A Study of Factors affecting the Exports of the Garment Industry in Sri Lanka

Hansi K. Abeynanda
Department of Electrical & Computer Engineering
Sri Lanka Institute of Information Technology
Malabe, Sri Lanka
kavindika.a@sliit.lk

***Abstract*— Since the export of textiles and apparel products is one of the biggest industries in Sri Lanka, and one which plays a key role in advancing the country's economy, this paper examines the main factors affecting the exports of the garment industry in Sri Lanka. After detailed analysis of the Sri Lankan garment industry, garment exports by direct competitors to the United States and the European Union, Inflation rate, Foreign Exchange rate, Generalised System of Preferences Plus scheme, wage of workers, number of unskilled migrants, tsunami disaster have been considered in this study to identify the main factors which influence the exports of the garment industry. After identifying the main factors, this paper aims to develop a factor model to forecast the garment exports of Sri Lanka. For this purpose this paper has used MINITAB and SPSS as main statistical software.**

Keywords*— *Garment industry in Sri Lanka; garment exports; factor model; multiple linear regression; forecasting

I. INTRODUCTION

Garment industry has an important place in Sri Lanka's economy. It has become Sri Lanka's largest export industry since 1986. It is also the country's largest net foreign exchange earner since 1992. The textiles and garment industry turned out to be the leading driver of growth in the industrial sector in November 2013 for Sri Lanka, according to a press release issued by the Economic Research Department of the Central Bank of Sri Lanka. Therefore this paper examines the main factors which influence the exports of the garment industry in Sri Lanka. The European Union (EU) and the United States (US) are the major export destinations of garments of Sri Lanka. Among these two destinations US has been taken in this paper as the main target market as it accounts most percentage of the total garment exports of Sri Lanka.

China, Bangladesh, Indonesia and Cambodia are the main garment importers of US and the garment exports of those countries have been affected on the garment export amount of Sri Lanka. Therefore these four countries are considered as direct competitors of Sri Lanka's garment industry. As a result of this, garment exports of these four countries are taken as four factors which influence on the garment exports of Sri Lanka.

In economics, inflation is a sustained increase in the general price level of goods and services in an economy over a period of time. It can be defined as too much money chasing too few goods. When the general price level rises, each unit of currency buys fewer goods and services. Consequently, inflation reflects a reduction in the purchasing power per unit of money. Therefore it can be thought that the inflation rate effects on purchasing raw materials in the garment industry. In this fact, inflation rate has been taken as another factor which effects on the garment exports of Sri Lanka.

The inter-relationship between a nation's imports/exports and its exchange rate is complicated because of the feedback loop between them. The Foreign Exchange rate (FX rate) is another factor that affect the garment exports since the FX rate has an effect on the trade surplus (or deficit), which in turn affects the exchange rate, and so on. The Generalised System of Preferences plus (GSP+) facility which is considered as a dummy variable in this project was withdrawn in the year 2010. The EU's decision to withdraw the facility has been estimated to cost the government billions, and has had a huge impact on the garment industry, which was at the time a thriving sector in the country.

II. REVIEW OF LITEREATURE

This review is to examine early studies by other researchers related to factors affecting the exports of garment industries. Most researchers have performed general overviews of the garment industry in Sri Lanka throughout their early studies. Challenges, Prospects, Strategies for future development of the garment industry in Sri Lanka and effects of trade agreements towards the garment industry have been discussed in most research papers [1]. The analysis regarding the factors affecting the exports of the garment industry in Sri Lanka is limited. These facts motivate this paper to discuss the factors affecting the exports of the garment industry in Sri Lanka.

