

Exploring Co-Integration and Causality between Foreign Trade and Economic Growth: Econometric Evidence from India

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Abstract – The study tries to delve into the causal relationship between trade and growth rate of GDP. The study has tried to check whether there has been any causal relationship between trade and growth rate of GDP in general and whether any change (positive or negative). The study examines the dynamics of the relationship between India's foreign trade and economic growth in India during 1991-91 to 2017-18. In the present study, an attempt has been made to analyze the data collected through Secondary source. The results discusses the extent of in order to analyze the stationarity of India's Foreign Trade and GDP and in this section also find out the long run and short run relationship between Foreign Trade and GDP.

Key Words: GDP, Foreign Trade, Growth Rate, Unit Root Test, Cointegration Test etc.

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INTRODUCTION

Foreign trade has played an important role in India's economic growth in the past two decades (Semi et. al., 2017; Ghoshal, 2015). It has enhanced competitiveness; expanded business opportunities for domestic markets. By removing unnecessary barriers, it made easier for India and the world to export and import. Since the economic reforms introduced in the year 1991, India has radically changed its trade relations with the world economies. The trade between India and the world economies has risen sharply in the present decade. The study examines the dynamics of the relationship between India's foreign trade and economic growth in India during 1991-91 to 2017-18. Dutt and Ghosh (1996), Nidugala (2000), Nataraj et al. (2001), Bhattacharya and Bhattacharya (2009), Ray, (2011), Kaur and Sidhu (2011) and Agrawal (2014) highlighted that the Gross Domestic Product (GDP) is used as the proxy for economic growth in India. In the present study, an attempt has been made to analyze the data collected through Secondary source. The results are divided into two sections. The first section (i) is devoted towards the estimates of average relationship India's GDP and Foreign Trade. The second section (2) discusses the extent of in order to analyze the stationarity of India's Foreign Trade and GDP and in this section also find out the long run and short run relationship between Foreign Trade and GDP.

RESEARCH METHODOLOGY

Sources and collection of data:

The study is based on the availability of secondary data which collected from different sources such as Direction of trade Statistics, IMF, World Bank,, Asian Development Bank, Handbook of RBI, UNCOMTRADE.

TECHNIQUES OF ANALYSIS

To explores the association of India's GDP (IGDP) and Foreign Trade (FT) during 1991 to 2017 study used regression model. The study regress GDP on Trade and another Trade regress on GDP.

$$GDP = \alpha + \alpha_1 FT + \mu_i \dots\dots\dots (1)$$

$$FT = \beta + \beta_1 GDP + \mu_i \dots\dots\dots (2)$$

The regression equations (1 and 2) of GDP on Trade and Trade and GDP show the average relationship between GDP and Foreign Trade. The results are obtained from the statistical Eview 10.

The study also checks the Foreign Trade and GDP time series data are stationary or not. To analysis the time series data are stationary or not, study uses the Unit Root Test. Unit Root Test explains with the help of Augmented Dickey-Fuller (ADF) Test and Phillips-Perron (PP) Test at level and first difference.

A random walk process may have no drift, or it may have drift or it may have both deterministic and stochastic trends. To allow for the various possibilities, the Dickey fuller test is estimated in the three forms,

$$GDP_t \text{ is a random Walk: } \Delta GDP_t = \delta GDP_{t-1} + u_t \quad (3)$$

$$GDP_t \text{ is a random Walk with drift: } \Delta GDP_t = \beta_1 + \delta GDP_{t-1} + u_t \quad (4)$$

GDP_t is a random Walk with drift around a stochastic trend:

$$\Delta GDP_t = \beta_1 + \beta_2 t + \delta GDP_{t-1} + u_t \quad (5)$$

Here t is trend variable. $H_0: \delta = 0$, There is Unit Root (The time series is nonstationary)

$H_1: \delta < 0$, the time series is stationary.

Augmented Dickey-Fuller (ADF) Test

Intercept Model:

$$\Delta GDP_t = \beta_1 + \delta GDP_{t-1} + \sum_{i=1}^m \alpha_i \Delta GDP_{t-i} + \varepsilon_t \quad (6)$$

$$\Delta FT_t = \beta_1 + \delta FT_{t-1} + \sum_{i=1}^m \alpha_i \Delta FT_{t-i} + \varepsilon_t \quad (7)$$

Trend and Intercept model

$$\Delta GDP_t = \beta_1 + \beta_2 t + \delta GDP_{t-1} + \sum_{i=1}^m \alpha_i \Delta GDP_{t-i} + \varepsilon_t \quad (8)$$

$$\Delta FT_t = \beta_1 + \beta_2 t + \delta FT_{t-1} + \sum_{i=1}^m \alpha_i \Delta FT_{t-i} + \varepsilon_t \quad (9)$$

The Equation 6 and 7 are show the ADF intercept model and equation 8 and 9 are shows ADF trend and intercept model in case of GDP and FT.

