Determinants of the Export Demand for Philippine Abaca Fiber

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Abstract: This study determined the statistical relationship and degree of association between the export demand for Philippine abaca fiber and its determinants through the multiple regression method. Coefficients of the variables provided information about the elasticity of the export demand for Philippine abaca fiber. Descriptive method was used to describe the historical behavior of each of the variables. Statistical tests were done using E-views version 7 software. Results of the study show that export demand for Philippine abaca fiber has declined over the years. Real GDP of the importing countries and real effective exchange rate were found to be statistically significant with the export demand for Philippine abaca fiber. Of the determinants identified, Real GDP exhibited the highest degree of linear association with the export demand for Philippine Abaca Fiber based on its correlation coefficient of -0.93. The export demand for Philippine abaca fiber was found to be price inelastic and income elastic. Since the government is determined to bring back the dominance of Philippine abaca fiber in the international arena, and considering the trend of the export demand of the abaca fiber and its elasticity, the government through its implementing agencies such as the Department of Agriculture and Philippine Fiber Industry Development Authority must prioritize programs that will intensify and sustain the production of abaca fiber with the highest quality as it guarantees better price as compared to those of lower quality. The government can also promote higher-value processing by providing technical support to the farmers, traders and manufacturers in this industry as this will create additional value to the product, implying higher revenue or income. Market expansion may also be looked into to offset the weakening demand of the traditional market.

Keywords: abaca production, supply enhancement, Manila hemp, demand modelling, regression,

1. Introduction

Known internationally as Manila Hemp, abaca is one of the Philippines' best-known export products. It has provided livelihood to farmers and manufacturers, and has generated employment in the abaca manufacturing industry. It is one of the major contributors of foreign exchange earnings to the country's economy, generating 130.3 million in Free on Board US dollars in 2016, despite the decrease in volume demand from major markets (Fiber Industry Development Authority, 2017).

The historical and economic relevance of Philippine abaca fiber in the world has long been recognized as emphasized in many literature. The importance of Philippine abaca fiber has been further heightened by the growing global concern for environmental protection and conservation, which has opened limitless opportunities to the abaca industry. However, there is a lack of scientific studies exploring the behaviour

of the export demand for Philippine abaca fiber, which is the gap in literature this study attempted to fill.

This paper explicates the historical behavior of the Export Demand for Philippine Abaca Fiber, its elasticity, and its statistical relationship with the determinants identified such as its export price, real effective exchange rate, and income as proxied by the real gross domestic product (GDP) of the major importing countries.

2. Objectives

The main objective of this study is to determine the relationship and the degree of linear association between the export demand for Philippine abaca fiber and its determinants which are its export price, real effective exchange rate, and real GDP of the major importing countries through the multiple regression method. Coefficient of the variables was also calculated which provided information about the elasticity of the export demand for Philippine abaca fiber. Specifically, this paper seeks to:

1. Describe the historical behaviour of the export demand for Philippine abaca fiber
2. Determine the statistical relationship between the independent variables and the export demand for Philippine abaca fiber, individually and collectively.
3. Determine the income and price elasticity of the export demand for Philippine abaca fiber

3. Methodology

This study utilized secondary data. Annual time series of export price of Philippine abaca fiber and export quantity have been collected from the published report of Philippine Fiber Industry Development Authority (FIDA). Information about the real effective exchange rate and real gross domestic product of the major importing countries on the other hand were taken from the Bangko Sentral ng Pilipinas and World Bank's website, respectively.

The descriptive method was used in order to describe the historical behavior of the export demand for Philippine abaca fiber, its Export price, real exchange rate, and real GDP of the major importing countries.

3.1 Statistical Treatment of Data

Multiple linear regression model was used in this study as the dependent variable is a function of several regressors.

Equation 1 shows the model of this study. That is,

$$X = XP^{b1}\ rXR^{b2}\ rGDP^{b3} \qquad (eqn.\ 1)$$

The equation was converted into a double log linear form as shown in equation 2 in order to satisfy Ordinary Least Square (OLS).

$$lnX = lnb_0 + b_1 lnXP + b_2 lnrXR + b_3 lnrGDP + \mu \qquad (eqn.\ 2)$$

where:

ln	=	the natural log of the base e = 2.718
b_s	=	beta coefficients
ln*X*	=	the natural log of export demand for Philippine abaca fiber
lnXP	=	the natural log of export price of Philippine abaca fiber
lnrXR	=	the natural log of real effective exchange rate
lnrGDP	=	the natural log of real GDP of major importing countries

This model also provides the slope coefficient β which measures the elasticity of Y with respect to X, that is, the percentage change in Y for a given (small) percentage change in X. (Gujarati, 2003).