Ganeshan Wignaraja (November 2007) has examined the links between firm-level export performance, foreign ownership and the acquisition of technological capabilities in a sample of 205 clothing enterprises in Sri Lanka [2]. In this study the firm-level export function for Sri Lankan clothing firms was estimated using a Tobit model. The capital per employee (RVE), skill adjusted wage rate (WAGE), share of skilled workers in employment (SKW), level of education of the chief executive officer (CEOED), years of experience of the chief executive officer (CEOEXP), foreign ownership (FE), firm size (SIZE), technological capabilities (TI) and effect of an urban location (LOC) were considered as the factors affecting the firm level export performance. After a

detailed analysis, the researcher has found that WAGE, SKW, FE, SIZE, TI and LOC are directly involved with the firm-level export performance.

In the research study "The determinants of textile and apparel export performance in Asian countries" by Xinxin Wang (2013) compared the textile and apparel export performances among 11 major Asian developing countries over a 12 year period (2000-2011) [3]. Trends in textile and apparel export activities for this set of countries were also examined and identified the effects of industrial, economic, and trade factors, including the number of production facilities, the number of employees, labor costs, lead time, logistic performance, exchange rates, quotas, and tariffs on the textile and apparel export performances of the considered 11 developing Asian countries. This study employed a two-phase quantitative method. The goal of the first phase was to compare the textiles and apparel export performance among 11 major developing Asian countries over a twelve-year period. The goal of the second phase of the study was to identify the effects of industry, economic, and trade factors on export performance and compare the differences of these effects among the 11 developing Asian countries in consideration. The determinant factors included labor costs, number of employees, number of production facilities, lead time, logistic performance, exchange rates, tariff rates, and quotas. Data were analyzed using SPSS 17.0 and SAS 9.3. Descriptive statistics were utilized in both phases to descriptively analyze the export performance and the determinants of export performance among Asian developing countries. Auto-regression was employed to explore the impact of labor costs, number of employees, and exchange rate on textile and apparel export performance.

III. Research problem

This paper aims to determine the main factors affecting the exports of the garment industry in Sri Lanka. After determining the main factors it is supposed to forecast the exports using the determined factors.

IV. Determinants to be included

After detailed analysis of the Sri Lankan Garment Industry, following set of variables were considered in this study to determine the main factors which influence the exports of the garment industry in Sri Lanka and for forecasting [2].

1. Garment exports of Sri Lanka to US (Y)
2. Garment exports of the direct competitors to US (X_1, X_2, X_3 and X_4)
   Where X_1 = Garment exports of China to US
   X_2 = Garment exports of Bangladesh to US
   X_3 = Garment exports of Cambodia to US
   X_4 = Garment exports of Indonesia to US
3. Inflation rate (X_5)
4. FX rate (X_6)
5. Number of unskilled migrants (X_7)
6. Wage of workers (X_8)
7. GSP+ scheme – dummy variable (X_9)
   $X_9 = 0$, when GSP+ is not available and $X_9 = 1$, when GSP+ is available.
8. Tsunami disaster – dummy variable (X_{10})
   $X_{10} = 0$, before 2004 and $X_{10} = 1$, after 2004.

V. The data sample

Monthly data for above selected variables were gathered for a period of 18 year time horizon from 1998 to 2015 for the study. Necessary data were collected from the following listed sources.

1. Central Bank of Sri Lanka (CBSL)
2. Web- http://www.otexa.ita.doc.gov/msrpoint.htm -Office of textiles and apparel (OTEXA)

The data set used in this paper consists of both continuous and categorical data. X_1, X_2, X_3, X_4, X_5, X_6, X_7, and X_8 are continuous variables and the other two variables, X_9 and X_{10} are categorical variables. Each variable vector contains 216 elements.

VI. Methodology

a. *Estimation process*

Principle Component Analysis (PCA) was done by using MINITAB to determine number of factors. PCA is a statistical procedure that uses an orthogonal transformation to convert a set of observations of possibly correlated variables into a set of values of linearly uncorrelated variables called principal components. The number of principal components is less than or equal to the number of original variables. MINITAB was used for the Principle Component Analysis to convert the underlying data structure to a smaller number of uncorrelated variables. Afterwards SPSS was used to do the factor analysis to summarize the data covariance structure in a few dimensions of the data. However, the emphasis in factor analysis is the identification of underlying "factors" that might explain the dimensions associated with large data variability. Here the dummy variables, 'Tsunami' and 'GSP' were not taken to the factor analysis part, because the factor analysis can be done only with the continuous variables [4]. But 'Tsunami' and 'GSP' were taken as the predictors in the multiple regression part as it is fair to include binary variables in regression analysis.