The ADF tests the null hypothesis (H_0) against the alternative (H_1) hypothesis;

H_0 : Each variable has a unit root; H_1 : Each variable does not have a unit root

Phillips-Perron (PP) Test

$$\Delta \ln GDP_{t-1} = \alpha_0 + \beta \ln GDP_{t-1} + \varepsilon_t \quad (10)$$

$$\Delta \ln FT_{t-1} = \alpha_0 + \beta \ln FT_{t-1} + \varepsilon_t \quad (11)$$

The Equation 10 and 11 are show the PP Test on GDP and FT. Coefficient from AR (1) regression to account for the serial correlation in ε_t , $H_0: \beta = 0$; $H_1: \beta > 0$

RESULTS AND DISCUSSIONS

The present attempt explores the association of India's GDP and Foreign Trade during 1991 to 2017. The study regress GDP on FT and another FT regress on GDP.

$$\widehat{GDP}_1 = 215745.3 + 2.488 * FT_i \quad (12)$$

Std. Error (54036.40) (0.125)

t-Statistic (3.992) (19.81)

$\bar{R}^2 = 0.937$

$$\widehat{FT}_1 = -62141.87 + 0.377 * GDP_i \quad (13)$$

Std. Error (23909.02) (0.019)

t-Statistic (-2.599) (19.815)

$\bar{R}^2 = 0.937$

The regression equation (12) shows the average relationship between GDP and Foreign Trade. The results show that there is positive average relationship between GDP and FT. The intercept term is positive which shows that if FT is equal to zero then GDP is \$ 215745.3 US Million Dollar. The study test the null hypothesis that there is no relationship between GDP and FT that is slope of coefficient $\beta_2 = 0$. The study reject the null hypothesis there is no relationship between GDP and FT. It is also shows that FT has significant effect on the GDP at five percent level.

The regression equation (13) of FT on GDP shows show that there is positive average relationship between GDP and FT. The intercept term is negative i.e. if GDP is equal to zero then FT is negative \$ -62141.87 US Million Dollar. It is also shows that GDP has significant effect on the FT at five percent level.

In this section also study check the Foreign Trade and GDP time series data are stationary or not. In this section analyses the long run and short run relationship between Foreign Trade and GDP during 1991-92 to 2017-18. To analysis the time series data are stationary or not, study uses the Unit Root Test. Unit Root Test explains with the help of Augmented Dickey-Fuller (ADF) Test and Phillips-Perron (PP) Test at level and differences. To explore the long run relationship among GDP and FT, used the Johansen Cointegration Tests. The present section determining whether one time series is significant in forecasting another used, Granger causality test. To examine the long run relationship used the Error Correction Model.

Dickey-Fuller (DF) Test

$$\widehat{GDP}_1 = 20690.56 GDP_{-1} \quad (\text{Random Walk}) \quad (14)$$

Std. Error (0.014)

t-Statistic (5.970)

$\bar{R}^2 = 0.023$ $d = 1.604$

$$\widehat{GDP}_t = 20690.56 + 0.069 GDP_{t-1} \dots \text{(Random Walk with drift)} \dots (15)$$

Std. Error (29019.77) (0.024)

t-Statistic (0.712) (2.812)

$$\overline{R}^2 = 0.216 \quad d = 1.618$$

$$\widehat{GDP}_t = -24958.99 + 13451.40 t - 0.075 GDP_{t-1}$$

(drift around a stochastic trend) (16) Std. Error (3476231) (6397.327) (0.071)

t-Statistic (-0.717) (2.102) (-1.011)

$$\overline{R}^2 = 0.314 \quad d = 1.707$$

$$\widehat{FT}_t = 0.047 FT_{t-1} \dots \text{(Random Walk)} \dots (17)$$

Std. Error (0.033)

t-Statistic (1.392)

$$\overline{R}^2 = 0.080 \quad d = 1.652$$

Std. Error (0.033)

t-Statistic (1.392)

$$\overline{R}^2 = 0.080 \quad d = 1.652$$

$$\widehat{FT}_t = 28537.82 + 0.004 FT_{t-1} \dots \text{(Random Walk with drift)} \dots (18)$$

Std. Error (20531.83) (0.049)

t-Statistic (1.389) (0.0856)

$$\widehat{FT}_t = -22433.28 + 8693.99 t - 0.2204 FT_{t-1}$$

(drift around a stochastic trend) (19) Std. Error (31651.17) (4277.435) (0.116)

t-Statistic (-0.708) (2.032) (-1.897)

A random walk process may have no drift, or it may have drift or it may have both deterministic and stochastic trends. To allow for the various possibilities, the Dickey fuller test is study in the three forms. The equations (14; 15; 16; 17; 18 and 19) show that the time series of GDP and total trade are not stationary.

