

A Time-Series Analysis of Export-Led shipping demand Hypothesis for Sri Lanka

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Abstract- Aim of this study is to evaluate the development of Sri Lankan exports over the recent past and try to highlight a relationship between exports and shipping services, which can be used for forecasting future demand for shipping services derived by country's exports. Evolution of Sri Lankan exports from early post-independence era to present and the historical background of country's economic policies that have affected the export sector are being studied to get an in depth understanding of trend, patterns and performance of country's export sector. Data analysis is carried out using already established statistical methods and deep researches in to the plausibility of those methods are not aim of the study. The study is structured to test the plausibility of two hypotheses. Regression analysis used to find relationship between cargo loaded and value of exports. Vector Auto regression analysis used to forecast a best forecasting model for shipping demand using export in the country. First hypothesis is Sri Lankan exports derive a demand for shipping services and the second is that the derived demand for shipping by exports can be forecasted by using export performance data over a period of time. The conclusion of the study is that the two hypotheses that were tested are valid.

Index Terms- Derived Demand, Cargo Loaded, Sea Cargo, export

I. INTRODUCTION

Export sector of a country is critical for a country's overall growth and contributes substantially to bring foreign currency in to the country. Values of exports and imports decide the trade balance of the country and will be reflected in the Balance of Payments. The contribution of Sri Lankan export to country's Gross Domestic Product has been as high as 33.6 per cent in 2001 even though it has declined to 17.8 per cent by 2011 due to various reasons (EASL, 2012). Sri Lanka being an island nation there are only two ways available for its exports to leave the country in search of their foreign markets. That is either as sea cargo or as air cargo. Due to the costly nature of air cargo services, shipping is the best mode of transport available for majority of Sri Lankan exporters. Figure I highlights the domination of shipping as the preferred mode of transport for Sri Lankan exports.

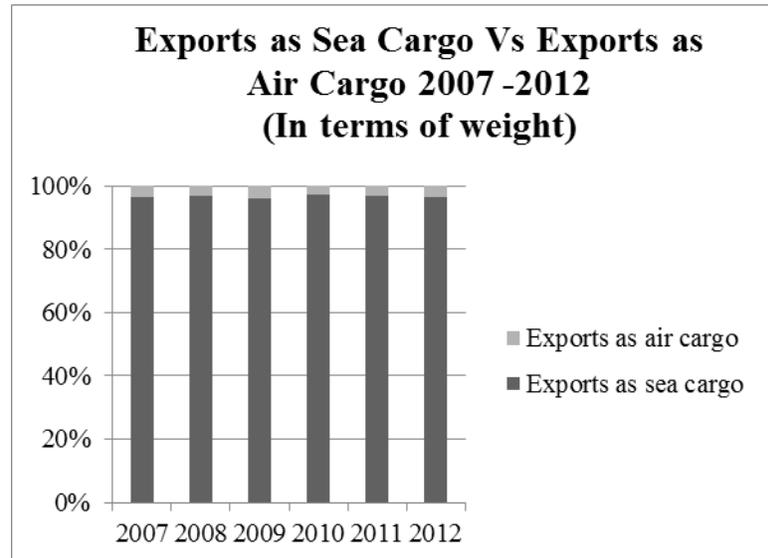


Figure I: Exports as Sea Cargo Vs Exports as Air Cargo 2007 -2012

Therefore, it can be seen that Sri Lankan exports create a demand for shipping services.

II. AIM OF THE STUDY

Aim of the study is to evaluate the development of Sri Lankan exports over the recent past and try to highlight a relationship between exports and shipping services, which can be used for forecasting future demand for shipping services derived by country's exports. Evolution of Sri Lankan exports from early post-independence era to present and the historical background of country's economic policies that have affected the export sector are being studied to get an in-depth understanding of trends, patterns and performance of country's export sector. Data analyses are carried out using already established statistical methods and a deep research in to the plausibility of those methods is not an aim of this study.

III. THE HYPOTHESES

The study is structured to test the plausibility of below hypotheses.

