *F6* which is explained 5% of the variations such as *X2 & X24* (Rubber & Printing industry) & it is primarily measure printing industry with increasing rubber products. 2 variables are correlated with *F7* which is explained 4% of the variations such as *X12 & X20* (Animal foods & Transport equipment) & it is primarily measure transport equipment with increasing animal foods. All 7 factors are explained 79% of the variations. According to the community values, most of the variable communities are above 0.65 except *UX4*. Community value of *UX4* is 55% and 45% of the specific variance is included. Based on the outcome of rotated FA, 7 groups can be clearly identified with different aspects in Sri Lankas Exports.

4.5.3: *FA* for Total Imports (*TI*)

According to the *PCA* outputs for *TI* (Figure 4.23 & Table 4.34), 8 components are identified. 80% of total variance are explained from these components.

Table 4.38: Unrotated Factor Loading and Communalities for *TI*

Variable	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8	Communality
Y1	**0.915**	0.019	0.014	-0.144	-0.080	-0.239	-0.036	0.050	0.925
Y2	**0.679**	0.284	0.022	-0.205	0.073	-0.201	-0.198	-0.076	0.674
Y3	**0.426**	-0.262	**0.428**	0.202	0.275	-0.387	-0.048	0.028	0.702
Y4	**0.408**	0.078	-0.329	-0.379	-0.524	-0.085	0.099	0.214	0.762
Y5	**0.605**	-0.405	-0.033	-0.138	-0.054	-0.236	0.005	0.108	**0.620**
Y6	**0.871**	0.288	0.094	0.062	0.125	0.030	-0.128	-0.108	0.898
Y7	**0.574**	0.132	0.099	-0.222	0.087	-0.206	0.011	-0.185	**0.490**
Y8	**0.829**	0.211	0.052	0.149	-0.040	-0.192	0.045	-0.212	0.842
Y9	**0.913**	0.128	0.076	-0.136	0.065	0.001	-0.054	0.088	0.888
Y10	**0.879**	-0.104	0.136	0.165	0.139	0.038	0.067	0.031	0.856
Y11	**0.818**	0.001	-0.297	-0.046	-0.182	0.003	0.070	0.009	0.798
Y12	**0.958**	0.080	-0.107	0.140	-0.034	-0.054	0.048	-0.050	0.964
Y13	**0.951**	0.049	0.043	0.006	0.107	0.036	-0.053	0.024	0.924

Y14	**0.775**	0.047	-0.269	0.294	-0.151	-0.158	0.100	-0.118	0.834
Y15	**0.948**	0.065	0.063	-0.009	0.054	0.092	-0.022	0.040	0.920
Y16	**0.897**	-0.076	0.129	0.021	0.053	-0.026	0.181	0.005	0.864
Y17	**0.889**	0.190	-0.112	0.006	0.060	-0.010	-0.045	-0.006	0.844
Y18	**0.868**	-0.031	0.253	-0.011	0.126	-0.063	-0.014	0.012	0.839
Y19	**0.886**	0.064	-0.076	0.175	0.080	0.057	0.054	-0.096	0.848
Y20	**0.557**	-0.154	0.086	0.386	-0.250	0.149	0.005	0.039	**0.577**
Y21	**0.894**	0.221	0.010	-0.042	-0.048	0.026	0.021	-0.013	0.854
Y22	**0.948**	0.084	0.000	-0.028	0.048	0.136	-0.012	0.015	0.928
Y23	0.330	**-0.854**	-0.187	-0.228	0.179	0.005	-0.079	-0.031	0.964
Y24	-0.070	**-0.655**	-0.193	-0.145	0.170	-0.024	-0.124	-0.375	0.677
Y25	0.407	**-0.739**	-0.112	-0.141	0.157	0.029	-0.082	0.219	0.824
Y26	**0.575**	-0.010	-0.096	-0.455	-0.141	-0.037	0.336	-0.059	0.685
Y27	**0.932**	0.043	0.062	-0.025	0.006	0.122	-0.058	0.072	0.899
Y28	**0.961**	0.003	-0.100	-0.005	0.069	0.002	-0.019	-0.004	0.939
Y29	**0.968**	0.005	-0.111	0.047	0.024	-0.008	-0.022	0.019	0.954
Y30	0.266	-0.222	-0.150	0.146	**-0.424**	-0.170	**-0.576**	0.084	0.711
Y31	0.301	-0.391	0.758	0.016	-0.291	0.144	0.058	0.027	0.928
Y32	**0.508**	-0.220	0.719	-0.063	-0.247	0.135	0.044	0.028	0.909
Y33	**0.926**	0.061	-0.125	0.112	-0.049	0.080	-0.048	-0.015	0.901
Y34	**0.779**	-0.167	-0.168	-0.145	-0.010	0.245	-0.001	0.175	0.774
Y35	-0.089	-0.345	-0.213	0.239	-0.264	**0.404**	0.018	-0.453	0.668
Y36	**0.959**	0.065	0.042	-0.034	0.039	0.068	-0.008	-0.040	0.935
Y37	**0.893**	0.003	-0.093	-0.017	0.119	0.040	-0.163	0.020	0.849
Y38	**0.600**	-0.078	0.049	-0.002	-0.372	-0.340	-0.086	-0.040	**0.632**
Y39	**0.828**	0.062	0.056	0.146	-0.032	0.055	0.031	-0.050	0.722
Y40	**0.601**	-0.102	-0.135	0.016	0.117	-0.023	-0.014	-0.271	**0.477**
Y41	**0.547**	0.016	-0.170	0.291	0.017	0.277	-0.206	0.363	0.664
Y42	**0.909**	0.094	-0.076	0.044	0.013	0.053	-0.014	-0.061	0.850
Y43	**0.914**	-0.084	0.025	-0.084	0.136	0.125	0.026	0.013	0.884
Y44	**0.943**	0.001	-0.000	-0.096	0.126	0.078	-0.024	-0.009	0.920
Y45	**0.592**	-0.297	-0.035	0.227	-0.253	-0.179	0.328	-0.103	0.706
Y46	**0.529**	0.164	0.106	**-0.438**	-0.095	0.343	0.039	-0.101	0.648