Tables: 1 Unit Root Test on Variables

Variables	Model	ADF Test Statistic			PP Test Statistic		
		Level	First Difference	Second Difference	Level	First Difference	Second Difference
GDP	Intercept	2.812 (-2.981)	-0.999 (-2.998)	-7.890* (-2998)	2.719 (-2.98)	2.965 (-2.986)	-8.619* (-2.991)
	Trend & Intercept	-1.011 (-3.595)	-1.971 (-3.622)	-7.679* (-3.622)	-0.866 (- 3.595)	-4.044* (-3.603)	-----
FT	Intercept	-0.085 (-2.981)	-4.105* (-2.986)	-----	-0.145 (-2.981)	-4.073* (-2.986)	-----
	Trend & Intercept	-4.070* (-3.663)	-----	-----	-1.897 (-3.5)95	-4.033 (-3.603)	-----

Note: * indicates significant of 5 percent level.

The study analysis the Augmented Dickey-Fuller and Phillip-Perron tests to identify stationary of the data. The results of the unit root test (ADF and PP test) are exhibited in table 1. The ADF and PP test are performed for two models; intercept as well as trend and intercept. Both models are performed on the level as well as d difference of the series. On the basis of the pure random walk model (i.e., intercept, trend) both the rates are not GDP is nonstationary time series. The GDP is stationary at I (2) in ADF intercept and trend + intercept I Model. The same type results found in case of PP intercept and trend + intercept model. The GDP is stationary at I (2) and I (1) in intercept and Trend + intercept PP model.

The Indian foreign trade time series data is nonstationary in intercept ADF model and PP Model. The FT is stationary at I (1) in intercept ADF model; I(0) in intercept +trend ADF model and I(1) intercept and trend + intercept PP Model.

JOHNSON CO INTEGRATION TEST

The next step is to search for co integrating relationships among the GDP and FT. Here the Johansen-Julesius test which provides the most efficient estimate of the Cointegrating significant vectors and also identifies the number of cointegrating relationships among the non-stationary variables is employed. In other words, the study has to examine whether or not there exists a long run relationship between variables (stable and non-spurious co-integrated relationship). In our case, the mission is to determine whether or not foreign trade (FT) and economic growth (GDP) variables have a long run relationship in a bivariate framework in table 2.

Table 2: Johansen Co- integration Tests

Null Hypothesis	Alternative Hypothesis	λ_{trace} Value	5 % critical
$r=0$	$r > 0$	18.34	15.494
$r \leq 1$	$r > 1$	2.504	3.841
λ_{max} tests		λ_{max} Value	
$r=0$	$r > 0$	15.880	14.264
$r \leq 1$	$r > 1$	2.504	3.841

The λ_{trace} Value and the λ_{max} Value statistics for determining the number of cointegrating vectors (r) wherein the null hypothesis of no cointegration ($r = 0$) versus the alternatives of $r > 0$ and $r > 1$ have been tested. The results reported in Table reveal that the null hypothesis of no cointegration ($r = 0$) rejected at the 5 percent level of significance. But the null hypothesis that $r \leq 1$ is accepted at the 5% level

confirming that there are only one cointegrating vectors among the variables. Nataraj et al. (2001) has stated that while the estimated cointegrating vectors show the long run equilibrium relationship among GDP and Foreign trade, the dynamic adjustments that occur in the short run leading to stable long-run relations in response to various shocks to the system remain unspecified.

The normalized cointegrating equation is

$$\text{LnGDP} = 2.946 \text{ LnFT} \dots\dots\dots(20)$$

(5.04315)

Log likelihood= -469.60

Granger causality test

Granger causality test is a technique for determining whether one time series is significant in forecasting another (Granger. 1969; Granger and Newbold, 1974). FT and GDP are, in fact, interlinked and correlated through various channel. There is theoretical or empirical evidence given by Dutt and Ghosh (1996), Nataraj et al. (2001), Nidugala (2000) and Ray (2011) that could conclusively indicate sequencing from either direction. For this reason, the Granger Causality test was carried out on FT and GDP. Ray (2011) suggested the causality equation between GDP and FT.

