The Relationship among Export, Import and Economic Growth in Sri Lanka:
Granger Causality Analysis

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Abstract

This study aimed to find out the causal relationship among the variables of export, import and Economic growth on Sri Lankan context. The methodology used in this study was quantitative. The time series data were collected from the Annual Report of Central Bank of Sri Lanka for the period from 1980 – 2015. The variables used in this study were exports, imports, and Economic Growth (GDP). The Economic Growth was the dependent variable and the export and import was the independent variables. Thus, study was to be involved with the economic growth of Sri Lanka and Balance of Payment of the country (BOP). In case of Sri Lankan macro level environment, within the period of 1980 to 2015, this was to be observed throughout the granger causality analysis that there are three unidirectional causalities runs from Gross domestic product to import, Gross domestic product to export and Export to import appropriately. Thus meant that the lagged value of Gross domestic product would cause the present value of Export, import and the past value of export could cause the present value of import. Any policy implementation regarding growth driven export hypothesis was proved to be worthwhile in Sri Lankan context, and any past policy wise modification in national output would be derived expected development in international trade of Sri Lanka.

Keywords: Export, Import, Gross Domestic Product, Granger Causality, Time Series
Introduction

The macro-econometric dynamics between the variables; export, import and economic growth, are stated as below mentioned manner. The first is unidirectional causality motion; it upraises the famous export led growth hypothesis, second bidirectional causal relationship and third independence causality. The core of unidirectional causality from export to economic growth means growth in the export level generally leads to the economic growth through the foreign trade multiplier effort. Unidirectional causality from import to economic growth. The mechanics behind on this causal relation is foreign exchanges made available by export growth allow the importation of capital goods which, in turn, increase the production potential of an economy. Third, the volume of the competition in exports markets cause economies of scale and an acceleration of technical progress in production (Francisco, 2000). Further, the competitiveness in global market leads to production of innovative product and making able the local producers in meeting competition in global market. The contribution of various countries in the global trade states highly significant relation between two variables, expansion in exports and growth in economic activity. Many studies confirm that there is a powerful relation between said variables as export, import and economic growth (Usman, et. al, 2012).

Research Problem

The relationship between export growth and economic growth has long been one of the major areas concerned in the theoretical and empirical literature in international trade and development economics. These highlight the importance of export promotion to achieve higher economic growth.

Objectives

To find out the causal relationship among the variables of export, import and Economic growth on Sri Lankan context

Hypotheses in Relations with the Granger Causality Analysis

\[ H_0; \text{export does not granger causes GDP} \]
\[ H_0; \text{GDP does not granger causes export} \]
\[ H_0; \text{import does not granger causes GDP} \]
\[ H_0; \text{GDP does not granger causes import} \]
\[ H_0; \text{export does not granger causes import} \]
\[ H_0; \text{import does not granger causes export} \]

Methodology

The advance univariate and multivariate Time series analysis have been carried out to discover the existence of co-integration vectors based on the performance of export, import and the economic growth over the last thirty three years from the period of 1980 - 2013. The time series data have been collected from the annual report of Central Bank of Sri Lanka. E-view- versions 7, has been utilized in this study.
Accordingly the following mode has been developed and the test involves estimating the following pairs of regressions:

\[
\begin{align*}
\text{LN}_GDP_{CN_t} &= \sum_{i=1}^{n} C(1)_i \times \text{LN}_EX_{CN_{t-i}} + \sum_{i=1}^{n} C(2)_i \times \text{LN}_GDP_{CN_{t-j}} + u_{1t} \\
\text{LN}_EX_{CN_t} &= \sum_{i=1}^{n} C(3)_i \times \text{LN}_EX_{CN_{t-i}} + \sum_{i=1}^{n} C(4)_i \times \text{LN}_GDP_{CN_{t-j}} + u_{2t}
\end{align*}
\]

\[
\begin{align*}
\text{LN}_GDP_{CN_t} &= \sum_{i=1}^{n} C(1)_i \times \text{LN}_IM_{CN_{t-i}} + \sum_{i=1}^{n} C(2)_i \times \text{LN}_GDP_{CN_{t-j}} + u_{1t} \\
\text{LN}_IM_{CN_t} &= \sum_{i=1}^{n} C(3)_i \times \text{LN}_IM_{CN_{t-i}} + \sum_{i=1}^{n} C(4)_i \times \text{LN}_GDP_{CN_{t-j}} + u_{2t}
\end{align*}
\]

\[
\begin{align*}
\text{LN}_IM_{CN_t} &= \sum_{i=1}^{n} C(1)_i \times \text{LN}_EX_{CN_{t-i}} + \sum_{i=1}^{n} C(2)_i \times \text{LN}_IM_{CN_{t-j}} + u_{1t} \\
\text{LN}_EX_{CN_t} &= \sum_{i=1}^{n} C(3)_i \times \text{LN}_EX_{CN_{t-i}} + \sum_{i=1}^{n} C(4)_i \times \text{LN}_IM_{CN_{t-j}} + u_{2t}
\end{align*}
\]

The granger causality test assumes that the information relevant to the prediction of the respective variables; GDP and EX, GDP and IM, EX and IM, is contained solely in the time series data on these variables. Where it is assumed that the disturbances \(u_{1t}\) and \(u_{2t}\) are uncorrelated.

