Exports and Economic Growth
A Causality Test for Indian Economy

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Abstract The present study proposes to investigate the causality between exports and economic growth (GDP) in India over the period 1972-2014. In the investigation of economic growth the role of the export variable has been emphasized. The study takes into account the recent advances in econometric techniques. The Co-integration test indicates that there is co-integration between exports and economic growth in India during the above said study period. Using the Granger causality test, we empirically find that there is unidirectional causality between exports and economic growth. In other words, causality runs from exports to economic growth and not vice versa. More specifically the study supports export-led growth (ELG) hypothesis.

Keywords: Exports, Economic Growth, Gross Domestic Product (GDP), Stationary, Unit Root, Augmented Dickey-Fuller (ADF) Test, Co-integration, Granger Causality, India.

Introduction

Economic development is one of the main objectives of every nation in the world and economic growth is fundamental to economic development. There are many contributors to economic growth. Exports are considered as one of the major contributor among them. Exports of a country play an important role in the economy. A healthy balance, a sustainable development with trade and foreign exchange reserves to maintain the country’s export growth should be a constant and high rate. Exports as a whole affect industrial development. There is a close connection between export expansion and economic growth. Countries that adopted export oriented development strategies experienced extremely high rates of growth.

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They were also able to maintain their growth momentum during periods of worldwide recession better than were the countries that maintained their import substitution policies. Analysis has pointed to a number of reasons why the export oriented growth strategy seems to deliver more rapid economic development than the import substitution strategy. If exports increase at a faster pace as compared to imports, nothing can stop an economy from being a developed one.

Export growth, therefore, is often considered to be a main determinant of the production and employment growth of an economy which is shown in gross domestic product (GDP) growth (Ramos, 2001). He suggests that the hypothesis of export-led growth (EIG) is substantiated by the following four arguments. First, export growth leads, by the foreign trade multiplier, to an expansion of production and employment. Second, the foreign exchange made available by export growth allows the importation of capital goods, which, in turn, increase the production potential of an economy. Third, the volume of and the competition in exports markets cause economies of scale and an acceleration of technical progress in production. Fourth, given the theoretical arguments mentioned above, the observed strong correlation of export and production growth is interpreted as empirical evidence in favour of the ELG hypothesis. India’s exports have also grown much faster than GDP over the past few decades. A broad political consensus has emerged over the last decade about the imperative need for India to achieve and maintain a seven per cent plus annual growth rate of real gross domestic product (GDP) in order to make a significant and durable dent on the long-standing problem of abject poverty. In this context, the present study is a part of the wider study that seeks to explore the positive instrumental role that export-orientation is capable of playing in India’s quest for a sustainable rapid economic growth. The export-led growth (ELG) paradigm has received renewed attention following the highly successful East Asian export-led growth strategy during the 1970s and 1980s, and especially if compared to the overall failure of import substitution policies in most of Africa and Latin America. The export-led growth (ELG) hypothesis implies not only that exports and economic growth are highly correlated but that the former uni directionally causes the latter.

Review of Literature

Amavilah (2003) examined the role of exports in economic growth for Namibia’s economy for the period 1968-1992. The study found no significant impact of exports on economic growth. Awokuse (2005) in his study on Japanese economy found empirical support for ELG hypothesis. Balaguer (2002) also examined the export-led growth (ELG) hypothesis in

Spanish during the period 1961 to 2000 and found that there is positive relationship between export and real output. Darrat (1986) analysed the causal relationship between export and economic growth for four Asian (Hong Kong, South Korea, Singapore, and Taiwan) countries and found no evidence for ELG hypothesis in all the four economies. However, in case of Taiwan the study found the evidence in favour of GLE hypothesis. Erfani (1999) analysed the causal relationship between exports and economic growth for several developing countries in Asia and Latin Amercia during the period 1965-1995. He found that there is a significant positive correlation between exports and economic growth. The study also supports the hypothesis that exports lead to higher output. Ram (1987) in his study analysed the relationship between exports and economic growth and found a significant impact of exports on economic growth. Ramos (2001) found a bidirectional relationship between exports-output growth and imports-output growth in the Portuguese economy during the period 1865 to 1998. Subasat (2002) examined the empirical linkage between exports and economic growth and reported that export oriented countries (middle-income countries) grow faster than the relatively less export-oriented countries. The study also found that in case of low and high income countries export promotion does not have any significant impact on economic growth.