UY4	-0.282	0.241	0.275	-0.276	-0.176	0.089	-0.463	**-0.306**	**0.636**
Variance	26.438	2.954	2.104	1.542	1.398	1.178	1.025	0.969	37.607
% Var	0.563	0.063	0.045	0.033	0.030	0.025	0.022	0.021	0.800

It is clearly seen the *PCA* analysis of *TE* (Table 4.38) there are few commodities highlighted into one *PC*. With selection of 8 PC's, unrotated factor analysis is carried out for *TI*. There are significant improvement results compared to *PCA* method for *TI*. That mean there are few commodities highlighted into one factor such as *Y3, Y30 & Y46*. Furthermore, *Y30* is overlapped both *F5* & *F7*. According to the table 5.24 in values of unrotated factor loadings & considering most influence commodities into each factor (above +/- 0.4, close to +/-1), 31 commodities are highly correlated with *F1* such as *Y1-Y22, Y26-Y29, Y32-Y33* & *Y36-Y46. F1* is explained 56% of the variations. Similarly, 3 variables are highly correlated with *F2* which is explained 6% of the variations such as *Y23, Y24* & *Y25*. Only one variable is correlated with *F3* which is explained 5% of the variations such as *Y3.* Only one variable is correlated with *F4* which is explained 3% of the variations such as *Y46.* Only one variable is correlated with *F5* (moderately) which is explained 2% of the variations such as *Y30.* Only one variable is correlated with *F6* (moderately) which is explained 2% of the variations such as *Y35.* Only one variable is correlated with *F7* (moderately) which is explained 2% of the variations such as *Y30.* Only one variable is correlated with *F8* (weekly) which is explained 2% of the variations such as *UY4.* All 8 factors are explained 80% of the variations. According to the community values, most of the variable communities are above 0.7 except *Y5, Y7, Y38, Y40 & UY4*. As exampled, community value of *Y1* is 0.925 (1-0.913=0.075) i.e 93% total of variations is explained by the 8 factors & specific variance is minimum. But, *Y5, Y7, Y38, Y40 & UY4* variable is showing high specific variance (below 40%).