H_{1a}: Sri Lankan cargo loaded does depend on exports (exports derive a demand for shipping services)

H_{1b}: The derived demand for shipping by exports can be forecasted by using export performance data over a period of time

IV. LITERATURE SURVEY

The relationship between Sri Lankan exports and economic growth has been studied by many economists. Though there is a straight forward relationship between the exports and the shipping industry, this is much less discussed in Sri Lankan scenario. The demand for shipping has been extensively studied worldwide but not much attention given to this aspect in Sri Lankan scenario. The "Export Led Growth" hypothesis is a hot topic in this subject area and its validity has been tested by many academics around the world with reference to various countries including Sri Lanka (Dilrukshini, 2008). Some have concluded supporting the hypothesis and some the other way. The literature survey of this study first looks in to the historical background of economic policies affecting the Sri Lankan exports. Then related literature is being referred to understand the content and behaviour of Sri Lankan exports. Finally a brief reference of some literature is made on demand for shipping services.

Further stressing on this fact he points out that in 1966/67 wool; meats; iron and steel products accounted for 39.2 per cent of the value of exports, but only 3.3 per cent of the volume. Coal and coke and iron ore, on the other hand accounted for only 3.9 percent of the value, but 41.1 percent of the volume. Pointing out the derived demand for shipping services by Australian exports, he has tabulated the changes in vessels and net tonnage cleared from Australian ports towards various markets in the world for the period 1960/61 to 1965/66. Then he has highlighted the varying levels of demand stability derived by different categories of exports by tabulating the indices of export tonnage levels for the period of 1961/62 to 1966/67. The seasonality patterns of primary exports have also being heighted by tabulating the monthly variations in terms of „000 freight tons for the period of July 1966 to June 1967 by categorizing the primary exports as bulk, refrigerated and non-refrigerated.

Akdemir, B., Bilgili, E., Ziarati, M., & Stocton, D. (2008) in their study on Supply and Demand in Shipping Market, have used intelligent neural networks to forecast demand. An attempt has been made to forecast the total dry bulk fleet. In this study the forecasting results from the neural networks have been compared with the forecasting results from multi-variable regression analysis.

V. METHODOLOGY

The study is designed to answer two research problems.

1. Do Sri Lankan exports derive a demand for shipping services?

2. Can that demand be forecasted by analyzing export performance data of the country over a period of time?

Finding the answers is carried out by a statistical analysis of relevant data gathered from secondary sources. Targeted sources of data are the Central Bank of Sri Lanka and Sri Lanka Customs. These two governmental organizations carry out collection and storage of data related to Sri Lankan exports and publishes them in their annual reports of statistics.

VI. IDENTIFICATION OF KEY VARIABLES

The main variable in focus is "demand for shipping services". A demand for shipping services is generated when there is cargo available to be transported by ships. A country (or a port) can generate a demand for shipping services in two ways.

1. When there is out bound cargo available to be loaded
2. When there is inbound cargo available to be landed

This study is focusing on the first aspect, as the exports are out bound cargo. There we can identify another variable which can be used to interpret demand for shipping generated by out bound cargo in quantitative terms; that is "amount of cargo loaded" to ships calling Sri Lankan ports.

Another key variable is the "number of vessels arrived" to Sri Lankan ports. While it is reasonable to expect a positive correlation between exports and vessels arrived (or between cargo loaded and vessels arrived), it should be notated that vessels arrival will be substantially affected by the amounts of imports and transshipment cargo. The number of vessels arrived also includes the number of passenger ship arrivals even though it is very small compared to the total number.

The other key variable is "exports". The study is aimed at studying the dependability of demand for shipping up on exports. Exports can be measured in terms of quantity and in terms of value. Since this study is aimed at forecasting demand for shipping, ideally exports should be measured in terms of quantity in order to avoid the effect of price changes when it is measured in terms of value. But due to the difficulties faced in data collection, the export data used in final statistical analysis is measured in value terms.