Sinha (1999) examined the causal relationship between export instability, investment and economic growth in Asian countries using time series data and the cointegration methodology framework. The study reported a negative relationship between export instability and economic growth for Japan, Malaysia, Philippines and Sri Lanka but a positive relationship for South Korea, Myanmar, Pakistan and Thailand. The study found mixed results for India. Thornton (1995) reported that real exports and real GDP in Mexico over the period 1895 to 1995 were cointegrated and there was a positive and significant relationship running from exports to economic growth. Vohra (2001) analysed the relationship between exports and economic growth in India, Pakistan, Philippines, Malaysia and Thailand over the period of 1973 to 1993. The study showed that exports have a positive and significant impact on economic growth.

The current study is a modest attempt to further investigate the long run and causal relationship between exports and gross domestic product (economic growth) in India during the period 1972-2014.

Data and methodology

The present study is aimed at to investigate the dynamics of relationship between exports and economic growth in India. The study is based on secondary data on exports and gross domestic product (GDP), which have been taken from Economic Survey of India 2014-2015. Annual data has been used in the study over the period of 1972 to 2014. Exports and economic growth are the two main variables of the study. The real gross domestic product (GDP) has been used as the proxy for economic growth in India. The study is modest attempt to analyse the long-run and causal relationship between exports and economic growth in India. The econometric techniques like cointegration and Granger causality techniques have been used. While these techniques are generally applied in multivariate models, this study uses these techniques in a bivariate model. These econometric techniques gained popularity in recent empirical research for a number of reasons, namely (i) the simplicity and relevance in analyzing the time series data, and (ii) the ability to ensure stationarity and to provide additional channels through which Granger-causality could be detected when two variables are cointegrated.

In order to avoid spurious causality both of the variables under consideration need to be stationary. The existence of long run equilibrium (stationary) relationship among economic variables is referred to in the literature as cointegration. The major requirement of the Granger-causality test is that the time series under consideration must be stationary. Thus, in order to determine the order of integration of each variable exports and (GDP), the standard Augmented Dickey-Fuller (ADF) unit root test has been applied. If the variables are found to be co-integrated, then the model can be estimated in levels even if the variables are non-stationery. To determine the optimal lag length, the Akaike Information Criterion (AIC) has been used. Both the variables have been taken in their natural logarithms to avoid the problem of hetero-scedasticity.

Empirical results

Co-integration analysis requires to test the unit roots in each variable. For this purpose we apply Augmented Dickey-Fuller (ADF) stationary test on logarithmic form of exports and gross domestic product.

Unit Root Test: Unit root test is used to check whether the time series are stationary or not. A time series is said to be stationary if its mean and variance remain unchanged over time. In other words, a time series will be stationary if its probability distribution remains unchanged as time proceeds. To test the unit root problem the most widely used test is Augmented Dickey-Fuller (ADF) test. The general form of ADF test can be written as:

$$\Delta Y_t=\alpha+\beta t+\delta Y_{t-1}+\sum_{1=1}^{k}\gamma_i\Delta Y_{t-i}+u_t \quad \ldots(1)$$

If δ=0, then the series is said to have a unit root and is non-stationary. Hence, if the null hypothesis, δ=0 is rejected for the above equation it can be concluded that the time series does not have a unit root and is integrated of order zero [I(0)] i.e. it has stationary properties. The results are summarized in Table-1

Table-1 Results of ADF Test

Name of Variable	**Level**		
	Intercept	**Trend**	**None**
Gross Domestic Product (Y)	0.164575(-3.6228)	-1.834538(-4.2324)	18.79987(-2.6280)
Exports (X)	0.156860(-3.6228)	-1.348963(-4.2324)	11.02110(-2.6280)

Name of Variable	**First Difference**		
	Intercept	**Trend**	**None**
Gross Domestic Product (Y)	-5.409177(-3.6289)	-5.325662(-4.2412)	-1.013888(-2.6300)
Exports (X)	-4.622903(-3.6289)	-4.574661(-4.2412)	-1.822859(-2.6300)

Values in parenthesis are MacKinnon critical values for rejection of hypothesis of a unit root at 1 per cent.

