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# Causality analysis between exports, imports and economic growth of Pakistan

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**ABSTRACT**
*The objective of study is to identify causal relationships among the variables such as exports, imports and Gross Domestic Product (GDP) in case of Pakistan. The study uses time series data for the period from 1981-2016. Stationarity is checked with the Augmented Dickey Fullers' (ADF) test, and the Engle Grange approach is utilized to determine the long run relationship among variables of the study. Moreover, causality among the selected variables is tested by using the Vector Error Correction Model (VECM). We found that the causality runs from GDP to imports and exports. Furthermore, no causal relation is found from exports to GDP and from imports to GDP, but the causality goes from GDP to these two variables. The causality from GDP to exports and imports are positive and significant. Finally, the results indicate that the causal relationship between GDP and imports is stronger than the GDP and exports.*

**Keywords**
Imports, Exports, Economic Growth, Causality
**JEL Classification**
F14; F43



## 1. Introduction

Economic growth of an economy can be viewed as a shift in its production possibility frontier or an increase in the country's total output or production. Many factors affect economic growth that also includes country's imports and exports of the country. Exports lead to an increase in output or growth rate of a country. Export-led growth hypothesis states that an increase in exports enhances economic growth. Exports directly contribute to the gross domestic product (GDP). Exports allow a country to benefit from the large markets or economies of scale (Helpman & Krugman, 1985). Rodrick (1988) stated that exports lead firm to large-scale production, technological change and an increasing rate of capital formation.

Inversely, the relationship from economic growth to export is called growth-led exports. When domestic output increases more than domestic demand, then economic growth affect the export growth (Sharma & Dhakal, 1994). Therefore, both the relationship from exports growth to economic growth and from economic growth to exports growth is possible. There may be a two-way causality from export growth to economic growth and vice versa (Ramos, 2001).

It is important to investigate the relationship between exports and economic growth. Sharma et al. (1991) employed Granger Causality approach and found a positive association between exports and economic growth rates. Some studies also found a negative relationship between them especially for countries like Korea and Hong Kong

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(Dodaro, 1993). Hatemi (2002) also tested the exports and economic growth relationship in case of Japan and found a bi-directional causality.

In this research paper, Engle-Granger and Vector Error Correction Model (VECM) have been applied to test for cointegration and causality relationships among exports, imports and economic growth rate in the case of Pakistan. Previously, it has been shown that the causality between GDP and exports is bidirectional over the period 1971-2014, such as exports cause to GDP of the country and GDP cause to exports (Hussain, 2014). Some other studies have also investigated the causality between exports and economic growth of Pakistan (Shirazi & Manap, 2004, and Iqbal et al., 2012). This research not only uses more recent data but also investigates the imports and economic growth nexus as well.

## 2. Literature Review

Exports and imports both play a key role in the economic development of a country. Examination of the impact of exports and imports on economic growth has been remained under empirical and theoretical investigations. The empirical research has found mix results about these relationships. Some of the previous research on the said relationship is reviewed as follows:

Gibba and Molnar (2016) tested the relationship between export and economic growth using data for the period of 1980-2010 for Gambia. They found causality relationship running from export to economic growth of Gambia. Oxley (1993) and Ram (1985) also found similar results. Furthermore, some studies found causality from growth rate to exports (Shihab et al., 2014) and Findly, 1984). Alkhateeb et al. (2016) used data for the period 1980 to 2013 for Saudi Arabia and found a bi-directional causality between exports and growth.

