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Abstract—this paper establishes an approach to forecast Air freight exports and imports volumes in Sri Lanka for the period of 2008-2013. Further the paper also applies Granger Causality to test the causality between air cargo import and export and also between air cargo import-inflation and air cargo exports-inflation. The secondary data used in the analysis were obtained from Civil Aviation Authority, Sri Lanka, and Census and statistics department of Sri Lanka, Logistic and Freight Forwarder association and Central Bank Sri Lanka covering the period from 2008 2013 (Monthly figures). The variables used are Air freight export volumes; Air freight imports volumes, CCPI and USD exchange rate. The statistical software used in the analysis is E-views 7. Furthermore it was also exposed that there is a bi-directional causality between Air freight export volumes and inflation rates in Sri Lanka.

Key words - Air freight imports, Air freight exports, Granger Causality.

I. INTRODUCTION

Today the air cargo industry is known to be one of the most booming industries in the world as more than 40% of the world trade is delivered by air. (World Air Cargo Forecast 2012-2013 by Boeing Commercial Airplanes). It is forecasted that the world air cargo Traffic will nurture 5.2% per year during the next 20. It is also expected that these advancements will lead to higher growth in world economy in terms of GDPs and investments. The purpose of this research is to test the causality between air cargo movements and economy. The study uses two time series model to forecast future air cargo volumes in Sri Lanka. Further the study aims to examine the causal relationship between air cargo volumes and two economic variables; average exchange rate and inflation. This research paper is based on monthly time series data which were obtained from period of year 2008 to 2013.

II. METHODOLOGY & EXPERIMENTAL DESIGN

Data used in this research paper is monthly figures covering the period of 2008-2013 and the variables are air freight exports, air freight imports and monthly inflation rates in Sri Lanka. Data were gathered from Central Bank, Sri Lanka, Sri Lanka Logistics and Freight Forwarders’ Association and Airport and Aviation Services, Sri Lanka. E-views software is used as the statistical tool for all the below mentioned analysis.

Prior to the main analysis all the available data is converted into logarithms to ensure the stability of the variances of all the time series and to transform them in to normality. Further since this research is more interested in data sets with positive values, it is vital to convert data in to logarithms in advance of carrying out the analysis.

The first step of the econometric methodology that involves the analysis of data commences with tests of stationary and to test for the order of integration of the variables or the presence of the unit root of the series. And also ARIMA models are used for time series forecasting. The second step is to test for Granger Causality between the variables. Then the VEC model is used as the third step to estimate the causal relationships among the variables. The final step is to find the existence of co integration to check the long run equilibrium relationship among the time series variables.

A. Unit root test and providing stationarity

Before starting the analysis of the research, it is important to get the stationary status of each of the time series tested painstakingly to identify trends and seasonality in those time series. For a given time series to be stationary, its’ properties has to be independent from the time at which the particular series is observed. Stationary time series look much the same at any time irrespective of the time that it is been observed. Therefore time series with trend and seasonality are not stationary as those time series will have different values at different times.

B. Differencing

Differencing is the process of computing the variance between two consecutive observances in order to
stabilize the mean of the time series removing the changes in different time series values and minimizing the probabilities of trend and seasonality. There are certain situations where de-trending is not sufficient to make a time series stationary. Because sometimes even after the de-trending mean, variance and autocorrelation (the correlation of a time series with its’ past and future values) are not constant. In such cases it is essential to transmit it into series of period to period differences. Such time series said to be difference stationary. But sometimes it is difficult to identify trend stationary and difference stationary separately. In such situations unit root test can be employed to get a better solution while determining the order of integration as well. Unit root can be tested through Augmented Dickey Fuller (ADF) test and Phillips Perron (PP) test under few different criteria’s: At level, At first difference & at second difference.

C. Test for normality
Under normality, Skewness~N (0, 6/n) and [kurtosis-3]~N (0, 24/n) Therefore t-tests can be used to test normality of the given time series. But for each series normality has to be tested separately. J&B test combines these two tests together and perform one single test to check for the normality.
H0: Data is Normal
H1: Data is not normal

D. Box-Jenkins ARIMA Modelling
Box Jenkins (B&J) models have the possibility of including both AR and MA terms. Therefore B&J models are said to be pretty much flexible than the other models. And for an effective modelling at least about 50 data points and good experience are requires in B&J modelling. The following table summarizes how sample autocorrelation function is applied for the detection of AR or MA model.