In Table 1 null hypothesis of unit root against alternative hypothesis of stationary is tested. Results given in the above table reveal that both the variables exports (X) and gross domestic product (Y) in logarithmic form are non-stationary at level. Therefore, the null hypothesis of unit root at level cannot be rejected. However, at first difference null hypothesis of unit root is rejected for both the variables. Therefore, both the variables are integrated of order one [I(1)].

Co-integrating Regression: The regression of a non-stationary time series may produce spurious results. But the two time series will be co-integrated time series, if one is regressed on another, though individually they contain a unit root do not produce spurious results. More specifically if the two time series are integrated of order one [I(1)] and the residual term (u_t) obtained after regressing one non-stationary time series on another non-stationary time series is subjected to unit root analysis and found that it is stationary, that is, it is [I(0)]. This is an interesting situation for although the two time series are individually [I(1)], that is they have stochastic trends, but their linear combination is [I(0)]. So to speak, their linear combination cancels out the stochastic trends in two time series. This is a case of co-integrated time series, called co-integrating regression. Suppose Y and X are two non-stationary time series, then the co-integrating regression is given by:-

$Y_t=b_0+b_1X_t+u_t$ …(2)

In the present study the model becomes:

$\text{Log}(Y_t)=b_0+b_1\text{Log}(X_t)+u_{1t}$ …(3)

$\text{Log}(X_t)=b_0+b_1\text{Log}(Y_t)+u_{2t}$ …(4)

The estimated form of the above model is given by:

Log (Y_t)	= 4.903672	+ 0.783686 X_t	…(5)
Std. Error	= (0.117380)	(0.011177)	
t-statistic	= 41.77598	70.11588	
R^2	= 0.99 and	DW=0.381	

F-statistic = 4916.24

And

Log(X_t)	= -6.139771 +	1.267Log (Y_t)	….(6)
Std. Error	= (0.23655)	(0.0181)	
t-statistic	= -25.955	70.116	
R^2	= 0.99 and	DW = 0.383	
F-statistic	= 4916.24		

To test whether the residuals obtained from the above regressions are stationary, that is, [I(0)], the Augmented Dickey-Fuller (ADF) test has been applied. The general form of ADF test can be written at level as follows:

$$\Delta u_t=\alpha+\beta t+\delta u_{t-1}+\sum_{1=1}^{k}\gamma_i\Delta u_{t-i}+\in_t \qquad \ldots(7)$$

If the null hypothesis, δ=0 is rejected for the above equation it can be concluded that the time series does not have a unit root and is integrated of order zero [I(0)]. The results are given in Table-2 and Table-3.

Table-2 Results of ADF Test for Stationary of Residuals from Co integration Regression of Log (Y_t)on Log (X_t).

ADF Test Statistic	-6.463891	1%critical value* 5% critical value 10% critical value	-4.2412 -3.5426 -3.2032

* MacKinnon critical values for rejection of hypothesis of a unit root.

Table-3 Results of ADF Test for Stationary of Residuals from Co integration Regression of Log (X_t)on Log (Y_t).

ADF Test Statistic	-6.452872	1%critical value* 5% critical value 10% critical value	-4.2412 -3.5426 -3.2026

*MacKinnon critical values for rejection of hypothesis of a unit root.

It is obvious from the above results in Table-2 that the computed value (-6.463891) is much more negative than the theoretical value (-4.2412) at 1 per cent level, confirming that the residual term (u_{1t}) does not have unit root, which suggests that gross domestic product (GDP) and exports are cointegrated series. Similarly, the results of Table-3 show that the computed value (-6.452872) is much more negative than the theoretical value (-4.2412) at 1 per cent level, confirming that the residual term (u_{2t}) does not have unit root, which suggests that exports and gross domestic product (GDP) are co-integrated series. Therefore, though the gross domestic product and exports series are non-stationary in log level form, being integrated series of order one, [I(1)], their linear combination is found to be stationary in level form showing clearly the fact that GDP and exports are co-integrated in the long run. In other words, this implies there exists a long run equilibrium relationship between GDP and exports, implying thereby the Granger-causality model can be estimated in levels.