Table 4.39: Rotated Factor Loading, Varimax and Communalities for *TI*

Variable	Factor 1	Factor 2	Factor 3	Factor 4	Factor 5	Factor 6	Factor 7	Factor 8	Communality
Y1	**0.817**	-0.142	0.173	-0.265	0.112	-0.241	-0.229	-0.122	0.925
Y2	**0.714**	0.025	-0.025	-0.120	-0.180	-0.142	-0.264	-0.163	0.674
Y3	0.349	-0.237	0.382	**0.399**	0.215	-0.122	-0.339	-0.209	0.702
Y4	0.257	0.003	-0.042	**-0.781**	0.084	-0.272	-0.056	0.028	0.762
Y5	0.425	**-0.467**	0.208	-0.208	0.226	-0.233	-0.157	-0.075	0.620
Y6	**0.930**	0.100	0.098	0.039	-0.061	-0.059	-0.068	-0.010	0.898
Y7	**0.580**	-0.058	0.080	-0.117	-0.080	0.011	-0.179	-0.303	0.490
Y8	**0.836**	0.123	0.116	-0.020	0.156	-0.164	-0.001	-0.251	0.842
Y9	**0.878**	-0.072	0.178	-0.183	0.002	-0.053	-0.204	0.059	0.888
Y10	**0.820**	-0.164	0.292	0.061	0.247	-0.020	-0.036	0.068	0.856
Y11	**0.739**	-0.122	-0.024	-0.380	0.213	-0.192	0.093	0.032	0.798
Y12	**0.921**	-0.031	0.078	-0.124	0.249	-0.172	0.034	-0.025	0.964
Y13	**0.922**	-0.121	0.172	-0.069	0.079	-0.068	-0.093	0.072	0.924
Y14	**0.734**	0.021	-0.057	-0.107	0.394	-0.290	0.168	-0.111	0.834
Y15	**0.911**	-0.084	0.212	-0.120	0.074	-0.048	-0.064	0.103	0.920
Y16	**0.812**	-0.150	0.310	-0.114	0.256	0.019	-0.067	-0.047	0.864
Y17	**0.896**	-0.009	-0.009	-0.135	0.081	-0.102	-0.070	0.033	0.844
Y18	**0.811**	-0.145	0.341	0.009	0.080	-0.038	-0.183	-0.040	0.839
Y19	**0.886**	-0.049	0.072	-0.015	0.210	-0.052	0.094	0.019	0.848
Y20	**0.458**	0.011	0.342	0.028	0.282	-0.266	0.257	0.182	0.577
Y21	**0.880**	0.068	0.133	-0.216	0.056	-0.072	-0.055	0.004	0.854
Y22	**0.924**	-0.083	0.161	-0.157	0.059	-0.026	-0.015	0.116	0.928
Y23	0.153	**-0.950**	0.101	-0.067	0.111	-0.062	0.080	0.027	0.964
Y24	-0.122	**-0.718**	-0.077	0.112	-0.076	-0.020	0.274	-0.217	0.677
Y25	0.214	**-0.803**	0.173	-0.070	0.191	-0.099	-0.065	0.218	0.824
Y26	0.477	-0.166	0.105	**-0.584**	0.084	0.156	-0.051	-0.208	0.685
Y27	**0.883**	-0.095	0.234	-0.151	0.047	-0.084	-0.053	0.148	0.899
Y28	**0.920**	-0.179	0.076	-0.143	0.142	-0.105	-0.039	0.039	0.939
Y29	**0.918**	-0.150	0.083	-0.143	0.182	-0.155	-0.023	0.059	0.954
Y30	0.147	-0.167	0.043	-0.050	-0.085	**-0.793**	0.070	0.128	0.711

Y31	0.105	-0.120	**0.947**	0.012	-0.008	-0.055	0.046	0.001	0.928
Y32	0.344	-0.052	**0.882**	-0.064	-0.060	-0.028	-0.033	-0.008	0.909
Y33	**0.895**	-0.058	0.077	-0.135	0.149	-0.180	0.085	0.105	0.901
Y34	**0.683**	-0.314	0.111	-0.313	0.099	-0.026	0.030	0.296	0.774
Y35	-0.097	-0.173	0.025	0.026	0.012	-0.057	**0.790**	0.009	0.668
Y36	**0.928**	-0.096	0.194	-0.141	0.059	-0.047	-0.026	0.027	0.935
Y37	**0.873**	-0.205	0.041	-0.070	0.026	-0.139	-0.065	0.113	0.849
Y38	**0.459**	-0.055	0.241	-0.237	0.134	-0.476	-0.064	-0.234	0.632
Y39	**0.797**	0.006	0.209	-0.050	0.160	-0.100	0.062	0.026	0.722
Y40	**0.606**	-0.243	-0.029	0.004	0.062	-0.039	0.143	-0.156	0.477
Y41	0.522	-0.017	-0.002	0.032	0.163	-0.210	0.024	**0.564**	0.664
Y42	**0.895**	-0.057	0.080	-0.128	0.106	-0.098	0.038	0.031	0.850
Y43	**0.862**	-0.256	0.201	-0.129	0.084	0.044	-0.037	0.093	0.884
Y44	**0.911**	-0.202	0.147	-0.138	0.042	-0.002	-0.067	0.059	0.920
Y45	0.431	-0.158	0.273	-0.160	**0.525**	-0.189	0.197	-0.212	0.706
Y46	**0.527**	-0.013	0.211	-0.414	-0.316	0.217	0.064	0.051	0.648
UY4	-0.184	0.188	0.085	0.032	**-0.719**	-0.127	0.056	-0.148	0.636
Variance	23.433	3.065	2.987	2.129	1.879	1.668	1.336	1.111	37.607
% Var	0.499	0.065	0.064	0.045	0.040	0.035	0.028	0.024	0.800