VII. LIST OF IDENTIFIED KEY VARIABLES

1. Demand for shipping services
2. Amount of cargo loaded to ships calling Sri Lankan ports
3. Number of vessels arrived at Sri Lankan ports
4. Amount of Sri Lankan exports

VIII. PROCUREMENT OF DATA

Following data was collected from various issues of "Economic & Social Statistics of Sri Lanka" published annually by the Central Bank of Sri Lanka.

- Number of vessels arrived at Sri Lankan ports each year from 1987 to 2011
- Amount of cargo loaded to ships at Sri Lankan ports each year in MT „000 from 1987 to 2011
- Total value of Sri Lankan exports in each year in Rs. Mn. From 1987 to 2011

In addition, the amounts of exports (registered) that left the country as sea cargo and as air cargo in each year from 2007 to 2012 measured in MT.000 were obtained from Sri Lanka Customs.

Table I: Descriptive Statistics of Key-Variables

Descriptive Statistics Summary: Vessels Arrived, Cargo Loaded, Exports						
Variable	Mean	StDev	Variance	CoefVar	Minimum	Maximum
Vessels Arrived	3976	643	413026	16.16	2614	4814
Cargo Loaded	10717	6418	41186792	59.88	3464	25610
Exports	418159	329418	1.08516E+11	78.78	41133	1167588

During the period from 1987 to 2011, maximum number of vessel arrivals is recorded in 2008 where as the minimum is recorded in 1987. Average number of vessel arrivals per year is 3976 during the period. The cargo loaded has been at its lowest in 1987 and at its peak in 2011. Data series of the number of

vessel arrivals shows a relatively low dispersion with a coefficient of variation at 16.16, however, the dispersion of cargo loaded and export data series are high.

Table II: Correlations: Vessels Arrived, Cargo Loaded, Exports

Correlations: Vessels Arrived, Cargo Loaded, Exports		
	Vessels Arrived	Cargo Loaded
Cargo Loaded	0.588 0.002	
Exports	0.606 0.001	0.979 0.000

Above values suggest good correlations between all three key variables. Especially the correlation between cargo loaded and exports is shown to be very strong. This strong correlation is explained by the fact that majority of Sri Lankan exports using Shipping as the preferred mode of transport. Relatively weaker

correlation values of cargo loaded vs. vessels arrived and exports vs. vessels arrived can be explained by the fact that the number of vessels arrive will also depend on imports, trans-shipments and re-exports apart from cargo loaded or exports.

Table III: Results and Findings: Sri Lankan Exports Derive a Demand for Shipping

The regression equation is					
cargo loaded = 2742 + 0.0191 export					
Predictor	Coef	SE Coef	T	P	
Constant	2741.8	437.6	6.27	0.000	
export	0.0190725	0.0008284	23.02	0.000	
S = 1336.92 R-Sq = 95.8% R-Sq(adj) = 95.7%					
Analysis of Variance					
Source	DF	SS	MS	F	P
Regression	1	947373739	947373739	530.04	0.000
Residual Error	23	41109263	1787359		
Total	24	988483003			

Table III, a regression analysis is carried out to check the relationship between the amounts of cargo loaded to ships arrived at Sri Lankan ports and the Total value of Sri Lankan exports using annual data from 1987 to 2011.

If there is cargo to be loaded at a certain port, ships will call that port for business. Thus, availability of cargo creates a demand for shipping services. If it can be proved that the availability of cargo depends on exports, the hypothesis, Sri

Lankan Exports Derive a Demand for Shipping Services can be proven valid.

Above results show a linear relationship between the amount of cargo loaded and the value of exports. R-square value of 95.8% suggests a strong dependency of the amount of cargo loaded upon the value of exports; substantially supporting cargo loaded does depend on exports. Thus, the null hypothesis can conveniently be not accepted.