b. *Factorizing process*

After determining the number of factors using MINITAB, SPSS was used for the factorization. For this factor analysis, garment exports of China to US (X_1), garment exports of Bangladesh to US (X_2),garment exports of Cambodia to US (X_3), garment exports of Indonesia to US (X_4), inflation rate (X_5), FX rate (X_6), number of unskilled migrants (X_7) and wage of workers (X_8) were taken as the independent variables. Principle component method was selected as the extraction method and entered the number of factors to be extracted using the number of factors obtained in the PCA done using MINITAB. Extraction method refers to the mathematical method that SPSS uses to compute the factors or components. Since the measured units of above mentioned variables are

different, correlation matrix of the data set was considered throughout the extraction method.

The rotation method refers to the mathematical method that SPSS rotate the axes in geometric space. This makes it easier to determine which variables are loaded on which components. The 'Varimax' rotation method was used as the rotation method in this analysis.

c. *Forecasting*

After the factorization, forecasting process was done by using the linear regression analysis. Consequently the following linear model was proposed for the forecasting [5].

$$Y = a + b_1F_1 + b_2F_2 + \cdots + cX_9 + dX_{10} \quad (1)$$

Where $Y = (y_1, y_2, \cdots, y_{216})'$ represents the exports vector, $F_j = \left(f_{j1}, f_{j2}, \cdots f_{j216}\right)'$, $j = 1, 2, \cdots, k,\ 1 \le k \le 8$ are random variables called factors, $f_{ji},\ j = 1, 2, \cdots, k, 1 \le k \le 8, i = 1, 2, \cdots, 216$ are called factor scores on factor F_j, a and $b_j, j = 1, 2, \cdots, k, 1 \le k \le 8$ are constants. When $k = 1$ we call the model a single factor model and when $k \ge 2$ we call it a multi factor model. The estimated factor score f_{ji} on factor F_j for month i can be represented as follows [6].

$$f_{ji} = w_{j1}z_{i1} + w_{j2}z_{i2} + \cdots + w_{j8}z_{i8},$$
$$j = 1, 2, \cdots, k,\ 1 \le k \le 8,\ i = 1, 2, \cdots, 216 \quad (2)$$

The regression weights $w_{jr}, j = 1, 2, \cdots, k,\ 1 \le k \le 8, r = 1, 2, \cdots, 8$ are multi decimal values referred to as factor score coefficients and $z_{ir},\ i = 1, 2, \cdots, 216,\ r = 1, 2, \cdots, 8$ are standardized values of the variables $X_1, X_2, X_3, X_4, X_5, X_6, X_7$ and X_8. i.e. z_{ir} can be written as follows.

$$z_{ir} = \frac{x_{ir} - \overline{x_r}}{\sigma_r},\ i = 1, 2, \cdots, 216, r = 1, 2, \cdots, 8 \quad (3)$$

Where x_{ir} is the i^{th} element of the random variable X_r and σ_r is the standard deviation of X_r. Substituting (3) in (2), we can obtain the following.

$$f_{ji} = w_{j1}\left(\frac{x_{i1} - \overline{x_1}}{\sigma_1}\right) + w_{j2}\left(\frac{x_{i2} - \overline{x_2}}{\sigma_2}\right) + \cdots + w_{j8}\left(\frac{x_{i8} - \overline{x_8}}{\sigma_8}\right),$$
$$j = 1, 2, \cdots, k, 1 \le k \le 8, i = 1, 2, \cdots, 216 \quad (4)$$

Finally, substituting (4) in (1), we can build up the linear model (1). Consequently we will be able to predict the future garment exports of Sri Lanka to US using the following equation.

$$y_i = a + b_1f_{i1} + b_2f_{i1} + \cdots + cX_{i9} + dX_{i10}, i \in N^+ \quad (5)$$

VII. Test Results and Analysis

a. Factorization

Using PCA in MINITAB it is found that the whole data set can be factorized in to 3 factors. (See *Fig. 1*). Since there are large drops in the eigenvalues of first, second and third components in the scree plot, it can be summarized that we can consider three factors although the third eigenvalue is less than one [7].