To examine more precise results, rotated factor analysis (Varimax) is carried out for *TI*. There are significant improvement results compared to *PCA* method & unrotated factor analysis for *TI*. According to the table 4.39 in values of rotated factor loadings & considering most influence commodities into each factor (above +/- 0.5, close to +/-1), 33 commodities are highly correlated with *F1* such as *Y1-Y2, Y6-Y22, Y27-Y29, Y33-Y34, Y36-Y40, Y42-Y44 & Y46* (Food, Beverages, Vegetables, Sea Food, Oils, Spices, Fruits, Medical, Vehicles, Furniture, Clothing, Rubber Products, Printed material, Stationary, Telecommunication devices, Textiles, Chemical products, Plastics, Paper, Base metals, Fertilizer, Vehicles, Agriculture inputs, Building Materials & other investments). *F1* is explained 50% of the variations & it is primarily Sea Foods/ Foods with increasing scores of country general human needed products. Similarly, 3 variables are correlated with *F2*

which is explained 7% of the variations such as *Y5, Y23, Y24 & Y25* (Dairy Products, Fuel, Crude Oil & Petroleum Products) & it is primarily measure Fuel with increasing Crude oil & Petroleum products. 2 variables are correlated with *F3* which is explained 6% of the variations such as *Y31 & Y32* (Diamonds & Gold) & it is primarily measure Diamonds and precious. 3 variables are correlated with *F4* which is explained 5% of the variations such as *Y3-Y4 & Y26* (Sugar, Cereals & Coal) & it is primarily measure Cereals and milling industry products. 2 variables are correlated with *F5* which is explained 5% of the variations such as *Y45 &UY4* (Transports Equipment & Unclassified products) & it is primarily measure unclassified products with transport equipment. Only one variable is correlated with *F6* which is explained 4% of the variations such as *Y30* (Wheat and Maisel). Only one variable is correlated with *F7* which is explained 3% of the variations such as *Y35* (Fertilizer). Only one variable is correlated with *F8* which is explained 2% of the variations such as *Y41* (Unmanufactured Tobacco). All 8 factors are explained 80% of the variations. According to the community values, most of the variable communities are above 0.7 except *Y40, Y46 & UY4*. Community values of *Y40, Y46 & UY4* are 55% and 45% of the specific variance is included. Based on the outcome of rotated *FA*, 8 groups can be clearly identified with different aspects in Sri Lankas Imports.

4.6: SUMMARY

Under chapter 5, based on the analysis chapter conclusion and discussions are developed.

CHAPTER 05
CONCLUSION AND DISCUSSION

The aim of the research is to evaluation impact of the exports & imports commodities in the country economic. Mainly, following objectives are elaborated, behavior of the exports and imports, to determine which type of commodity is mainly impact to the country economic, to understand theoretically link between the total exports and imports commodities groups & to revisit the total exports and imports groups by investigating hidden factors which are impacting to county economic. The data are collected mainly from 2007 to 2017 monthly basis (US/ Rupee) from Central Bank of Sri Lanka and Census & Statistic Department Sri Lanka. Both exports and imports are categorized into four groups respectively. Under the export group, there are 33 commodities for Agriculture, Industrial, Mineral & Unclassified groups. Similarly, the import group, there are 47 commodities for Consumer, Intermediate, Investment and Unclassified groups. Initially, behavior of the variables is examined using basically statistical theories and graphical charts. The variable is economical since simple time series analysis is used to identify the component of the exports & imports as well as main categories in each group. Secondly, advance statistical methods are carried out. As first, the correlation analysis is a statistical method used to exam the strength of relationship between two variables. Th aim of the study is to evaluate a general overview of the relationship in each category as well as major groups. With identifying the relationship, *PCA* is used to revisit the commodity group and how well organized the groups. After the identifications of gaps from *PCA*, *PCA* is used to reorganize the commodity groups for exports & imports respectively. To getting more accurate and reliable results, *FA* analysis is carried out for exports & imports to identify the factors clearly. Initially applied the *FA* analysis (unrotated) then carried out factor rotation (VARIMAX, rotated) method for more simplifications. Finally using the selected factors, multiple regression analysis is conducted to identify the impact for the exports and imports.