Where;

\[\text{LN}_GDP_{CN}= \text{Dependent variable (natural logarithm of GDP at constant local currency)}\]
\[C(1)_i = \text{coefficient of first lagged LN}_EX_{CN_{t-i}}\]
\[C(2)_j = \text{coefficient of second lagged LN}_EX_{CN_{t-j}}\]
\[C(3)_i = \text{coefficient of first lagged LN}_IM_{CN_{t-i}}\]
\[C(4)_j = \text{coefficient of second lagged LN}_IM_{CN_{t-j}}\]
\[\text{LN}_EX_{CN}= \text{Independent variable (natural logarithm of Export at constant local currency)}\]
\[\text{LN}_IM_{CN}= \text{Independent variable (natural logarithm of Import at constant local currency)}\]
\[D = \text{differentiated value / first difference}\]
\[(t-i) = \text{i}^{\text{th}} \text{lagged value / past value}\]
\[(t-j) = \text{j}^{\text{th}} \text{lagged value / past value}\]

**Significance of the Study**

This dissertation, through an analysis, will provide useful information for potential exporters, potential importers and the policy makers who could affect through their decisions on external sector and economic growth phase of Sri Lanka. Major consideration of this research can be stated as the period of the research, it covers the post war period. At the same time the usage of advance univariate and multivariate analysis can be revealed a different scenario behind on this research phenomenon.

**Literature Review**

Kogid, Mulok, Ching, Lily, Ghazali and Loganathan (2011), results show that there is no co integration exists between economic growth and import, but there exists bilateral causality between economic growth and import. Results also show that import could indirectly contribute to economic growth, and economic growth could also directly contribute to import. These findings may be vital for future economic growth policy.
Kim, Lim and Park (2003), researchers found that Granger causality from imports to total factor productivity (TFP) growth, but no causality from exports to TFP growth. Researchers also investigated the impact of trade and other variables on TFP growth. According to the results, imports have a significant positive effect on TFP growth but exports do not. In addition, results indicated that the positive impact of imports arises not only from the competitive pressures associated with the imports of consumer goods but also from technological transfers embodied in imports of capital goods from developed countries.

Yuhong Li, Zhongwen Chen, Changjian San (2010), the result suggests that there exist long term or short term causality between GDP and total export and import as well as between GDP and export, foreign trade is the long term and short term reason of GDP growth, but no evidence can prove that there exists long term stationary causality between import trade and GDP.

Dritsakis, (2005) investigated used Granger causality analysis based on error correction model. The results of the study suggested that exports have a causal effect on the development process for the countries of European Union, USA, while there is no causal relationship between the examined variables for Japan. This indicates the presence of a common trend or a long-run relationship between the variables of these examined countries, while there is no long-run relationship between for the variables of Japan. The results of causality analysis suggest that there is a “strong bilateral causal relationship” between exports and economic growth for European Union consistent with the studies in the EU. While the results for Japan suggest that there is not either a long run relationship or any causality between exports and economic growth.

Arshia Amiria.b and Ulf-G Gerdtham (2012) in their study “Relationship between exports, imports, and economic growth in France evidence from co-integration analysis and Granger causality with using geo-statistical models” emphasized the existence of long run unidirectional causality from exports and imports to economic growth in France from 1961 to 2006.

Research Gap

A number of studies have been done in relation to the relationship derivation purpose on GDP, export and import by scholars representing various institutions such as CBSL, universities, etc. The particular researches differ from this study in two manners. One is the period of the research, that has been starting from 1980 to 2015; including the liberalized free trading economy accompanied with the post war emergencies and second is the research model, which has strictly utilized the advance time series analysis under which the Johnson Co-integration test to identify the long term equilibrium relationship between the variables among the variables were performed.

Data Analysis and Discussion

Causality

Causality can be described as the relationship between cause and effect. Basically, the term ‘causality’ suggests a cause and effect relationship between two sets of variables, say, Y and X. Recent advances in graphical models and the logic of causation have given rise to new ways in which scientists analyse cause-effect relationships.
In line with most of the literatures in econometrics, one variable is said to Granger cause the other if it helps to make a more accurate prediction of the other variable than had we only used the past of the latter as predictor. Granger causality between two variables cannot be interpreted as a real causal relationship but merely shows that one variable can help to predict the other one better. Given two time series variables $X_t$ and $Y_t$, $X_t$ is said to Granger cause $Y_t$ if $Y_t$ can be better predicted using the histories of both $X_t$ and $Y_t$, than it can by using the history of $Y_t$ alone.