Table IV: Vector Auto regression Estimates for Variables

Vector Autoregression Estimates

Date: 04/30/13 Time: 13:45

Sample (adjusted): 3 25

Included observations: 23 after adjustments

Standard errors in () & t-statistics in []

	CARGO_LOA DED	EXPORT	VESSELS_AR RIVED
CARGO_LOADED(-1)	0.641306 (0.31313) [2.04806]	8.722872 (13.9636) [0.62469]	-0.047471 (0.08396) [-0.56543]
CARGO_LOADED(-2)	0.395868 (0.43190) [0.91657]	2.086358 (19.2601) [0.10833]	0.020734 (0.11580) [0.17905]
EXPORT(-1)	-0.001902 (0.00806) [-0.23580]	0.923035 (0.35960) [2.56684]	0.003338 (0.00216) [1.54392]
EXPORT(-2)	0.005412 (0.00932) [0.58064]	-0.016179 (0.41568) [-0.03892]	-0.002814 (0.00250) [-1.12594]
VESSELS_ARRIVED(-1)	0.712211 (0.92002) [0.77413]	-17.13061 (41.0273) [-0.41754]	0.727592 (0.24668) [2.94959]
VESSELS_ARRIVED(-2)	-1.050521 (0.96027) [-1.09398]	2.657624 (42.8222) [0.06206]	-0.055372 (0.25747) [-0.21506]
C	1011.999 (2108.16) [0.48004]	33534.43 (94011.1) [0.35671]	1356.104 (565.240) [2.39917]
R-squared	0.973269	0.979545	0.724426
Adj. R-squared	0.963245	0.971875	0.621086
Sum sq. resids	23658696	4.70E+10	1700778.
S.E. equation	1216.005	54226.34	326.0347

F-statistic	97.09182	127.7017	7.010106
Log likelihood	-191.8387	-279.1834	-161.5633
Akaike AIC	17.29032	24.88551	14.65768
Schwarz SC	17.63590	25.23110	15.00326
Mean dependent	11316.13	450692.3	4090.348
S.D. dependent	6342.707	323340.9	529.6554
<hr/>			
Determinant resid covariance (dof adj.)	2.51E+20		
Determinant resid covariance	8.44E+19		
Log likelihood	-625.5530		
Akaike information criterion	56.22200		
Schwarz criterion	57.25875		

Final multivariate model of forecasting shipping demand with the use of export:

IX. CONCLUSION

Analyses of data resulted in a forecasting model as expected. The developed final forecasting model can forecast the expected number of vessels that will arrive at Sri Lankan ports using the value of exports, amount of cargo loaded and number of vessels arrived during the past two years. Even though it would have been more meaningful to have a model to forecast the amount of cargo to be loaded in order to interpret demand for shipping better, the results of vector auto regression estimates indicated that such a model would be reliable.

To check the level of accuracy of the model, it was used to calculate the number of vessels arrived from 2002 to 2011 and compared with the actual values. The comparison is shown in table V. The percentage error of the forecasted values has varied from 6.91 per cent to 0.04 per cent. The average percentage error in forecasted values is 2.32 per cent. If only the two years of 2010 and 2011 were considered. The last two years in the studied time series, the average percentage error of forecasting is 0.7 per cent.

Table V: Checking the Accuracy of Forecasting Model

	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Vessels Arrived	4062	4,032	3,883	4,139	4469	4710	4814	4456	4067	4323	NA
Forecasted value of vessels arrived	4043	4118	4151	4167	4262	4505	4825	4562	4068	4264	4727
Error	19	-86	-268	-28	207	205	-11	-106	-1	59	NA
Percentage of errors	0.47	2.14	6.91	0.68	4.63	4.34	0.22	2.39	0.04	1.35	NA

The final conclusion of the study is that the two hypotheses that were tested are valid. The first hypothesis was proven to be valid and there the results of regression analysis suggested a strong straight line relationship between the value of exports and the amount of cargo loaded. The second hypothesis was proven valid and the final output was a model which can forecast the demand for shipping in terms of number of expected ship arrivals. Much better model would have been a one that can forecast the amount of cargo to be loaded. The vector auto regression analysis indicated that such a model would be significantly accurate.

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