During the study period of from 2007-Jan to 2017-Octomber, TI is showing an increasing trend compared to TE & key indices are showing that TI is double than TE. Furthermore, TI is clearly show that higher variation compared to TE. There are no any specific variations or seasonal behaviors for both exports & imports. But, there are two main periods. 2007-2011 there was no trend for TI after 2011-217 there was increasing trend. When consider TE, 2007-2013 there was no variation, 2013 it was jumped to higher point later 2014-2017 data was fluctuated around the average value. In total exports, total industrial exports are higher than compared to others. When considering total eight main groups, there are two major sets. One is called Major 1 & Major 2. AX1, IX2, CY1, IY2 & IY3 are belong to Major 1 and MX3, UX4 & UY4 are belong to Major 2. There are significant variations & improvement in Major 1 group. In Major 2 group is showing sharply improvements. In Major 2, there are four seasons. First one is 2007-2011 period (no trend), second one is 2011-2012 (increasing trend), third one was 20120-2015 (sharply decreasing trend thereafter no trend). Finally, 2015-2017 there was sharply increasing trend. Except IY2, other categories were showing increasing trend furthermore. Furthermore, Tea is given a higher contribution to the agriculture exports groups & there is a risk for agriculture products snice there is no rapid improvement compared to other commodities. In industrial exports, Textiles and Garments industries are showing favorable improvement. At the same time, Ceramic and Gems products are getting a high return with low risk. There is no a big improvement in Mineral exports. Considering imports commodities, industrial imports is a higher among the main sub categories. Also, it is showing higher variations. When considering each group, there are more consumer goods compared to main consumer commodities in the consumer imports. Out of all consumer goods, Food and Beverages is highlighted. In the Intermediate Good Imports, Fuel is highest imports & Unmanufactured Tobacco is getting lowest imports. Also, there is low risk for Textile & Textile articles. In Investment Goods Imports, Machinery and equipment is showing highest.

When studying the significance in each commodity group, *AX1 & IX2* are given higher contributions to the total exports & it is highly positive relationship with significant. Since,

there is a strong evidence given by industrial and agriculture improvements, which are impacting to the country economic. Also, *IY2 & IY3* are significantly highly positive related with the total imports. At the same time, unclassified imports commodities are showing a negative impact to the total imports. Moving to the correlation analysis in each group, all the agriculture exports are positive relationship with *AX1*. Among them, Tea is showing significant relationship & other exports commodities as well. In the industrial exports, Textile, Garments, Rubber & Wood products are high positive relationship. But, Gems, Jewelry & Printing products are negatively impacting to the industrial exports. In Mineral industries are showing slower improvement compared to other two groups. But, it is also positively impacting to the total exports. In the import's category, most of the commodities are highly positive relationship with consumer imports. Out of them, Beverage, Foods, Medical items & furniture are high contributions to the consumer imports. In industrial imports category, contribution of Textile products, Petroleum and Chemical products are higher compared to others. But, most the industrial exports commodities are showing moderate relationship. Machinery, Building Material & Transports equipment are highly related with Investment Goods imports. At the overall, Garment, Textiles & Petroleum products are impacting to both imports & exports. Only agriculture products are showing higher contribution to the country exports commodities. One of the main objectives was found out that to elaborate the existing commodity categories accurate. Based on the PCA study for main sub group, AX1 group is classified to two main components with 75% explained. Tea, Coconut, Kernel Products, Other Spices, Vegetable, Minor agriculture & Sea food are belonging to 1st component and this component can be viewed as measure of the general needed foods in human life. It is clearly segregated Rubber & Unmanufactured Tobacco into second group namely secondary agriculture foods. Assumed that AX1 grouping is accreted. There is no proper grouping for IX2. Since, there are 5 main components with 83% variance. But out of 18 commodities, 13 expenditures are belong to 1st component such as Food beverages & tobacco, Animal Fodder, Textile and Garments, Garments, Textile, Other make up textile, Rubber Products, Gem Diamond and Jewelry, Machinery and mechanical appliances,