The mostly renowned nine basic definitions of causality are as follows; A relation between events, process or entities in the same time series subject to several conditions; A relationship between events, processes or entities in a time series such that when one occurs, the other follows invariably; A relationship among variables such that one has the efficacy to produce or alter another; A relationship among variables such that without one, the other could not occur; A relationship between experienced events, processes or entities and extra experimental events, processes or entities; A relation between something and itself (self-causality); A relation between an event, process or entity and the reason or explanation for it; A relation between an idea and an experience and A principle or category incorporating into experience one of the previous ones.

More generally, since the future cannot predict the past, if variable $X$ granger cause variable $Y$, than the changes in $X$ should precede changes in $Y$. there for, in a regression of $Y$ on other variable (including its own past values), if we include past or lagged values of $X$ and it significantly improves the prediction of the $Y$, so it can be said $X$ granger causes $Y$. Similarly if variable $Y$ granger cause variable $X$, than the changes in $Y$ should precede changes in $X$. there for, in a regression of $X$ on other variable (including its own past values), if we include past or lagged values of $Y$ and it significantly improves the prediction of the $X$, so it can be said $Y$ granger causes $X$.

**Bivariate causality**

Bivariate causality deals with two pairs of variables; this is slightly differed from the multivariate causality on which the test involves vector auto regressive technique to detect the multi-dimensional causal directions.

The bivariate causality test involves estimating the following pairs of regressions:

$$
\text{LN}_t\text{GDP}_\text{CN} = \sum_{i=1}^{n} C(1)_i \ast \text{LN}_t\text{EX}_\text{CN} + \sum_{i=1}^{n} C(2)_j \ast \text{LN}_t\text{GDP}_\text{CN} + u_{1t}
$$

$$
\text{LN}_t\text{EX}_\text{CN} = \sum_{i=1}^{n} C(3)_i \ast \text{LN}_t\text{EX}_\text{CN} + \sum_{i=1}^{n} C(4)_j \ast \text{LN}_t\text{GDP}_\text{CN} + u_{2t}
$$

The first part of the equation postulates that the current GDP is related to past value of itself, as well as that of export and the second part of the equation postulates that the current export is related to past value of itself, as well as that of GDP.
\[
\text{LN\_GDP\_CN}_t = \sum_{i=1}^{n} C(1)_i \cdot \text{LN\_IM\_CN}_{t-i} + \sum_{i=1}^{n} C(2)_j \cdot \text{LN\_GDP\_CN}_{t-j} + u_{1t}
\]

\[
\text{LN\_IM\_CN}_t = \sum_{i=1}^{n} C(3)_i \cdot \text{LN\_IM\_CN}_{t-i} + \sum_{i=1}^{n} C(4)_j \cdot \text{LN\_GDP\_CN}_{t-j} + u_{2t}
\]

The first part of the equation postulates that the current GDP is related to past value of itself, as well as that of import and the second part of the equation postulates that that the current import is related to past value of itself, as well as that of GDP.

\[
\text{LN\_IM\_CN}_t = \sum_{i=1}^{n} C(1)_i \cdot \text{LN\_EX\_CN}_{t-i} + \sum_{i=1}^{n} C(2)_j \cdot \text{LN\_IM\_CN}_{t-j} + u_{1t}
\]

\[
\text{LN\_EX\_CN}_t = \sum_{i=1}^{n} C(3)_i \cdot \text{LN\_EX\_CN}_{t-i} + \sum_{i=1}^{n} C(4)_j \cdot \text{LN\_IM\_CN}_{t-j} + u_{2t}
\]

The first part of the equation postulates that the current GDP is related to past value of itself, as well as that of export and the second part of the equation postulates that that the current export is related to past value of itself, as well as that of GDP.

The granger causality test assumes that the information relevant to the prediction of the respective variables; GDP and EX, GDP and IM, EX and IM, is contained solely in the time series data on these variables. Where it is assumed that the disturbances \(u_{1t}\) and \(u_{2t}\) are uncorrelated

**Unidirectional causality**

Unidirectional causality statistically interpreted as the casual direction runs merely from one variable to other variable (GDP→Ex) but not any feedback causality (not Ex→GDP) is detected, thus if there is a detected unidirectional causality from GDP to export, this is typically means the set of estimated coefficient on lagged export is not statistically different from zero (\(\sum_{i=1}^{n} C(1) \neq 0\)) and the set of estimated coefficient on lagged GDP is statistically different from zero (\(\sum_{i=1}^{n} C(4) = 0\)).