Other statistical tests were employed in this study. To avoid spurious regression, unit root test was made for all variables using the Augmented Dickey-Fuller Test; the degree of statistical linear association between each of the independent variables to the dependent variable was measured using the Pearson correlation test - coefficient values can range from +1 to -1, where +1 indicates a perfect positive relationship, - 1 indicates a perfect negative relationship, and a 0 indicates no relationship exists; to check the significance of the individual coefficient and the significance of the entire equation, *t*-test and *f*-test were used, respectively; test for goodness of fit was done using the adjusted coefficient of determination adjusted R^2; Durbin-Watson test was employed to detect first-order autoregressive serial correlation; to test for the presence of heteroskedasticity, this paper used White Heteroskedaticity test; to confirm that the model is correctly specified, Ramsey-Reset was employed; Jarque-Bera test was used to determine the normality of the error terms; Variance Inflation Factor (VIF) was utilized to detect perfect or near perfect multicollinearity; Chow Breakpoint Test for structural stability.; and Johansen Test for Cointegration to check if the variables used in the study have a long-term or equilibrium relationship. All tests were performed employing Eviews version 7 software .

3.2 Treatment of Data

Export demand for Philippine abaca fiber was expressed in bales of 125 kilograms for the year 1983 to 2002 and for 2013, and in metric ton for the year 2003 to 2012. Thus, data on export demand for the year 2003 to 2012, was converted into bales of 125 kilograms to align with data of 1983 to 2002 and 2013, by using the formula in equation 3.

$$X = \frac{[Y(1000)]}{125} \qquad \textit{(eqn. 3)}$$

Where:

X = the export demand in bales of 125 kilograms

Y = the export demand in metric tons

Since the export price of Philippine abaca fiber varies depending on the grade of the fiber and if it was spindle- stripped or hand-stripped, weighted average was taken using the formula:

$$XP_t = \frac{\sum(Px_t\, Qx_t)}{Q_t} \qquad \textit{(eqn. 4)}$$

Where:

XP_t = weighted average of export price at a given time

Px_t = export price per grade at a given time

Qx_t = export demand per grade at a given time

Q_t = total demand for export fiber at a given time

Real Gross Domestic Product of the major importing countries was at constant prices with year 2005 as the base year. Using the United States Department Labor Consumer Price Index Inflation Calculator, data on export price of Philippine abaca fiber was also adjusted to inflation with year 2005 as the base year to allow better comparison among the variables.

As a proxy variable for income, the average of the real gross domestic product of United Kingdom (UK), Japan, and China, which are the major importing countries of Philippine abaca fiber was taken using the formula:

$$rGDP = \frac{rGDP_{UK} + rGDP_J + rGDP_C}{} \qquad \textit{(eqn. 5)}$$

Where:

rGDP = average real gross domestic product of the major importing countries

$rGDP_{UK}$ = real gross domestic product of United Kingdom (UK)

$rGDP_J$ = real gross domestic product

		of Japan
$rGDP_C$	=	real gross domestic product of China

4. Results and Discussion

4.1 Historical behaviour of the export demand for Philippine abaca fiber

The figure below shows the historical behavior of the export demand for Philippine abaca fiber from 1983 to 2013. In general, export demand for Philippine abaca fiber decreased over the 31-year period as shown in the graph. The export demand for Philippine abaca fiber was at its peak in 1984 and registered the lowest in 2013. A declining trend from 1986 to 1993 was exhibited. After which, fluctuation occurred until 2010. A declining trend was once again experienced from 2010 until 2013.