Hussain and Afaf (2014) investigate the effects of export and import on economic growth in the case of Saudi Arabia using 22 observations for the period from 1990-2011. They employed both co-integration and granger causality tests, found that although the causation from exports to growth was significant but imports to growth was not statistically significant. For exports, imports and growth causalities, Ajmi et al. (2015) did not find the significant relationships for South Africa. Asafu-Adjaye et al. (1999) also did not find causality relationship in the case of India. Therefore, the studies of Ajmi et al. (2015) and Asafu-Adjaye et al. (1999) did not find the evidence of export-led growth. However, Yuhong et al. (2010) found that the growth in imports promoted the rate of economic growth in China. In addition to this, Achchuthan (2013) also concluded that as imports increases, economic growth also increases. The studies of Haseeb et al. (2014), Irwan et al. (2015), and Khan et al. (2016) examined the exports and economic growth relationshipsand they found that exports and growth have significantly positive association. Yuksel and Zengin (2016) analyzed the export, import and growth causality relationship for six developing countries (Argentina, Brazil, China, Malaysia, Mexico and Turkey) using data for the period from 1961-2014. Using time series econometrics techniques to measure for causality and co-integration, it was found that in case of Argentina, increase in exports causes an increase growth rate. However, in China and Turkey case. Imports cause an increase in exports. The relationship between the imports and economic growth has not been similar for countries under study.

Due to the mixed results indicated in the studies reviewed above, it is pertinent to test the causality through co-integration between exports, imports and economic growth for Pakistan economy over the period 1981-2016.

## 3. Research Methods

### 3.1. Data

In order to examine the causality and co-integration among exports, imports and output or growth level of Pakistan, annual data for the period of 1981 to 2016 is used in this research. The data were collected from two major

databases i.e. International Financial Statistics (IFS) and Pakistan Economic Survey. All variables of the study are in nominal term and in millions of rupees. Moreover, these variables have been converted into natural logarithm.

### 3.2. Model

Earlier empirical formulations tested the causality by having only the economic growth and exports in the model (Emely, 1968). Other studies examined this relationship in the neoclassical framework (Balassa, 1978; Fosu, 1990). However, Guntukula (2018) tested the relationship between exports, imports and growth for different countries. We can formulate our model to study this relationship as follows:

$$GDP = f(X, M) \tag{1}$$

Equation (1) can be represented in log-linear econometric form as follows:

$$lnRGDP_t = a + \gamma lnRX_t + \delta lnRM_t + \varepsilon_t \tag{2}$$

Here, RGDP, RX and RM stand for real GDP, real exports and real imports, respectively. The last term of equation is white noise term. The parameters γ and δ represents that how a change in independent variables can affect to change GDP of the country. The *ln* stands for natural logarithm, all variables have been transformed into log form.

## 3.3. Econometric Analysis

#### *3.3.1. Engle-Granger Approach of Co-integration*

The study employs Engle-Granger (EG) Approach of co-integration in order to determine the long run relationship among variables of the model. However, in Engle Granger analysis it is important that the variables of model should be stationary at same level of integration where stationarity can be tested with the help of unit root test. After that, the residuals are obtained as a result of the estimated regression.

#### *3.3.2. The model of Vector Error Correction*

If co-integration is proven among variables of the model, then Granger causality can't be used in that situation to test for causal relationship. In such cases the Vector of Error Correction Model (VECM) is mostly applied to determine for the causal relationship. Literature reports that the VECM is helpful for measuring causality when variables are stationary at first order rather than level (Engle-Granger, 1987). Thus, Eq. (2) can be written in the form of VECM as follows:

$$\Delta lnRGDP_t = \alpha_0 + \sum_{i=1}^{m} \alpha_i \Delta lnRGDP_{t-i} + \sum_{i=1}^{n} \gamma_i \Delta lnRX_{t-i} + \sum_{i=1}^{p} \delta_i \Delta lnRM_{t-i} + \sigma EC_{t-1} + \varepsilon_t \tag{3}$$

where Δ is the difference operator; m, n, and p are the numbers of lag. The new term EC represent the error correction term and can be obtained from the long run relationship of the regression model. The value of EC term should be significant with negative sign.

## 4. Empirical Findings and Discussion

Use of time series data techniques require that the data is tested for stationarity so that to avoid any spurious results. Therefore, prior to using co-integration, first we need to test for unit root in all series of the study using Augmented Dickey Fuller (ADF) test. After that, we do co-integration analysis. The VECM will used to find for the nature of causality relationship.

### 4.1. ADF Test Results

In order to find that the series of model are stationary or non-stationary, we use ADF test and the results are given in table-1.