**Bidirectional causality**

Bidirectional causality statistically interpreted as the casual direction runs parallel from one variable to other variable (GDP→Ex) thus there a feedback causality (Ex→GDP) is detected, thus if there is a detected bidirectional causality from GDP to export, this is typically means the set of estimated coefficient on lagged export is statistically different from zero (\(\sum_{i=1}^{n} C(1) \neq 0\)) and the set of estimated coefficient on lagged GDP is statistically different from zero (\(\sum_{i=1}^{n} C(4) \neq 0\)).
Independence

Independence causality statistically interpreted as there is no casual direction runs from one variable to other variable, thus if there is a detected Independence causality from GDP to export, this is typically means the set of estimated coefficient on lagged export is not statistically different from zero ($\sum_{i=1}^{n} C(1) = 0$) and the set of estimated coefficient on lagged GDP is not statistically different from zero ($\sum_{i=1}^{n} C(4) = 0$).

Estimation of presence of casual direction

Granger and Sims’ causality test

Bivariate regressions of the form of pair wise granger causality;
\[
\text{LN}_GDP-CN_t = \sum_{i=1}^{n} C(1)_i \times \text{LN}_EX-CN_{t-i} + \sum_{i=1}^{n} C(2)_j \times \text{LN}_GDP-CN_{t-j} + \mu_1 t
\]
\[
\text{LN}_EX-CN_t = \sum_{i=1}^{n} C(3)_i \times \text{LN}_EX-CN_{t-i} + \sum_{i=1}^{n} C(4)_j \times \text{LN}_GDP-CN_{t-j} + \mu_2 t
\]
For all possible pairs of (GDP, Export) series in the group, the reported F-statistics are the Wald statistics for the joint hypothesis:
\[
\sum_{i=1}^{n} C(1)_i = 0
\]
\[
\sum_{i=1}^{n} C(4)_j = 0
\]
For each equation, the null hypothesis is that GDP does not Granger-cause Export in the first regression and that Export does not Granger-cause GDP in the second regression.

Bivariate regressions of the form pair wise granger causality;
\[
\text{LN}_GDP-CN_t = \sum_{i=1}^{n} C(1)_i \times \text{LN}_IM-CN_{t-i} + \sum_{i=1}^{n} C(2)_j \times \text{LN}_GDP-CN_{t-j} + \mu_1 t
\]
\[
\text{LN}_IM-CN_t = \sum_{i=1}^{n} C(3)_i \times \text{LN}_IM-CN_{t-i} + \sum_{i=1}^{n} C(4)_j \times \text{LN}_GDP-CN_{t-j} + \mu_2 t
\]
For all possible pairs of (GDP, Import) series in the group, the reported F-statistics are the Wald statistics for the joint hypothesis:
\[
\sum_{i=1}^{n} C(1)_i = 0
\]
\[
\sum_{i=1}^{n} C(4)_j = 0
\]
For each equation, the null hypothesis is that GDP does not Granger-cause Import in the first regression and that Import does not Granger-cause GDP in the second regression.

Bivariate regressions of the form pair wise granger causality;
\[
\text{LN}_IM-CN_t = \sum_{i=1}^{n} C(1)_i \times \text{LN}_EX-CN_{t-i} + \sum_{i=1}^{n} C(2)_j \times \text{LN}_IM-CN_{t-j} + \mu_1 t
\]
\[
\text{LN}_EX-CN_t = \sum_{i=1}^{n} C(3)_i \times \text{LN}_EX-CN_{t-i} + \sum_{i=1}^{n} C(4)_j \times \text{LN}_IM-CN_{t-j} + \mu_2 t
\]
**Estimation of presence of casual direction**

**Granger and Sims’ causality test**

Bivariate regressions of the form of pair wise granger causality;
\[
\text{LN\_GDP\_CN}_t = \sum_{i=1}^{n} C(1)_i \cdot \text{LN\_EX\_CN}_{t-i} + \sum_{i=1}^{n} C(2)_i \cdot \text{LN\_GDP\_CN}_{t-i} + u_{1t} \\
\text{LN\_EX\_CN}_t = \sum_{i=1}^{n} C(3)_i \cdot \text{LN\_EX\_CN}_{t-i} + \sum_{i=1}^{n} C(4)_i \cdot \text{LN\_GDP\_CN}_{t-i} + u_{2t}
\]

For all possible pairs of (GDP, Export) series in the group, the reported F-statistics are the Wald statistics for the joint hypothesis:
\[
\sum_{i=1}^{n} C(1)_i = 0 \\
\sum_{i=1}^{n} C(4)_i = 0
\]

For each equation, the null hypothesis is that GDP does not Granger-cause Export in the first regression and that Export does not Granger-cause GDP in the second regression.