E. ACF & PACF plots
The ARIMA class of time models requires a certain degree of good experience to make it more accurately since they are quite complex and powerful forecasting tools in nature. The principal tools for doing this are ACF plots and PACF plots. The process of calculating sample ACF and PACF from the given series and match them with the theoretical ACF and PACF is vital for the identification of B&J time series modelling. The sample ACF computed using the observed series may not always match exactly with the true autocorrelation functions for any ARIMA as calculations are done using a limited sample of data. And therefore it is difficult to identify the exact ARIMA model fits with the observed time series since few patterns related to several ARIMA models can be seen there. Thus several economical models can be identified at this stage of the model selection process. Box and Jenkins gave seasonal ARIMA of the time series as,

ARIMA (p, d, q) × (P, D, Q)S.
Where p = non-seasonal AR order, d = non-seasonal differencing, q = non-seasonal MA order, P = seasonal AR order, D = seasonal differencing, Q = seasonal MA order, and S = time span of repeating seasonal pattern.

<table>
<thead>
<tr>
<th>Shape</th>
<th>Indicated model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exponential, decaying to zero</td>
<td>AR model. Use the partial autocorrelation plot to identify the order of the AR model</td>
</tr>
<tr>
<td>Altering positive and negative, decaying to zero</td>
<td>AR model. Use the partial autocorrelation plot to help identify the order.</td>
</tr>
<tr>
<td>One or more spikes, rest are essentially zero</td>
<td>MA model. Order identify by where plot becomes zero</td>
</tr>
<tr>
<td>Decay, starting after a few lags</td>
<td>Mixed AR and MA model</td>
</tr>
<tr>
<td>All zero or close to zero</td>
<td>Data is essentially random</td>
</tr>
<tr>
<td>High values at fixed intervals</td>
<td>Include seasonal AR model</td>
</tr>
<tr>
<td>No decay to Zero</td>
<td>Series is not stationary</td>
</tr>
</tbody>
</table>

F. Granger Causality Test
Granger Causality is a technique based on predictions rather than causation and was developed by Prof. Clive Granger (1969) to determining the causal relationship between two variables. This concept is used to determine whether one variable can be used to predict the other and if so, what the direction of that relationship is. Ordinarily regressions mirror “mere” co-relations. According to Poof.Clive Granger’s definition (1969), “a variable Y is Causal for another Variable X if knowledge of the past history of Y is useful for predicting the future state of X over above knowledge of the past history of X itself. So if the prediction of X is improved by including Y as a predictor, then Y is said to be Granger causal for X.”
III. RESULTS

A. Descriptive statistics

As per descriptive statistics of two variables, it can be confirmed that both Logarithm of air freight imports (LIM) and Logarithm of air freight exports) has been distribute normally since Jarque-Bera value is greater than 0.05.

According to figure 3 & 4, it can be seen that the both LEX & LIM have increasing trends with a seasonal pattern over period of time where 2008-2014. Further more it can be seen that seasonality at every month of April. Then it can be recommended seasonal ARIMA model for the forecasting model of air freight export of Sri Lanka.

B. Test for stationarity

<table>
<thead>
<tr>
<th>Method used</th>
<th>Stationarity</th>
<th>Variable</th>
<th>P-Value</th>
<th>Significance</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADF Level</td>
<td>exports</td>
<td>0.9639</td>
<td>Insignificant</td>
<td></td>
</tr>
<tr>
<td></td>
<td>imports</td>
<td>0.1639</td>
<td>Insignificant</td>
<td></td>
</tr>
<tr>
<td>1st difference</td>
<td>exports</td>
<td>0.0903</td>
<td>Insignificant</td>
<td></td>
</tr>
<tr>
<td></td>
<td>imports</td>
<td>0.0000</td>
<td>significant</td>
<td></td>
</tr>
<tr>
<td>2nd difference</td>
<td>exports</td>
<td>0.0001</td>
<td>significant</td>
<td></td>
</tr>
<tr>
<td></td>
<td>imports</td>
<td>0.0000</td>
<td>significant</td>
<td></td>
</tr>
<tr>
<td>PP Level</td>
<td>exports</td>
<td>0.0900</td>
<td>Insignificant</td>
<td></td>
</tr>
<tr>
<td></td>
<td>imports</td>
<td>0.0001</td>
<td>significant</td>
<td></td>
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<tr>
<td></td>
<td>imports</td>
<td>0.0000</td>
<td>significant</td>
<td></td>
</tr>
</tbody>
</table>

Note – Significant levels considered is 5%

As per the Phillips Perron Test, exports have been stationary at 1st difference. Since P value of PP test was less than 0.05. It can be confirms that the export time series has a long term mean. Therefore time series of air freight export recommended for the model building. The imports data has also been stationary at level as per the Phillips Perron since P value of PP test was less than 0.05. It can be confirms that the Imports time series has a long term mean. Then time series of air freight export recommended for the model building.