**Table-1: ADF Test Results of Unit Root with Constant and Trend**

| Variable | At level | | At 1st difference | |
|---|---|---|---|---|
| | t-statistics | Critical Value at 5 % | t-statistics | Critical Value at 5 % |
| *RGDP* | -2.332 (0.406) | -3.548 | -4.414* (0.006) | -3.548 |
| *RX* | -0.571 (0.974) | -3.548 | -7.457* (0.000) | -3.548 |
| *RM* | -2.201 (0.474) | -3.548 | -6.371* (0.000) | -3.548 |

*Note: the values in parenthesis are probability values. The * represent 1 percent level of significance.*

None of the variables in the model indicated by the *p-values* in parentheses besides the t-statistics are stationary at level. However, at first difference, all become stationary. When all variables are stationary at first difference, then co-integration can be used for analysis.

### 4.2. Results of Engle-Granger Co-integration

We first estimate the model given in equation 2 using the ordinary least squares method, so as to get the estimated residuals. The estimated residuals are tested for unit root using ADF test and Phillips-Perron (PP) test. The results of unit root of error term are given in table-2.

**Table-2: Unit Test Results of Residuals**

| Equation of regression | ADF Test at level | | Phillips Perron Test at level | |
|---|---|---|---|---|
| *GDP = f(X, M)* | t-test | p-value | t-test | p-value |
| | -1.836 | 0.063 | 1.950 | 0.050 |

From results in table-2, it can be seen that the residuals are stationary at level using both the unit roots. We can conclude that there is long run relationship among exports, imports and economic growth. Finally, the vector error correction model is used for testing causality among the variables.

## 4.3. Results of Vector Error Correction Model (VECM)

In order to run the VECM model to determine the causalities, we first specify the lag length using lag length criteria. The optimum lag length is calculated "1" as indicated by * in table-3 below. The optimum lag length was decided on the basis AIC and SC. The details of results are given in table-3.

**Table-3: Results of Lag Length selection Criteria**

| Lag | FPF | AIC | SC | HQ |
|---|---|---|---|---|
| 1 | 1.32e-07* | -7.331098* | -6.922959* | -7.193772* |
| 2 | 1.40e-07 | -7.279104 | -6.462827 | -7.004452 |
| 3 | 1.95e-07 | -6.981379 | -5.756964 | -6.569401 |

**. Indicates lag order which is selected by the different criterion such as AIC, SC and HQ etc.*

After calculating the lag length, the VECM results are obtained and given in the table 4. By looking at table-4, the significance of causality is determined by the *p-values*. A *p-value* less than 0.05, it indicates the existence of the casual relationship given in the first column in table 4. It can be seen that gross domestic product causes both the exports and imports but the reverse is not true. So, there is unidirectional causality running from GDP to the exports and imports.

**Table-4: Results of Vector Error Correction Model for Exports, Imports and Growth**

| Causality Direction | Lag length | Chi-sq | P-value | Results |
|---|---|---|---|---|
| Exports →GDP | 1 | 2.998 | 0.223 | No causality relationship |
| Imports →GDP | 1 | 2.500 | 0.286 | No Causality relationship |
| GDP →Exports | 1 | 6.791 | 0.033 | Causality relationship |
| GDP →Imports | 1 | 8.006 | 0.018 | Causality relationship |

## 5. Conclusion

The main objective of this study was to empirically examine the causal relationship between exports and economic growth as well as imports and economic growth of Pakistan over the period of 1981-2016. The study employed ADF test to check for the unit root, Engle-Grange approach of co-integration and the VECM analysis for testing the causal relationship. The Engle-Granger approach is performed to identify co-integration among exports, imports and economic growth. The Engle Granger result revealed that variables exhibit long run relationship or have co-integration. The VECM of causality analysis was used to test the causality. We found a unidirectional causality running from GDP to exports and imports but not vice versa.. The causality from GDP to exports and imports are positive and significant. This implies that increase in GDP increases exports and imports in context of the Pakistan economy over the period of analysis. Results also indicate that the causal relationship between GDP and imports is stronger than the GDP and exports.

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