Bivariate regressions of the form pair wise granger causality;
\[
\text{LN\_GDP\_CN}_t = \sum_{i=1}^{n} C(1)_i \cdot \text{LN\_IM\_CN}_{t-i} + \sum_{i=1}^{n} C(2)_i \cdot \text{LN\_GDP\_CN}_{t-i} + u_{1t} \\
\text{LN\_IM\_CN}_t = \sum_{i=1}^{n} C(3)_i \cdot \text{LN\_IM\_CN}_{t-i} + \sum_{i=1}^{n} C(4)_i \cdot \text{LN\_GDP\_CN}_{t-i} + u_{2t}
\]

For all possible pairs of (GDP, Import) series in the group, the reported F-statistics are the Wald statistics for the joint hypothesis:
\[
\sum_{i=1}^{n} C(1)_i = 0 \\
\sum_{i=1}^{n} C(4)_i = 0
\]

For each equation, the null hypothesis is that GDP does not Granger-cause Import in the first regression and that Import does not Granger-cause GDP in the second regression.

Bivariate regressions of the form pair wise granger causality;
\[
\text{LN\_IM\_CN}_t = \sum_{i=1}^{n} C(1)_i \cdot \text{LN\_EX\_CN}_{t-i} + \sum_{i=1}^{n} C(2)_i \cdot \text{LN\_IM\_CN}_{t-i} + u_{1t} \\
\text{LN\_EX\_CN}_t = \sum_{i=1}^{n} C(3)_i \cdot \text{LN\_EX\_CN}_{t-i} + \sum_{i=1}^{n} C(4)_i \cdot \text{LN\_IM\_CN}_{t-i} + u_{2t}
\]

For all possible pairs of (Export, Import) series in the group, the reported F-statistics are the Wald statistics for the joint hypothesis:
\[
\sum_{i=1}^{n} C(1)_i = 0 \\
\sum_{i=1}^{n} C(4)_i = 0
\]

For each equation, the null hypothesis is that Import does not Granger-cause Export in the first regression and that Export does not Granger-cause Import in the second regression.

For all possible pairs of (Export, Import) series in the group, the reported F-statistics are the Wald statistics for the joint hypothesis:
\[
\sum_{i=1}^{n} C(1)_i = 0 \\
\sum_{i=1}^{n} C(4)_i = 0
\]

For each equation, the null hypothesis is that Import does not Granger-cause Export in the first regression and that Export does not Granger-cause Import in the second regression.
Causality is a technique on which the causal direction is to be detected in causality test the tested null hypothesis is GDP does not granger cause export. To check the statistical significance of the null the Granger and Sims’ technique has been used.

**Empirical analysis and findings**

The empirical analysis of the research is encompassed by the following test estimation using E-views 7. The granger causality test is carried out to discover the type of causality and the direction of causality of the three mentioned variables at different lag levels. The granger causality test is carried out for second, fourth and sixth lag levels to find out how much the directional causalities are lag sensitive and in which manner the unidirectional, bidirectional and independence, causality directions changes as per the lag lengthens.

**Pair wise granger causality test**

Chart No.1. Granger causality test estimation at second legged level

<table>
<thead>
<tr>
<th>Pairwise Granger Causality Tests</th>
<th>Date: 07/10/15 Time: 23:55</th>
<th>Sample: 1 34</th>
<th>Lags: 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Obs F-Statistic Prob.</td>
<td>LN_EX_CN does not Granger Cause LN_GDP_CN</td>
<td>29</td>
<td>0.49327</td>
</tr>
<tr>
<td>LN_GDP_CN does not Granger Cause LN_EX_CN</td>
<td>3.68938</td>
<td>0.0401</td>
<td></td>
</tr>
<tr>
<td>LN_IM_CN does not Granger Cause LN_GDP_CN</td>
<td>29</td>
<td>0.12356</td>
<td>0.8843</td>
</tr>
<tr>
<td>LN_GDP_CN does not Granger Cause LN_IM_CN</td>
<td>4.12692</td>
<td>0.0288</td>
<td></td>
</tr>
<tr>
<td>LN_IM_CN does not Granger Cause LN_EX_CN</td>
<td>29</td>
<td>0.93485</td>
<td>0.4065</td>
</tr>
<tr>
<td>LN_EX_CN does not Granger Cause LN_IM_CN</td>
<td>6.41519</td>
<td>0.0059</td>
<td></td>
</tr>
</tbody>
</table>

Source: Authors estimation using E-view 7

* Alpha ($\alpha$) = 0.1, 0.05, 0.01
* Decision rule 1: reject H0 if P-value < $\alpha$-value (0.05).
* Decision rule 2: reject H0 if F-statistics > critical F-value.
* $N_1$= DF for denominator = 2 (lagged value), $N_2$= DF for numerator = 28 (n-k), F-values for the probability levels of 0.25, 0.1, 0.05, 0.01 are appropriately 1.46, 2.5, 3.34, 5.45.
According to the first and second rules of rejection, following causality directions were founded at the conventional level of significance (5%):