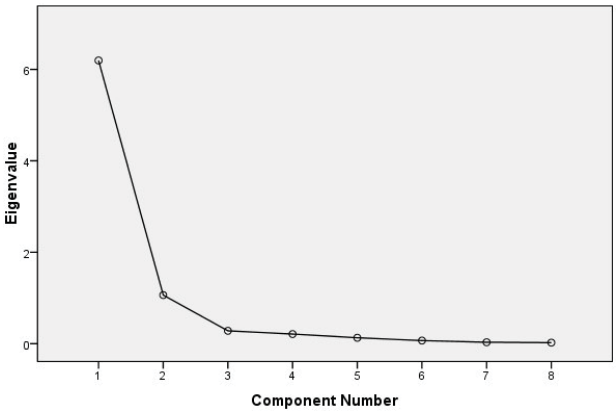

Fig. 1. Scree plot obtained in MINITAB

During the factorization process, SPSS was provided with the following rotated component matrix (See Table 1). According to the Table 1, F_1 is mostly defined by X_3, X_4, X_1 and X_2 since they have occupied the highest loadings for factor 1. The variables X_1, X_2, X_3 and X_4 represent the garment exports of direct competitors to the US. Therefore F_1 can be defined as 'External Sector Performance'. Similarly F_2 is mostly defined by X_7, X_8 and X_6. This set of three variables provide information regarding the participation of industrial workers in the Sri Lankan garment sector according to their financial status. Consequently F_2 can be represented as 'Financial needs of industrial workers'. Finally F_3 is completely defined by X_5. Therefore F_3 can be represented by 'Inflation' itself.

Table 2 shows us 94.242% of the data is defined by the determined three factors.

TABLE 1. ROTATED COMPONENT MATRIX. EXTRACTION METHOD: PRINCIPAL COMPONENT ANALYSIS

	Component		
	1	2	3
Cambodia_X3	0.894	0.383	0.072
Indonishia_X4	0.864	0.444	-0.057
China_X1	0.852	0.426	-0.077
Bangladesh_X2	0.769	0.539	-0.189
Unskilled_Migrants_X7	0.537	0.800	-0.183
Wagerate_X8	0.532	0.795	-0.254
FXrate_X6	0.638	0.682	-0.049
Inflation_X5	-0.021	-0.145	0.986

TABLE 2. TOTAL VARIANCE EXPLAINED

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	6.195	77.441	77.441	6.195	77.441	77.441	3.842	48.025	48.025
2	1.063	13.288	90.729	1.063	13.288	90.729	2.574	32.178	80.203
3	0.281	3.513	94.242	0.281	3.513	94.242	1.123	14.039	94.242
4	0.210	2.631	96.873						
5	0.129	1.612	98.485						
6	0.068	0.845	99.330						
7	0.031	0.390	99.720						
8	0.022	0.280	100.000						

Table 3 shows regression weights z_{ir}. Then F_1, F_2 and F_3 can be written as follows.