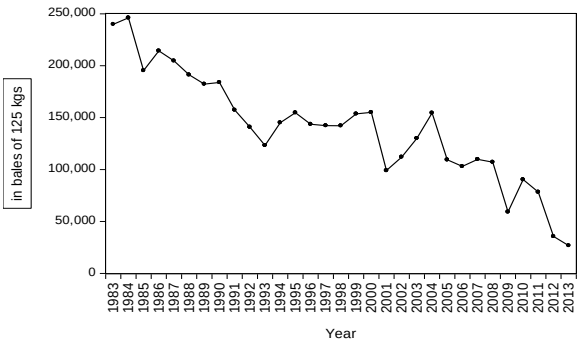

Figure 1. Export Demand for Philippine Abaca Fiber in Bales of 125 kgs

For the period 1995-2006, the introduction of synthetic and other cheaper natural materials, trade liberalization and global crisis have changed the demand structure of abaca fiber and other products in the domestic and export markets (Lantican, 2008).

Export demand drastically declined in 2001 from the prior year. The Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD) reported that during this time, Ecuador almost stole the export market as it accounted for 40 per cent of the shipments while the remaining 60 percent came from the Philippines.

In 2008, the Great Recession delivered the worst blow to the global economy since the 1930s. This did not spare the abaca industry. All of the major importing countries had reduced imports in 2009. In 2010 and 2011, economies of these countries slightly improved and global trade of abaca also picked up momentum (Philippine Rural Development Program, 2014).

An economic slowdown in 2012 was experienced again in UK along with many other European countries, United States, China and Japan. Market reports from Philippine Fiber Industry Development Authority and Food and Agriculture Organization attributed the decline in overall export volume to the economic slowdown in these major importing countries.

On the average, total export demand for Philippine abaca fiber during this 31-year period is about 139,706.7 in bales of 125 kilograms.

4.2 Statistical Results

Export Price was found to be stationary at level series while Export Demand, Real Effective Exchange Rate, and Real GDP were found to be stationary at first difference (Appendix 8). Results also showed presence of positive first-order serial correlation but was ruled out (Appendix 9).

About 77 percent of the variation in the Export Demand for Philippine Abaca Fiber is explained by the variation in its own Export Price, Real Effective Exchange Rate, and Real GDP of the major importing countries. Regression as a whole is highly statistically significant with the computed *F*-statistic of 36.14 greater than the critical *F* value of 2.98 at 3 and 26 degrees of freedom, at 5 percent level of significance (Appendix 10). In addition, diagnostic tests show that the variances of the error terms are homoscedastic (Appendix 12), the model is correctly specified (Appendix 13), error terms are normally distributed (Appendix 14), there is no serious multicollinearity among the regressors (Appendix 15), and the coefficients of the regression model between time periods are structurally stable (Appendix 16). Furthermore, a long-run or equilibrium relationship among the variables has also been revealed (Appendix 17).

Real GDP of the major importing countries was found to have a high degree of association to the Export Demand for Philippine Abaca Fiber while that of Export Price and Real Effective Exchange Rate is low (Appendix 11).

lnX = 36.147 - 0.04XP - 0.78lnrXR - 1.66lnrGDP
t-values *(7.54)* *(-0.20)* *(-1.49)* *(-5.28)*
p-values *(0.00)* *(0.84)* *(0.15)* *(0.00)*

$R^2 = 0.80$ $\bar{R}^2 = 0.77$ F = 24.64 d = 1.71

Critical values:

$F_{(3,26)} = 2.98$ $t_{0.975}(26) = 2.01$ $t_{0.90}(26) = 1.32$
$D_L = 1.21$ $D_U = 1.65$

Figure 2. Final Regression Results

Results of the regression showed that there is an insignificant negative relationship between the Export Demand for Philippine Abaca Fiber and its Export Price. Insignificant negative relationship between the Export Demand for Philippine Abaca Fiber and Real Effective Exchange Rate at 5 percent level of significance was found but as noted by Wooldridge (2012), if a variable is not statistically significant at the usual levels (10%, 5%, 1%), a *p* value of 20 can be used for small sample sizes. Therefore, Real Effective Exchange Rate is still statistically significant based on the absolute value of its *t*-ratio higher than the critical value. A highly statistically significant negative relationship on the other hand was revealed between Export Demand for Philippine Abaca Fiber and Real GDP of the major importing countries. The results further revealed that Export Demand for Philippine Abaca Fiber is price inelastic and income elastic (Appendix 12).