Unidirectional causality from GDP to Export, this indicates if the estimated coefficients on the second lagged GDP are statistically different from zero as a group ($\sum_{t=1}^{n} C(2) \neq 0$) and the set of estimated coefficient on the lagged Export is not statistically different from zero as a group ($\sum_{t=1}^{n} C(1) = 0$). On the other hand the null hypothesis (GDP does not granger cause Ex) is rejected or the alternative (GDP granger cause Ex) is accepted. Unidirectional causality from GDP to Import, this indicates if the estimated coefficients on the second lagged GDP are statistically different from zero as a group ($\sum_{t=1}^{n} C(2) \neq 0$) and the set of estimated coefficient on the lagged Import is not statistically different from zero as a group ($\sum_{t=1}^{n} C(1) = 0$).

Unidirectional causality from Export to Import, this indicates if the estimated coefficients on the second lagged Export are statistically different from zero as a group ($\sum_{t=1}^{n} C(2) \neq 0$) and the set of estimated coefficient on the lagged Export is not statistically different from zero as a group ($\sum_{t=1}^{n} C(1) = 0$). In summing up the above argument, there are unidirectional causality between GDP to export (GDP→Ex), GDP to import (GDP→Ex), Export to import (Ex→IM) so as the null hypothesis regarding above statement are rejected so its mean the alternative hypothesis is ultimately accepted at the conventional 5% level of significance.

For instance, though we increase the level of significance from 5% to 10%, from 10% to 25%, etc. The scene will not to be differed. In accordance with the rules of rejection there are three unidirectional causalities founded from GDP to import, GDP to export and export to import, rest of other variables are found to be independent. Further we decrease our conventional level of significance to 1%; none of the pairs prove to be with causal relationship other than causality from export to import This means at 1% significance level ultimately all null hypothesis are supposed to be accepted without the last $H_0$: the export does not granger cause import. So we can conclude if we increase the alpha value it leads the range of acceptance narrower.
According to the first and second rules of rejection, following causality directions were founded at the conventional level of significance (5%):

Unidirectional causality from GDP to import, this indicates if the estimated coefficients on the second lagged GDP are statistically different from zero as a group ($\sum_{i=1}^{n} C(2) \neq 0$) and the set of estimated coefficient on the lagged import is not statistically different from zero as a group ($\sum_{i=1}^{n} C(1) = 0$). None causality from GDP to Import, this indicates if the estimated coefficients on the second lagged GDP are statistically not different from zero as a group ($\sum_{i=1}^{n} C(2) = 0$) and the set of estimated coefficient on the lagged Import is not statistically different from zero as a group ($\sum_{i=1}^{n} C(1) = 0$). None causality from Export to Import, this indicates if the estimated coefficients on the second lagged Export are statistically not different from zero as a group ($\sum_{i=1}^{n} C(2) = 0$) and the set of estimated coefficient on the lagged Export is not statistically different from zero as a group ($\sum_{i=1}^{n} C(1) = 0$). In summing up the above argument, there is only unidirectional causality between GDP to import proved (GDP→IM), so as the null hypothesis regarding above statement is rejected so it’s mean the alternative hypothesis is ultimately accepted at the conventional 5% level of significance.

For instance, though we increase the level of significance from 5% to 25%, the scene will be little change. In accordance with the rules of rejection at the 25% level of significance, there are two unidirectional causalities founded from GDP to import and export to import, rest of the variables are found to be independent.
According to the first and second rules of rejection, following causality directions were founded at the conventional level of significance (5%): None causality from GDP to import, this indicates if the estimated coefficient on the sixth lagged GDP is not statistically different from zero as a group ($\sum_{i=1}^{n} C(2) = 0$) and the set of estimated coefficient on the lagged import is not statistically different from zero as a group ($\sum_{i=1}^{n} C(1) = 0$). None causality from GDP to Import, this indicates if the estimated coefficients on the second lagged GDP are statistically not different from zero as a group ($\sum_{i=1}^{n} C(2) = 0$) and the set of estimated coefficient on the lagged Import is not statistically different from zero as a group ($\sum_{i=1}^{n} C(1) = 0$). None causality from Export to Import, this indicates if the estimated coefficients on the second lagged Export are statistically not different from zero as a group ($\sum_{i=1}^{n} C(2) = 0$) and the set of estimated coefficient on thelagged Export is not statistically different from zero as a group ($\sum_{i=1}^{n} C(1) = 0$). In summing up the above argument, there is no any causality between the variables, so as the null hypotheses regarding above statements cannot be rejected so it’s mean the alternative hypothesizes are not accepted at the conventional 5% level of significance.