TABLE 3. COMPONENT SCORE COEFFICIENT MATRIX

	Component		
	1	2	3
China_X1	0.508	-0.409	-0.090
Bangladesh_X2	0.261	-0.104	-0.117
Cambodia_X3	0.581	-0.472	0.036
Indonishia_X4	0.489	-0.374	-0.060
Inflation_X5	-0.126	0.342	1.024
FXrate_X6	-0.176	0.500	0.173
Unskilled_Migrants_X7	-0.448	0.830	0.130
Wagerate_X8	-0.423	0.781	0.049

$$F_1 = (0.508 \times Z_1) + (0.261 \times Z_2) + (0.581 \times Z_3) + (0.489 \times Z_4) + (-0.126 \times Z_5) + (-0.176 \times Z_6) + (-0.448 \times Z_7) + (-0.423 \times Z_8) \quad (6)$$

$$F_2 = (-0.409 \times Z_1) + (-0.104 \times Z_2) + (-0.472 \times Z_3) + (-0.374 \times Z_4) + (0.342 \times Z_5) + (0.500 \times Z_6) + (0.830 \times Z_7) + (0.781 \times Z_8) \quad (7)$$

$$F_3 = (-0.090 \times Z_1) + (-0.117 \times Z_2) + (0.036 \times Z_3) + (-0.060 \times Z_4) + (1.024 \times Z_5) + (0.173 \times Z_6) + (0.130 \times Z_7) + (0.049 \times 8_8) \quad (8)$$

Where $Z_1, Z_2, Z_3, Z_4, Z_5, Z_6, Z_7$ and Z_8 are standardized variables of $X_1, X_2, X_3, X_4, X_5, X_6, X_7$ and X_8.

b. Forecasting

Test results for 95% confidence interval

The Multiple linear regression model was fixed using the stepwise method. The best model was fixed in five steps with a 95% confidence interval. The Variance Inflation Factors (VIF) obtained in Table 4 for all independent variables are less than 10. This fact illustrates that there is no significant multicollinearity between the independent variables [8]. Therefore the three factors determined above and the two dummy variables (GSP+ scheme and Tsunami disaster) are completely distinct factors that affect garment exports of Sri Lanka.

Then, by using the regression coefficients obtained in the fifth step of the Table 4, the multiple linear regression model can be estimated using the following equation.

$$Y = 38690000000 + 3525000000F_1 + 7117000000F_2 - 2393000000F_3 - 31710000000X_9 - 4862000000X_{10} \quad (9)$$

Next, using (5), (6), (7), (8) and (9) future garment exports can be predicted as follows.

$$y_i = 38690000000 + 3525000000 \times \begin{bmatrix} (0.508 \times z_{i1}) + (0.261 \times z_{i2}) + \\ (0.581 \times z_{i3}) + (0.489 \times z_{i4}) + \\ (-0.126 \times z_{i5}) + (-0.176 \times z_{i6}) + \\ (-0.448 \times z_{i7}) + (-0.423 \times z_{i8}) \end{bmatrix} + 7117000000 \times \begin{bmatrix} (-0.409 \times z_{i1}) + (-0.104 \times z_{i2}) + \\ (-0.472 \times z_{i3}) + (-0.374 \times z_{i4}) + \\ (0.342 \times z_{i5}) + (0.500 \times z_{i6}) + \\ (-0.830 \times z_{i7}) + (0.781 \times z_{i8}) \end{bmatrix} - 2393000000 \times \begin{bmatrix} (-0.090 \times z_{i1}) + (-0.117 \times z_{i2}) + \\ (0.0361 \times z_{i3}) + (-0.060 \times z_{i4}) + \\ (1.024 \times z_{i5}) + (0.173 \times z_{i6}) + \\ (0.130 \times z_{i7}) + (0.049 \times z_{i8}) \end{bmatrix} - 31710000000X_9 - 4862000000X_{10}, i \in N^+ \quad (10)$$