Wood and Paper Products, Printing Industry Products, Leather travel goods and Foot ware, Plastics and articles thereof, Base metals and articles & Other industrial and it can be called manufactured products. Likewise, Animal Fodder, Other made up textile articles, Rubber products, Gem diamonds and Jewelry, Petroleum products, Leather, travel goods and footwear & Base metals and articles are belonging to second group namely hard raw material. Animal Fodder, Gem diamonds and Jewelry, Machinery and mechanical, Transport equipment, Printing industry products & Ceramics products are belonging into third group namely soft raw material. Animal Fodder, Transport equipment, Petroleum products, & Ceramics products are belonging into fourth group namely re exports products. Animal Fodder, Printing industry products, Base metals and articles & Ceramics products are belonging into fifth group namely printing exports products. But, there is difficult to categorized into one or two groups also, few commodities are belonging to different groups with highly impacting. It is concluded that this group is not clearly categorized and can be grouped furthermore. In MX3 (Mineral) can be categorized into two group with 74% variance. One is Earths and stone & Ores, slag and ash namely fertilizer. Second one is Metals such as Earths and stone & Precious Metals. This group is much mora accurate compared to others.

Similarly considering total imports, there are three components in CY1 (Consumer Goods) with 78% variance. Food and Beverages, Seafood, Spices, Fruits, Consumer Goods, Pharmaceuticals, Vehicles, Furnitures, Telecommunication & nonfood consumables are belonging to first group namely human life needed. Sugar, Milking, Beverage & Cosmetics are belonging to second group namely sweet foods. Stationary and Oils/ fats are belonging to third group namely stationary items. CY1 group classification is given accurate. 74% variance is explained by IY2 with four components. Textiles, Chemical, Plastic, Paper, Metal, Fertilizer, Food Preparations & Rubber are belonging to first group namely the raw materials. Fuel, Crude oil & Fertilizer are belonging to second group namely fuel products. Diamonds & Gold are belonging to fourth group namely Gold products. Coal, Wheat, Fertilizer, Food Preparation & Unmanufactured Tobacco are belonging to Cereals Products group. Intermediate Goods commodity group is categorized

as similar products and sub group is also clearly categorized. IY3 can be clearly categorized into one group and there is no further grouping.

Finally, Agriculture Exports, Mineral Exports, Consumer Imports & Investments Goods Imports are categorized accurately. But there is no proper grouping for Industrial Exports & Intermediate Imports. Since, PCA method is applied to entire commodity group separately for reorganizing. There are seven components for TX (Total Exports). It is explained 79% variance. But there few products are belonging to different groups. It can be named the groups as following purely country production, raw material, unmanufactured material, food & metal products, re-exports, Printing industry and Ceramics products. Similarly, there are eight components for TI (Total Imports) with 80% variance. It can be named as following general consumable goods, Fuel Imports Commodities, Food & Beverage, other investments, Cereal products, secondary foods, unclassified products and petroleum products. For both TE & TI, there are some difficulties for purely grouping due to hidden factors & interrelating each component. Since to obtain more accurate results, Factor Analysis is carried out separately.

Under the *PCA* for TE, seven components were identified. First applied unrotated *FA* and to getting more reliable results, rotated FA was applied. According to the unrotated *FA*, 23 commodities are belonging to factor one. 5 are belonging to factor two. Two or three commodities are belonging to seven factors. Also, some of the commodities are overlap between factors. Since, rotated factor analysis was carried out. It was getting more accurate result. Tea, Coconut, Kernel Products, Spices, Vegetables, Agriculture Products, Sea food, Beverage, Textiles, Garments, Rubber Products, Machinery, Chemical Products, Wood products, Leather Footwear, Plastics, Other industrial & Erath stones are belonging to F1which is explained 48% of the variations & it is primarily measure Textile/ Garment with increasing scores of country own manufacturing products. Gems Diamonds and Jewelry, Petroleum Products & Ore for factor two & it is primarily measure Ore with increasing other hard raw material products. Base metals & Unclassified for factor three & it is primarily measure unclassified products. Only Unmanufactured Tobacco is