For instance, though we increase the level of significance from 5% to 25%, the scene will be little change. In accordance with the rules of rejection at the 25% level of significance, there are two unidirectional causalities founded from import to GDP (even this is to be attained at 10% level of significance) and exports to import; rest of the variables are found to be independent. To show that the granger causality test depends critically on the number of lagged term introduced in the model, we present below the results of the F test using several

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**Pairwise Granger Causality Tests**

<table>
<thead>
<tr>
<th>Date: 03/02/16  Time: 23:01</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sample: 1 34</td>
</tr>
<tr>
<td>Lags: 6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Null Hypothesis:</th>
<th>Obs</th>
<th>F-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>LN_GDP_CN does not Granger Cause LN_IM_CN</td>
<td>24</td>
<td>1.2792</td>
<td>0.3417</td>
</tr>
<tr>
<td>LN_IM_CN does not Granger Cause LN_GDP_CN</td>
<td>2.43071</td>
<td>0.0958</td>
<td></td>
</tr>
<tr>
<td>LN_EX_CN does not Granger Cause LN_IM_CN</td>
<td>24</td>
<td>1.76169</td>
<td>0.1967</td>
</tr>
<tr>
<td>LN_IM_CN does not Granger Cause LN_EX_CN</td>
<td>0.96404</td>
<td>0.4912</td>
<td></td>
</tr>
<tr>
<td>LN_EX_CN does not Granger Cause LN_GDP_CN</td>
<td>24</td>
<td>0.61267</td>
<td>0.7166</td>
</tr>
<tr>
<td>LN_GDP_CN does not Granger Cause LN_EX_CN</td>
<td>0.70908</td>
<td>0.6497</td>
<td></td>
</tr>
</tbody>
</table>

* $N_1$= DF for denominator = 6 (lagged value), $N_2$= DF for numerator = 28 (n-k), F-values for the probability levels of 0.25, 0.1, 0.05, 0.01 are appropriately 1.4, 2.0, 2.45, 3.53.

* Alpha ($\alpha$) = 0.1, 0.05, 0.01

* Decision rule 1: reject H0 if P-value < $\alpha$-value (0.05).

* Decision rule 2: reject H0 if F-statistics > critical F-value.
lags. In each case the null hypothesizes are as follow: Export does not Granger Cause Import, GDP does not Granger Cause Export, and Export does not Granger Cause Import appropriately.

Chart No.4

<table>
<thead>
<tr>
<th>Direction of causality</th>
<th>Number of legs</th>
<th>F value</th>
<th>Decision</th>
</tr>
</thead>
<tbody>
<tr>
<td>Export to Import</td>
<td>2</td>
<td>6.41519</td>
<td>Reject</td>
</tr>
<tr>
<td>Export to Import</td>
<td>4</td>
<td>1.89054</td>
<td>Do not</td>
</tr>
<tr>
<td>Export to Import</td>
<td>6</td>
<td>1.76169</td>
<td>Do not</td>
</tr>
<tr>
<td>Gdp to Export</td>
<td>2</td>
<td>3.68938</td>
<td>Reject</td>
</tr>
<tr>
<td>Gdp to Export</td>
<td>4</td>
<td>1.01631</td>
<td>Do not</td>
</tr>
<tr>
<td>Gdp to Export</td>
<td>6</td>
<td>0.70908</td>
<td>Do not</td>
</tr>
<tr>
<td>Gdp to Import</td>
<td>2</td>
<td>4.12692</td>
<td>Reject</td>
</tr>
<tr>
<td>Gdp to Import</td>
<td>4</td>
<td>3.74265</td>
<td>Reject</td>
</tr>
<tr>
<td>Gdp to Import</td>
<td>6</td>
<td>1.2792</td>
<td>Do not</td>
</tr>
</tbody>
</table>

Note these features of preceding results of the F test; up to two lags there is a unidirectional causality between the variables however at four legs there is only unidirectional causality between GDP to Import further we increase the lag level to six there is no statistically discernible relationship between any pair of variable. This reinforces the point made earlier that the outcome of the granger test is sensitive to the number of lags introduced in the model.

Conclusion

Likewise, regards with the Granger causality analysis this is to be evaluate according to the model evaluation criterions such as AIC, SC, HQC showing a higher negative values, the most suitable lag level to be favored. Because of the high lag sensitivity of the causality, whenever we attempt to modeling causal models like granger’s the most optimum level of lag has to be preferred. For instance, in the empirical analysis part, we crucially observed that increment of lag level denied causality between the series.