Insignificant negative relationship was found between the Export Demand for Philippine Abaca Fiber and its Export Price. This is similar to the findings of the study undertaken (Gul, et al; 2013) and in contrast to the findings of other studies done (Zheng, et. al., 2012), (Alam and Ahmed, 2012), and (Siddiqi, et. al., 2012), where a significant negative link between Export Demand and Export Price was found.

The Real Effective Exchange Rate was found to be insignificant at 5 percent level of significance and significant at 20 percent level of significance. The same findings of the studies made by Zheng, et. al., Alam and Ahmed and Siddiqi, et. al., were drawn which showed a statistically significant negative relationship between Real Exchange Rate and Export Demand.

Although statistically insignificant, the negative coefficient of Export Price is consistent with the theory of demand which posits that export price is negatively related to the export demand, *ceteris paribus*. The

relationship between Real Effective Exchange Rate and Export Demand based on the findings of the study was also consistent with the theory.

The Real GDP of the major importing countries was found to be highly statistically significant. This is not surprising as all of the studies reviewed showed similar results.

The negative coefficient of the Real GDP of the major importing countries indicates the inverse relationship between the Export Demand for Philippine Abaca Fiber and Income. This means that as the Income of the trading partners increases, the Export Demand for Philippine Abaca Fiber decreases, and vice versa. This result is consistent with the demand-bias argument.

Since the equation is in double logarithm functional form, the coefficients represent elasticities. The elasticities of Export Price, Real Exchange Rate, and Real GDP of the major importing countries are -0.04, -0.78, and -1.66, respectively. This implies that a 1 percent increase in Export Price decreases Export Demand by 0.04%. Similarly, a 1 percent increase in Real Effective Exchange Rate decreases Export Demand by 0.78 percent and one percent increase in the real GDP of the major importing countries decreases export demand by 1.66 percent. These figures indicate that Export Demand for Philippine Abaca Fiber is price inelastic with a coefficient for Export Price less than one, and is income elastic with a coefficient of the real GDP of importing countries greater than one.

5. Conclusion and Recommendation

Export price is not significantly related to the export demand for Philippine abaca fiber. This may be explained by the fact that there are only two countries commercially producing abaca fiber, with the Philippines holding a near monopoly of supply. The trading partners are limited to import this commodity to the Philippines and Ecuador. The significant relationship of Real effective exchange rate to the export demand for Philippine abaca fiber is not surprising as an appreciation of Philippine peso would mean a relatively more expensive Philippine abaca fiber for the importing countries, while depreciation would mean relatively cheaper Philippine abaca fiber. The inverse relationship of the real GDP of the major importing countries to the export demand for Philippine abaca fiber is due to the fact that abaca fiber is a raw material. With the increasing income of the trading partners, export demand shifted from abaca fiber to manufactures, primarily the abaca pulp.

Since the government is determined to bring back the dominance of Philippine abaca fiber in the international arena, and considering the trend of the export demand of the abaca fiber and its elasticity, the government through its implementing agencies such as the Department of Agriculture and Philippine Fiber Industry Development Authority must prioritize programs that will intensify and sustain the production of abaca fiber with the highest quality as it guarantees better price as compared to those of lower quality. The government can also promote higher-value processing by providing technical support to the farmers, traders and manufacturers in this industry as this will create additional value to the product, implying higher revenue or income. Market expansion may also be looked into to offset the weakening demand of the traditional market.

In view of the constraints of this paper, further study is recommended incorporating other factors that may significantly affect the export demand for Philippine abaca fiber such as the export price of Ecuador's abaca fiber, price of other substitutes, trade agreements between the Philippines and other counties, and domestic demand for the abaca fiber. Furthermore, the supply side of the export of Philippine abaca fiber may be looked into by future researchers in order to better understand the export performance of the abaca industry.