correlated with factor four. Also, Precious Metal is correlated with factor five. Rubber & Printing industry are correlated with factor six & it is primarily measure printing industry with increasing rubber products. Animal foods & Transport equipment are correlated with factor seven & it is primarily measure transport equipment with increasing animal foods. All 7 factors are explained 79% of the variations. Based on the outcome of rotated *FA*, seven groups can be clearly identified with different aspects in Sri Lankas Exports market. Same analysis was carried out for *TI*, eight components are identified from *PCA*. According to the unrotated *FA*, 31 commodities are belonging to factor one. 3 commodities are belonging to factor two. One or Two commodities are belonging to other six factors. Also, some of the commodities are overlap between factors. Since, rotated factor analysis was carried out. It was getting more accurate result. 33 commodities are highly correlated with factor one such as Food, Beverages, Vegetables, Sea Food, Oils, Spices, Fruits, Medical, Vehicles, Furniture, Clothing, Rubber Products, Printed material, Stationary, Telecommunication devices, Textiles, Chemical products, Plastics, Paper, Base metals, Fertilizer, Vehicles, Agriculture inputs, Building Materials & other investments with 50% of the variations & it is primarily Sea Foods/ Foods with increasing scores of country general human needed products. Similarly, 3 variables are correlated with factor two such as Dairy Products, Fuel, Crude Oil & Petroleum Products & it is primarily measure Fuel with increasing Crude oil & Petroleum products. 2 variables are correlated with factor three such as Diamonds & Gold & it is primarily measure Diamonds and precious. 3 variables are correlated with factor four such as Sugar, Cereals & Coal & it is primarily measure Cereals and milling industry products. 2 variables are correlated with factor five Transports Equipment & Unclassified products & it is primarily measure unclassified products with transport equipment. Only Wheat and Maisel is correlated with factor six. Only Fertilizer is correlated with factor seven. Only Unmanufactured Tobacco is correlated with factor eight. Eight factors are explained 80% of the variations. Based on the outcome of rotated FA, eight groups can be clearly identified with different aspects in Sri Lankas Imports.

According to the study, more analytical techniques are used to describe the objectives. Examine the behavior of the exports and imports in Sri Lanka which is not rapid improvements, but specific sectors have improvements such as Garment & Textile. Furthermore, continuously balance of the trade is negative value that mean import volume is bigger than exports volume. This is not a good point for GDP. When determining which type of commodity is mainly impact to the country economic, Garment & Textile, Tea & Petroleum Products are critical in Export sector. Unfortunately, there are lack of attention for agriculture sector.

- To understand theoretically link between the total exports and imports commodities groups in Sri Lanka.
- To revisit the total exports and imports groups by investigating hidden factors which are impacting to county economy.