C. Auto Correlation and Partial Auto Correlation

Model building is depended on pattern of Sample ACF and Sample PACF. The Correlogram test (figure 1 & 2) was carried to meet above mentioned condition. Auto correlation of exports (Figure 5) in 1st, 12th and 24th lags has been significantly different, and SPACF at lag 1 and
lag 12 significantly different from zero, confirming that seasonality in the Exports at long term difference of lag 12, whereas partial correlation for non-seasonal part has been exponentially decaying confirming that the best fitted model for Exports is a MA model.

The auto correlation of Imports (Figure 6) in 1st, 12th and 24th lags has been significantly different, and SPACF at lag 1, lag 11 and lag 23 significantly different from zero, confirming that seasonality in the Imports at long term difference of lag 12, whereas partial correlation for non-seasonal part has been exponentially decaying confirming that the best fitted model for Import is also a MA model.

D. Developed model

Based on the simultaneous inspection of both ACF and PACF of series it can be postulated the several possible models for both imports and Exports. Out of the all the identified possible models, the following two models were selected as the best fitted models in forecasting both Air freight imports and exports depending on the values obtained for section criteria AIC, log likelihood and SC. Further Durbin Watson statistics and Jarque-Bera tests confirmed that residuals are normally distributed. The Parameters for both the models were estimated through the least square method.

Table 3: Best Fitted models

<table>
<thead>
<tr>
<th>Model</th>
<th>Significance</th>
<th>DW</th>
<th>Log Likelihood</th>
<th>AIC</th>
<th>SC</th>
<th>Jaque-Bera</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exports</td>
<td>(2,1,0),(0,1,2)</td>
<td>0.00</td>
<td>1.304</td>
<td>85.587</td>
<td>2.827</td>
<td>2.648</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>0.00</td>
<td>18</td>
<td>78</td>
<td>64</td>
<td>4</td>
</tr>
<tr>
<td>Imports</td>
<td>(1,0),(0,1,2)</td>
<td>0.00</td>
<td>2.036</td>
<td>59.213</td>
<td>1.938</td>
<td>1.831</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>0.00</td>
<td>181</td>
<td>29</td>
<td>39</td>
<td>82</td>
</tr>
</tbody>
</table>

The model estimated for Air freight Exports:

\[(1 - \beta)(1 - \beta^{12})(1 + 0.477526\beta + 0.812844\beta^{2})Y_t = 1 - 0.225452\beta^{12} - 0.944658\beta^{12}1,12\]

The model estimated for Air freight Imports:

\[1 + 0.959656\beta Y_t = (1 + 0.002117\beta^{12})e_t\]

Where,

\[Y_t\] is the data for the considered year

\[(1-\beta) = Y_t - Y_{t-1}, \text{ the difference between considered year and value in previous year.}\]

\[(1-\beta^{12}) = Y_t - Y_{t-13}, \text{ the seasonal difference.}\]
E. Residual Test

Both the residual tests for two models confirmed that the residuals are normally distributed. (Mainly using Jaque-Bera Value)

IV. CONCLUSION & DISCUSSION
A solid forecasting mechanism in import and export sector is a vital element for any state’s economy. Therefore the two separate models were established for both air freight exports and imports using the Box-Jenkins ARIMA Modelling can be used to forecast future Air freight volumes. The Granger causality test carried out considering lag 2, revealed that there are uni directional causality between Imports-Exports and Inflation-Imports and bidirectional causality between exports-inflation since the null hypothesis could be rejected as their probabilities were less than 0.05 (significant). Further it was also observed that imports and exports do not show causality with average exchange rate.

The estimated forecasting model can be used in making the decisions on air freight related infrastructure capacity expansions, planning new infrastructure, implementing marketing strategies and other related operations. Further the revealed causality relationships are vital in policy implementations and other administrative purposes. The econometric results indicated that LEX and LIM significantly effect on LINF, a quite strong economic indicator in Sri Lanka. It suggested the historical values of LEX can be used to predict the future values of LINF more accurately than LINF itself. Therefore this finding could be an important tool in forecasting future inflation rates in the country and making changes to the existing monetary policies prior to sudden changes in inflation rates to continue the inflation rates at an optimal level so that sudden booms in inflation would not disturb the smooth flow of economy. Further the results also revealed a strong linkage between LEX and LIM which suggests that the past LIM values help to predict the future LEX values. This linkage can be used in avoid future trade imbalances where the value paid of country’s imports is greater than income they are receiving from their exports.

ACKNOWLEDGMENTS
This research gives acknowledgeable and practical experience for the theoretical subjects that we have been studying during the academic period of time with connected to Air freight trade volumes and related economic theories. I would also like to express my heartfelt gratitude for everyone who helped us in many ways to make this research an absolute success. Especially my parents, lectures and batch mates for their support, instruction & the understanding during the research.

REFERENCES


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