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APPENDICES

Appendix 1. Data Worksheet

Year	Export Demand (in bales of 125 kgs)*	Export Price (in US$ per bale)*	Real Effective Exchange Rate**	Real GDP (trillion US$)***	Year	Export Demand (in bales of 125 kgs)*	Export Price (in US$ per bale)*	Real Effective Exchange Rate**	Real GDP (in trillion US$)***
1983	239870	151.32	120.36	1.425737	1999	153629	161.75	103.44	2.518223
1984	246102	142.82	119.20	1.489777	2000	155063	123.33	90.56	2.612513
1985	195261	160.78	130.44	1.579540	2001	99134	165.63	85.45	2.676360
1986	214205	137.59	101.78	1.633060	2002	112066	83.13	85.78	2.745250
1987	204678	117.59	93.63	1.716810	2003	130007	156.64	78.44	2.850457
1988	191303	191.99	91.04	1.839577	2004	154482	160.39	75.08	2.966320
1989	182218	150.54	96.25	1.921567	2005	109475	170.84	79.05	3.086470
1990	183828	141.44	91.90	1.998867	2006	103095	120.71	87.26	3.229680
1991	157294	152.53	91.43	2.051180	2007	109848	125.23	94.49	3.406033
1992	140939	207.51	101.09	2.091863	2008	107084	177.32	97.34	3.479200
1993	123226	195.16	99.71	2.138917	2009	59180.8	150.63	95.65	3.455667
1994	145117	176.29	106.12	2.205313	2010	90344.8	133.07	100.00	3.660900
1995	154701	204.42	108.87	2.290770	2011	78336.8	150.38	100.68	3.792367
1996	143578	193.43	117.89	2.373880	2012	35649.6	165.95	105.55	3.938700
1997	142325	173.43	116.64	2.447357	2013	26758	139.33	109.79	4.099200
1998	142109	122.82	97.68	2.469630					

Appendix 2. Data Worksheet in Logarithms

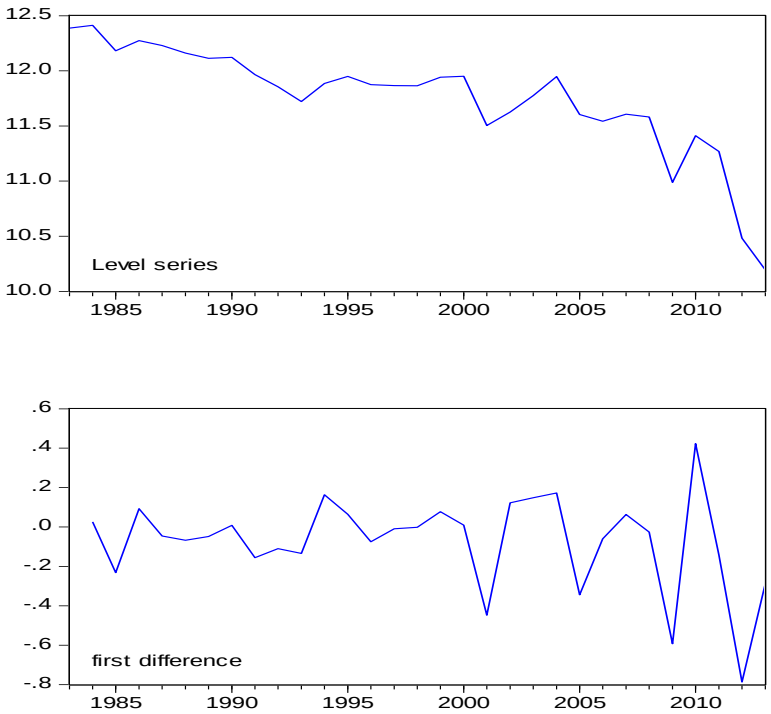
Year	Export Demand*	Export Price *	Real Effective Exchange Rate**	Real GDP***	Year	Export Demand*	Export Price *	Real Effective Exchange Rate**	Real GDP***
1983	12.38785	5.019397	4.790465	11.86761	1999	11.94229	5.086052	4.638983	12.43648
1984	12.41350	4.961585	4.780773	11.91155	2000	11.95159	4.814864	4.505967	12.47324
1985	12.18209	5.080037	4.870918	11.97006	2001	11.50423	5.109756	4.447982	12.49738
1986	12.27469	4.924278	4.622789	12.00338	2002	11.62685	4.420406	4.451807	12.52280
1987	12.22919	4.767204	4.539387	12.05339	2003	11.77535	5.05395	4.362368	12.56040
1988	12.16161	5.257443	4.511336	12.12246	2004	11.94783	5.077608	4.318557	12.60025
1989	12.11296	5.014229	4.566984	12.16607	2005	11.60345	5.140727	4.370083	12.63995
1990	12.12176	4.951876	4.520720	12.20551	2006	11.54341	4.793391	4.468932	12.68531
1991	11.96587	5.027361	4.515593	12.23134	2007	11.60685	4.830152	4.548450	12.73847
1992	11.85608	5.335180	4.616011	12.25098	2008	11.58137	5.177956	4.578219	12.75973
1993	11.72178	5.273820	4.602258	12.27323	2009	10.98835	5.014826	4.560740	12.75294
1994	11.88530	5.172130	4.664601	12.30379	2010	11.41139	4.890875	4.605170	12.81063
1995	11.94925	5.320177	4.690139	12.34181	2011	11.26877	5.013165	4.611906	12.84592
1996	11.87463	5.264916	4.769737	12.37745	2012	10.48149	5.111687	4.659232	12.88378
1997	11.86587	5.155774	4.759127	12.40793	2013	10.19459	4.936845	4.698561	12.92372
1998	11.86435	4.810720	4.581688	12.41699					