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Appendix

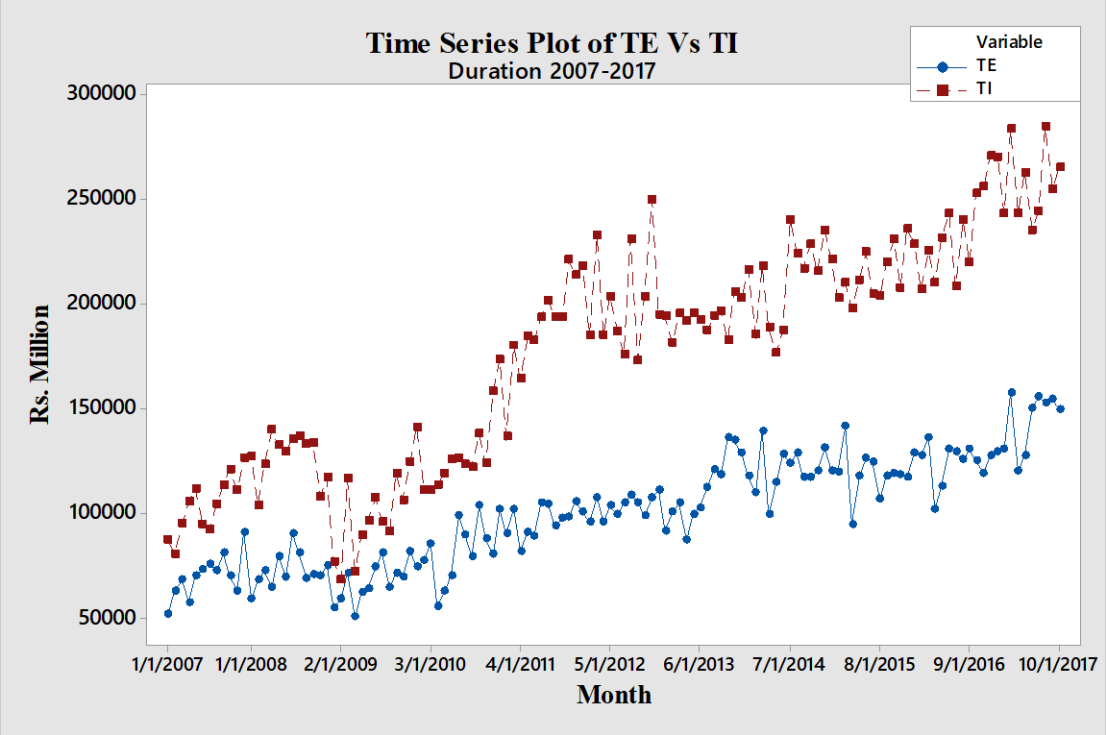

Figure a : Behavior of Total Export & Imports

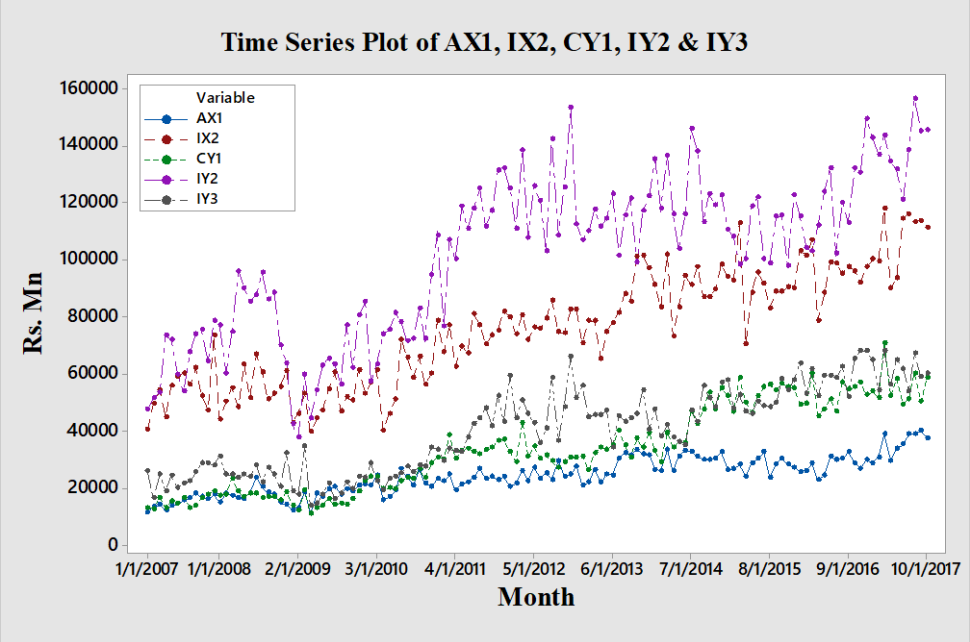

Figure b.1: Time Series Plot for Major Imports & Exports Categories

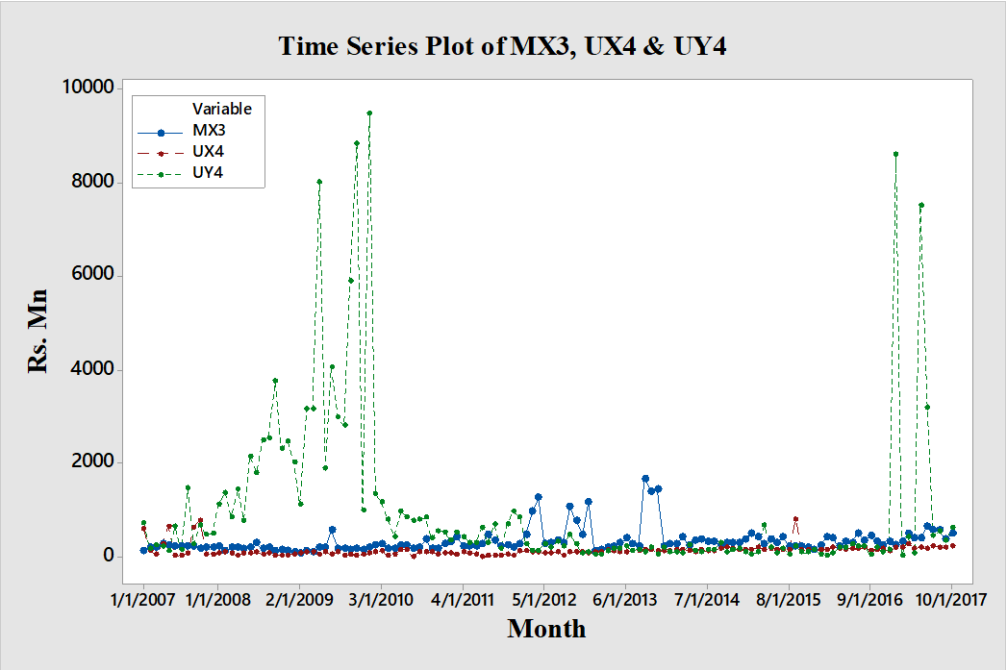

Figure b.2: Time Series Plot for Major Imports & Exports Categories