If causality (or causation) runs from FT to GDP, we have:

$$\Delta \text{GDP}_t = \alpha + \sum_{i=1}^p a_i \Delta \text{GDP}_{t-i} + \sum_{j=1}^q b_j \Delta \text{FT}_{t-j} + \partial \text{ECT}_{t-1} + \varepsilon_t \dots\dots\dots(21)$$

If causality (or causation) runs from GDP to FT, it takes the form:

$$\Delta \text{FT}_t = \beta + \sum_{i=1}^r c_i \Delta \text{FT}_{t-i} + \sum_{j=1}^q d_j \Delta \text{GDP}_{t-j} + \partial \text{ECT}_{t-1} + \varepsilon_t \dots\dots\dots(22)$$

The equation 21 and 22 show that GDP_t and FT_t represent gross domestic product and foreign trade respectively, ε_{it} is uncorrelated stationary random process, and subscript t denotes the time period. Therefore, it is assumed that the disturbance terms ε_{1t} and ε_{2t} are uncorrelated. In equation4, failing to reject:

H_0 : $b = 0$ implies that foreign trade does not Granger cause economic growth and alternative hypothesis that H_1 : $b \neq 0$. On the other hand, failing to reject H_0 : $d = 0$ implies that economic growth via GDP growth does not Granger cause foreign trade.

Tables: 3 Granger causality test on Variables

Null Hypothesis is	F-Statistic	Prob.
FT Does not Granger Cause GDP	4.041	0.033
GDP Does not Granger Cause FT	7.862	0.003

The decision rule: ΔFT_{t-1} Granger causes ΔGDP_t , the coefficient of the lagged values of FT as a group (b) is significantly different from zero based on F-test (i.e., statistically significant). Similarly, ΔGDP_{t-1} Granger causes ΔFT_t if d is statistically significant.

Error Correction Model

In the present section researchers study that GDP and FT are cointegrated; that is, there is a long term or equilibrium, relationship between the two. In the short run they may be disequilibrium (Sargan, 1984; Gujarti, 2005).

$$\Delta \text{GDP}_t = \alpha_0 + \alpha_1 \Delta \text{FT}_t + \alpha_2 u_{t-1} + \varepsilon_t \dots\dots\dots(23)$$

ECM equation (23) states that ΔGDP depends upon ΔFT and also on the equilibrium term. Where Δ denotes the first difference operator, ε_t is a random error term, $u_{t-1} = \text{GDP}_{t-1} - \beta_1 - \beta_2 \text{FT}_{t-1}$ is the one period lagged value of the error form the cointegrating regression $\text{GDP} = \alpha + \alpha_1 \text{FT} + \mu_i$.

$\Delta \text{GDP}_t = 0.453 \text{ GDP}_{t-1} - 2.284 \text{FT}_{t-1} - 265856.978 + 0.0824 \Delta \text{FT}_{t-1} + 0.409 \Delta \text{FT}_{t-2} + 82403.97$
SE (0.146) (0.283) (0.313) (20184.285)
t (3.098*) (0.291) (1.303) (4.082*)

$$\bar{R}^2 = 0.278 \quad d = 1.67 \dots\dots\dots(24)$$

Here $u_{t-1} = 1 \text{ GDP}_{t-1} - 2.284 \text{FT}_{t-1} - 265856.978$ is the one period lagged value of the error form the cointegrating regression or it represents the long run equilibrium between GDP and FT.

$$\Delta \text{FT}_t = \beta_0 + \beta_1 \Delta \text{GDP}_t + \beta_2 u_{t-1} + \varepsilon_t \dots\dots\dots(25)$$

ECM equation (25) states that ΔFT depends upon ΔGDP and also on the equilibrium term. Where Δ denotes the first difference operator, ε_t is a random error term, $U_{t-1} = \text{FT}_t - \beta_1 - \beta_2 \text{GDP}_{t-1}$ is the one period lagged value of the error form the cointegrating regression $\text{FT} = \beta + \beta_1 \text{GDP} + \mu_i$. Therefore, one can treat the error term in $U_t = \text{FT}_t - \beta_1 - \beta_2 \text{GDP}$ as the equilibrium error.

$$\Delta FT_t = -0.216 FT_{t-1} - 0.437* GDP_{t-1} + 116394.683 + 0.431\Delta GDP_{t-1} - 0.192 \Delta GDP_{t-2} + 8490.901$$

SE	(0.189)	(0.159)	(0.155)	(18618.50)
t	(-1.147)	(2.703*)	(-1.239)	(0.456)
\bar{R}^2	= 0.275	d= 1.68 (26)	

Here $u_{t-1} = 1 FT_{t-1} - 0.437* GDP_{t-1} + 116394.683$ is the one period lagged value of the error form the co integrating regression or it represents the long run equilibrium between GDP and FT.

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