*Sources: *Fiber Industry Development Authority*
***Bangko Sentral ng Pilipinas*
****WorldBank Data*

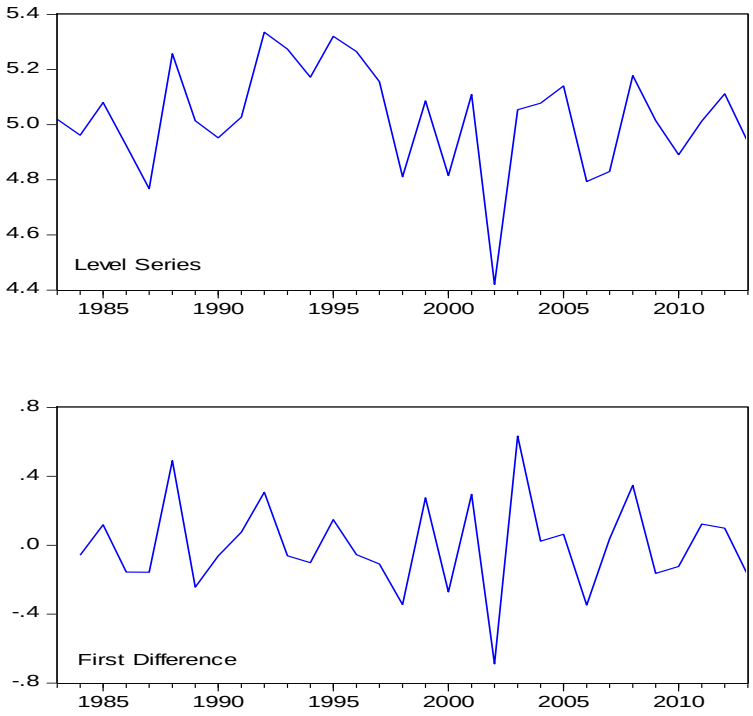
Appendix 3. Real GDP of Major Importing Countries

Year	UK*	Japan*	China*	Total	Average
1983	1.29	2.72	0.275	4.277	1.43
1984	1.31	2.84	0.317	4.469	1.49
1985	1.36	3.02	0.36E	4.739	1.58
1986	1.40	3.10	0.392	4.899	1.63
1987	1.48	3.23	0.438	5.150	1.72
1988	1.57	3.46	0.487	5.519	1.84
1989	1.61	3.65	0.508	5.765	1.92
1990	1.62	3.85	0.528	5.997	2.00
1991	1.60	3.98	0.577	6.153	2.05
1992	1.60	4.01	0.659	6.276	2.09
1993	1.65	4.02	0.751	6.417	2.14
1994	1.71	4.05	0.849	6.616	2.21
1995	1.80	4.13	0.942	6.872	2.29
1996	1.85	4.24	1.040	7.122	2.37
1997	1.90	4.31	1.130	7.342	2.45
1998	1.97	4.22	1.220	7.409	2.47
1999	2.03	4.21	1.310	7.555	2.52
2000	2.11	4.31	1.420	7.838	2.61
2001	2.16	4.32	1.540	8.029	2.68
2002	2.22	4.34	1.680	8.236	2.75
2003	2.29	4.41	1.850	8.551	2.85
2004	2.35	4.51	2.040	8.899	2.97
2005	2.42	4.57	2.270	9.259	3.09
2006	2.48	4.65	2.560	9.689	3.23
2007	2.55	4.75	2.920	10.218	3.41
2008	2.54	4.70	3.200	10.438	3.48
2009	2.43	4.44	3.500	10.367	3.46
2010	2.47	4.65	3.870	10.983	3.66
2011	2.52	4.63	4.230	11.377	3.79
2012	2.55	4.71	4.560	11.816	3.94
2013	2.60	4.78	4.910	12.298	4.10