Granger causality analysis

Chart No. 5. Granger causality analysis at second lag level

<table>
<thead>
<tr>
<th>pairwise hypothesis</th>
<th>F-statistics</th>
<th>5% C.V</th>
<th>P value</th>
<th>α value</th>
<th>Decision</th>
<th>Type of causality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Export → GDP</td>
<td>0.49</td>
<td>3.34</td>
<td>0.67</td>
<td>0.05 DNR</td>
<td>Unidirectional</td>
<td></td>
</tr>
<tr>
<td>GDP → Export</td>
<td>3.59</td>
<td>3.34</td>
<td>0.04</td>
<td>0.05 Reject</td>
<td>Unidirectional</td>
<td></td>
</tr>
<tr>
<td>Import → GDP</td>
<td>0.12</td>
<td>3.34</td>
<td>0.23</td>
<td>0.05 DNR</td>
<td>Unidirectional</td>
<td></td>
</tr>
<tr>
<td>GDP → Import</td>
<td>4.12</td>
<td>3.34</td>
<td>0.03</td>
<td>0.05 Reject</td>
<td>Unidirectional</td>
<td></td>
</tr>
<tr>
<td>Import → Export</td>
<td>0.63</td>
<td>3.34</td>
<td>0.41</td>
<td>0.05 DNR</td>
<td>Unidirectional</td>
<td></td>
</tr>
<tr>
<td>Export → Import</td>
<td>0.41</td>
<td>3.34</td>
<td>0.006</td>
<td>0.05 Reject</td>
<td>Unidirectional</td>
<td></td>
</tr>
</tbody>
</table>

Source = Author estimation using excel 2010

* Decision rule 1: reject $H_0$ if P-value < α-value (0.05).
* Decision rule 2: reject $H_0$ if F-statistics > critical F-value.
In a depth view on the model evaluation criterions like AIC, etc., the second lag level of causality has been taken as the optimum level of causality; the summarized version of the granger test that was adopted from the empirical part, given above. In accordance with the rules of rejection, following causal directions were found; unidirectional causality from Gross domestic product to export, unidirectional causality from Gross domestic product to Import and unidirectional causality from export to Import. More clearly speaking, the unidirectional causality from GDP to export and unidirectional causality from GDP to import meant that causality runs from GDP to export and import appropriately thus there is statistically detectible lead lagged relationship between the pair of variables

Typically unidirectional causality from Gross domestic product to export ($\text{GDP}_{t-1} \rightarrow \text{Ex}_t$) and unidirectional causality from Gross domestic product to Import ($\text{GDP}_{t-1} \rightarrow \text{Im}_t$) is meant that the past values of Gross domestic product ($\text{GDP}_{t-1}$) can be used to predict the present value of Export ($\text{Ex}_t$) and Import ($\text{Im}_t$) appropriately. Here the $\text{GDP}_{t-1}$ is the cause variable and the $\text{Ex}_t$ and $\text{Im}_t$ are the effect variables so as any policies implementation on national output will tremendously affect the export and import in Sri Lanka.

In case of Sri Lankan macro level environment, within the period of 1980 to 2015, this is to be observed throughout the granger causality analysis that there are three unidirectional causalities runs from Gross domestic product to import, Gross domestic product to export and Export to import appropriately. Thus meant that the lagged value of Gross domestic product will cause the present value of Export, import and the past value of export can cause the present value of import

**Hypothesis and objects**

The pair wise null hypotheses in relations with the granger causality analysis as follows;

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>status</th>
</tr>
</thead>
<tbody>
<tr>
<td>$H_0$; export does not granger causes GDP.</td>
<td>Do Not</td>
</tr>
<tr>
<td>$H_0$; GDP does not granger causes export.</td>
<td>Reject</td>
</tr>
<tr>
<td>$H_0$; import does not granger causes GDP.</td>
<td>Do Not</td>
</tr>
<tr>
<td>$H_0$; GDP does not granger causes import.</td>
<td>Reject</td>
</tr>
<tr>
<td>$H_0$; export does not granger causes import</td>
<td>Do Not</td>
</tr>
<tr>
<td>$H_0$; import does not granger causes export.</td>
<td>Reject</td>
</tr>
</tbody>
</table>

The status of hypothesis related with pair wise granger causality analysis given above, as per the rules of rejection the first null of each pairs are not supposed to be rejected. But Consequently, the second null of each pairs; $H_0$; GDP does not granger causes export; GDP does not granger causes import; Import does not granger causes export, are accepted.
Recommendation

This neo classical economic phenomenal will be supported by the study that was carried out so far, according to the findings, specifically the causality analysis reveals that there is a unidirectional causality dynamic between GDP to export. Thus, it means that any policy implementation regarding growth driven export hypothesis is proved to be worthwhile in Sri Lankan context, more clearly speaking, any past policy wise modification in national output, will be derived expected development in international trade of Sri Lanka.

References