Granger Causality Test: Granger causality test helps in determining the direction of causal relationship between different variables say exports and economic growth (GDP) in the present model. To test the causal relationship, the following model is used.

$$\text{Log}(Y_t)= \sum_{j=1}^{k} a_j \text{Log}(X_{t-j})+ \sum_{j=1}^{k} b_j \text{Log}(Y_{t-j})+u_{1t} \qquad \ldots(8)$$

$$\text{Log}(X_t)= \sum_{j=1}^{k} c_j \text{Log}(X_{t-j})+ \sum_{j=1}^{k} d_j \text{Log}(Y_{t-j})+u_{2t} \qquad \ldots(9)$$

Where u_{1t} and u_{2t} are two white noise random disturbance terms which are serially uncorrelated with mean zero and k is the maximum number of lags. To determine the optimal lag length (k), Akaike Information Criterion (AIC) has been used. In our model equation (8) will be used to test causation from exports to economic growth and equation (9) will be used to test the causality running from economic growth to exports. The steps in testing whether exports "Granger cause" economic growth (equation 8) are: Firstly, we regress GDP on past values of GDP, but do not include the lagged values of exports. This is called the restricted regression. After we run the regression, we obtain the restricted residual sum of squares, RSS_R. Secondly, we run the regression and include the lagged terms of exports. This is the unrestricted regression. After we run this regression, we obtain the unrestricted residual sum of squares, RSS_{UR}. Thirdly, the null hypothesis is $\Sigma aj=0$ for all values of j. In other words, the lagged exports terms do not belong in the regression. To test this hypothesis, the F test is applied, as shown below.

$$F = \frac{(RSS_R - RSS_{UR})/k}{RSS_{UR}/n-2k-1}$$

where, k is the maximum number of lags. If the F-value exceeds the critical F-value at the chosen level of significance, the null hypothesis is rejected, in which case the lagged exports variable belongs in the regression. This would suggest that exports "Granger cause" economic growth. We then use the same steps for equation (9) to test whether economic growth (GDP) "Granger causes" the exports.

Based on the results from equations (8) and (9) four possibilities representing possible causal relationship between exports and economic growth (GDP) may be formulated, which are defined as : (1) Exports "Granger cause" economic growth if exports improve the prediction of gross domestic product and the gross domestic product does not improve the prediction of the exports (i.e. $\Sigma aj\neq0$ and $\Sigma dj=0$). (2) The gross domestic product (economy) "Granger causes" exports if the economy improves the prediction of exports and exports do not improve the prediction of economy (i.e. $\Sigma aj=0$ and $\Sigma dj\neq0$). (3) A feedback relationship exists between exports and gross domestic product when exports "Granger cause" GDP and then GDP "Granger causes" exports (i.e. $\Sigma aj\neq0$ and $\Sigma dj\neq0$). (4) Independence is indicated when no causal relationship is found between exports and GDP (i.e. $\Sigma aj=0$ and $\Sigma dj=0$). Results obtained from equations (8) and (9) are summarized in Table-4.

Table-4 Results of Granger Causality

Null Hypothesis	F-Statistic	Probability	Direction of Causality
Exports (X) do not Granger Cause GDP (Y)	4.67*	0.01720	Exports Granger Cause GDP
GDP (Y) does not Granger Cause exports (X)	2.16	0.13315	--

*Significant at 5% level of significance.

Results indicate that there exists a unidirectional causal relationship between exports and GDP (economic growth). The study strongly supports the hypothesis of export-led growth (ELG).

Conclusion

The study is a humble attempt to test empirically the causal relationship between exports and economic growth (GDP) in India during the period 1972-2014. The existence of this relationship has been analyzed by using a co-integration and causality techniques. The stationary properties of the data and the order of integration of the data are, firstly, empirically investigated by the Augmented Dickey-Fuller (ADF) test. ADF test results show that the variables exports and gross domestic product (GDP) in logarithmic form were non-stationary in levels but stationary in first difference. The results of the tests for co-integration suggest that: first, exports and economic growth (GDP) are integrated in India implying thereby that there exists a long-run relationship between exports and economic growth. Second, there is unidirectional causal relationship between exports and economic growth in India. The causality proceeds from exports to economic growth and not vice versa. This conclusion implies that the exports-led growth (ELG) hypothesis is true in case of Indian economy during the study period under consideration.

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