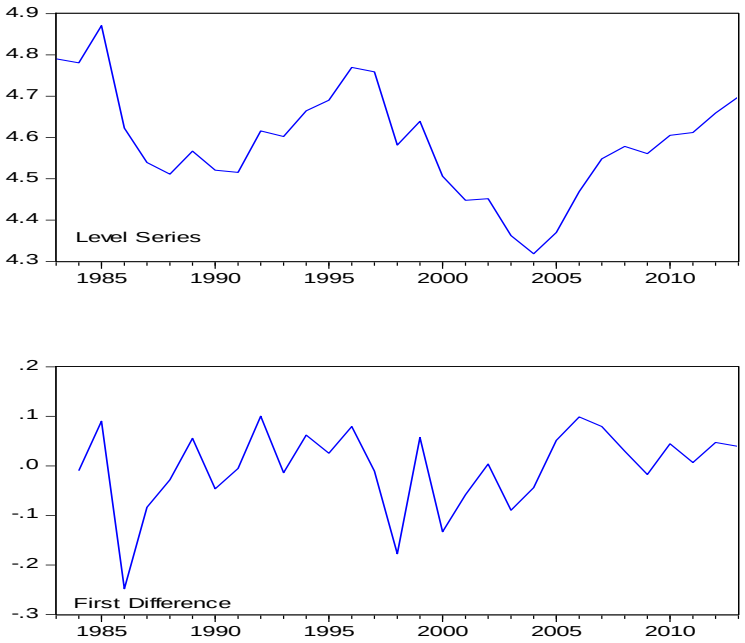
Appendix 4. Graph of Export Demand at Level Series and at First Difference



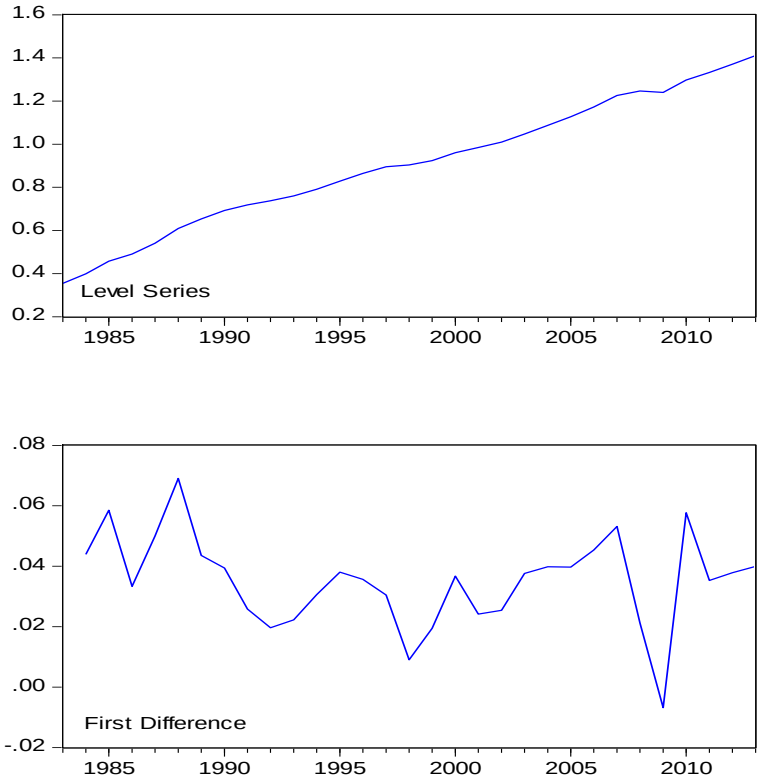
Appendix 5. Graph of Export Demand at Level Series and at First Difference



Appendix 6. Graph of Real Effective Exchange Rate at Level Series and at First Difference