TABLE 4. REGRESSION COEFFICIENTS OF VARIABLES

Model		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	4.461E10	9.388E8		47.512	0.000		
	GSP_X9	-4.437E10	1.119E9	-0.938	-39.643	0.000	1.000	1.000
2	(Constant)	4.053E10	1.033E9		39.245	0.000		
	GSP X9	-3.857E10	1.312E9	-0.816	-29.396	0.000	0.596	1.678
	REGR factor score 2	4.175E9	6.005E8	0.193	6.952	0.000	0.596	1.678
3	(Constant)	3.891E10	1.096E9		35.508	0.000		
	GSP X9	-3.627E10	1.420E9	-0.767	-25.540	0.000	0.480	2.082
	REGR factor score 2	4.844E9	6.113E8	0.224	7.923	0.000	0.543	1.841
	REGR factor score 3	-1.844E9	5.017E8	-0.085	-3.676	0.000	0.806	1.240
4	(Constant)	3.683E10	1.430E9		25.762	0.000		
	GSP X9	-3.331E10	1.930E9	-0.704	-17.257	0.000	0.255	3.919
	REGR factor score 2	5.704E9	7.174E8	0.264	7.951	0.000	0.387	2.584
	REGR factor score 3	-2.304E9	5.379E8	-0.106	-4.284	0.000	0.688	1.453
	REGR factor score 1	1.370E9	6.123E8	0.063	2.237	0.026	0.531	1.883
5	(Constant)	3.869E10	1.583E9		24.438	0.000		
	GSP X9	-3.171E10	2.003E9	-0.670	-15.827	0.000	0.231	4.335
	REGR factor score 2	7.117E9	8.935E8	0.329	7.965	0.000	0.243	4.117
	REGR factor score 3	-2.393E9	5.318E8	-0.111	-4.500	0.000	0.686	1.459
	REGR factor score 1	3.525E9	1.028E9	0.163	3.429	0.001	0.184	5.449
	Tsunami X10	-4.862E9	1.877E9	-0.110	-2.591	0.010	0.232	4.317

VIII. Discussion

The main purpose of this research is, determining the main factors influencing the Garment Exports of Sri Lanka, and forecasting the future garment exports. To achieve these objectives, some fair assumptions were carried out throughout this paper. For the data set of number of unskilled migrants (X_7), yearly data were collected. Therefore an assumption was made, there were same number of unskilled migrants in each month, and to obtain monthly data, yearly data were divided by twelve. Similarly the wage of workers (X_8) also taken by dividing the yearly data by twelve.

For the 95% confidence interval, it was found that the fitted model to predict the exports is a 3 factor model together with two dummy variables GSP+ scheme (X_9) and Tsunami disaster (X_{10}).

IX. Conclusion

Garment Exports of Sri Lanka mainly depends on the following factors.

1. External sector performance – Garment Exports of direct competitors of Sri Lanka to US.
2. Financial needs of industrial workers – Unskilled migrants, wage of workers and FX rate.
3. Inflation rate.

Future Garment Exports of Sri Lanka can be predicted using the following linear model.

$$y_i = 38690000000 + 3525000000 \times \begin{bmatrix} (0.508 \times z_{i1}) + (0.261 \times z_{i2}) + \\ (0.581 \times z_{i3}) + (0.489 \times z_{i4}) + \\ (-0.126 \times z_{i5}) + (-0.176 \times z_{i6}) + \\ (-0.448 \times z_{i7}) + (-0.423 \times z_{i8}) \end{bmatrix} + 7117000000 \times \begin{bmatrix} (-0.409 \times z_{i1}) + (-0.104 \times z_{i2}) + \\ (-0.472 \times z_{i3}) + (-0.374 \times z_{i4}) + \\ (0.342 \times z_{i5}) + (0.500 \times z_{i6}) + \\ (-0.830 \times z_{i7}) + (0.781 \times z_{i8}) \end{bmatrix} - 2393000000 \times \begin{bmatrix} (-0.090 \times z_{i1}) + (-0.117 \times z_{i2}) + \\ (0.0361 \times z_{i3}) + (-0.060 \times z_{i4}) + \\ (1.024 \times z_{i5}) + (0.173 \times z_{i6}) + \\ (0.130 \times z_{i7}) + (0.049 \times z_{i8}) \end{bmatrix} - 31710000000X_9 - 4862000000X_{10}\ ,\quad i \in N^+$$

$$z_{ir} = \frac{x_{ir} - \overline{x_r}}{\sigma_r}, \quad i = 1, 2, \cdots, 216, \qquad r = 1, 2, \cdots, 8.$$

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