Appendix 7. Graph of Real GDP at Level Series and at First Difference



Appendix 8. Augmented Dickey-Fuller Test Result

Parameters	At Level Series				At First Difference			
	Critical Values			ADFstat	Critical Values			ADF Stat
	1%	5%	10%		1%	5%	10%	
Export Demand	-4.30	-3.57	-3.24	-1.39	-3.69	-2.97	-2.63	**-5.26**
Export Price	-3.67	-2.96	-2.62	**-4.98**	--	--	--	--
Real Effective Exchange Rate	-3.67	-2.96	-2.62	-1.53	-3.68	-2.97	-2.62	**-5.20**
Real GDP	-4.30	-3.57	-3.22	-2.63	-3.68	-2.97	-2.62	**-4.13**

Appendix 9. Initial Regression

$$\ln X = 35.44 + 0.01\ln XP - 0.96\ln rXR - 1.55\ln rGDP$$

t-values (11.16) (0.03) (-2.53) (-9.65)
p-values (0.00) (0.98) (0.02) (0.00)

$R^2 = 0.78$ $\bar{R}^2 = 0.75$ $F = 31.35$ $d = 1.11$

Critical values:

$F_{(3,27)} = 2.96$ $t_{0.975}(27) = 2.05$
$D_L = 1.23$ $D_U = 1.65$

Appendix 10. Final Regression

$$\ln X = 36.147 - 0.04XP - 0.78\ln rXR - 1.66\ln rGDP$$

t-values (7.54) (-0.20) (-1.49) (-5.28)
p-values (0.00) (0.84) (0.15) (0.00)

$R^2 = 0.80$ $\bar{R}^2 = 0.77$ $F = 24.64$ $d = 1.71$

Critical values:

$F_{(3,26)} = 2.98$ $t_{0.975}(26) = 2.01$ $t_{0.90}(26) = 1.32$
$D_L = 1.21$ $D_U = 1.65$

Appendix 11. Pearson Correlation Test

	Export Price	Real Effective Exchange Rate	Real GDP
Pearson Correlation	**-.05**	**-.19**	**-.93**
Sig. (2-tailed)	.78	.31	.00
N	32	32	32

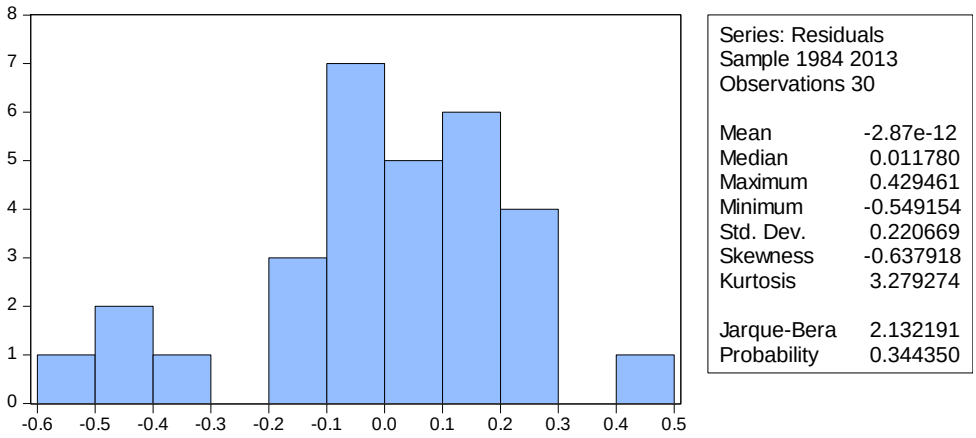
Appendix 12. White Heteroskedasticity Test

F-statistic	Probability
1.74	**0.15**

Appendix 13. Ramsey RESET

F-statistic	*t*-statistic	Probability
0.23	**0.48**	**0.64**

Appendix 14. Jarque-Bera Test



Appendix 15. Variance Inflation Factor

Variable	Centered VIF
LNXP	**1.07**
LNRXR	**1.06**
LNRGDP	**1.16**

Appendix 16. Chow Breakpoint Test

Breakpoints: 1993 2003	
F-statistic	Probability
0.79	**0.64**

Appendix 17. Johansen Cointegration Test

	t-statistic	Critical Value (0.05)	Probability
None	**58.09**	**40.17**	**0.00**
At most 1	**21.79**	**24.28**	**0.10**
At most 2	**5.85**	**12.32**	**0.45**
At most 3	**1.41**	**4.13**	**0.27**