Relationship Of Gdp Growth Rate, Trade Openness And Real Exchange Rate In India: An Analysis Through Auto Regressive Distributor Lag (Ardl) Model

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Abstract

This paper analyses the long run as well as short term relationship between GDP Growth Rate, Trade Openness and Real Exchange Rate with respect to Indian Economy. By using Auto Regressive Distributor Lag (ARDL) Model, the unrestricted and restricted Error Correction Model (ECM) are established. It finds a cointegrated long run association among these three variables. Choosing the correct lag (AIC -4.33, SIC-4.83) and applying it in Lagrange Multiplier (LM) test, this model verifies that errors are uncorrelated. Stability and Fitness of the model is also judged by Cumulative Sum Control (CUSUM) Test. Further, in the context of measuring the short-term relationship, the Error Correction Term signifies that there are 100% chances of rectification of disequilibrium in the next period to reach its equilibrium. Overall, the study shows that the impact of Trade Openness and Real Exchange Rate on GDP Growth Rate is positive (0.1581) and negative (-0.5122) respectively.

Keywords:

GDP Growth Rate, Exchange Rate, Trade Openness, Time Series, Cointegration, ARDL Model.

Introduction

Growth Rate of Indian Economy is driven by Industrial sectors rather than the other sectors of the economy. Study since 2000 onwards show that growth rate of GDP has been facing an incremental value, but, still, Indian growth rate is sceptical. The data shows the fluctuation in the growth rate which may happen because of many reasons contributed by India's macroeconomic variables. Also, the population of Indian economy contributes towards its development. Indian population is more than what is necessary to get a result of a sustainable growth. Because of high population, GDP per capita and growth rate per capita of India is considerably low over periods of time.

Furthermore, since 1994, India opened its economy for international operations. Exports were promoted and imports were in control with the liberalisation of India. In this regard, exchange rate -one of the major determinants of growth came into the discussion. Exchange rate is considered as Rupee per Dollar in most of the international transaction scenario in India. Since 1963, India faced continuous rupee devaluation with respect to dollar as it faced trade openness inside and outside country. But, continuous improvement in the trade openness cannot be seen in recent development of Indian Economy. Due to monetary and fiscal policies, openness to trade could not be predicted for India. Also, continuous change in the policies led to ambiguous result for value of openness to trade. On the other hand, openness to trade brings a positive growth to an economy- be it developed or developing.

Hence, these three factors- GDP growth rate, Exchange rate, and trade openness together, can be assessed to forecast the health of an economy like India. In this paper, we analysed the interrelationship of GDP growth rate, Exchange rate, and trade openness by analysing a short term and long-term equation-oriented model, i.e., Auto Regressive Distributor Lag Model (ARDL). 20 years' data of these three variables are taken from WDI statistics. Through this model, we tried to estimate the impact of, Exchange rate, and trade openness on GDP growth rate of India. Study shows that there is a long term cointegrated relationship between these three variables and any short run disequilibrium can be corrected 100 % to reach its long run equilibrium level which make the model reliable. The objectives of the study are as follows:

A.   To know whether there is any long run and short run association ship between the three variables.

B.   To know the impact of real exchange rate of India (Rs/$) and trade openness on GDP growth rate of India.

Literature Review [as applicable, remove this section if not required]

Ravindra H Dholakia and Raveendra Saradhi(2000) in their study "Exchange Rate Pass-Through and Volatility Impact on Indian Foreign Trade "analysed that India's Real Effective Exchange Rate (REER) is not competent enough to keep control on trade balance, but is sufficiently equipped with directing towards promotion of exports. This paper analysed an exchange rate pass through and exchange rate volatility with respect to Indian Economy. Xiangming Li (2003), in his article "Trade Liberalization and Exchange Rate Movement" examined that real exchange rate depreciation is necessitated for the trade openness and vice versa. For little evidences, after trade openness, the economy was carried out by appreciation of domestic currency, but, in many of the cases, for developing country, trade openness was followed by depreciation of home currency. Prabirjit Sarkar and Brototi Bhattacharyya (2005) proved in their study "Trade Liberalisation and Growth Case Studies of India and Korea" that over last 20 years trade liberalisation is the precondition for the growth of a developing economy. Taking India and Korea as the economies under consideration, this study found no specific relationship of trade openness and real GDP growth rate of the two economies. Muhammad A. Quddus and Ikram Saeed (2005), in, "An Analysis of Exports and Growth in Pakistan" Classified about making a long run relationship with export and GDP growth rate. Also, emphasis was given to find out a causality between exports and investment. This analysis obtained a positive causal relationship between from export to GDP growth rate proving an increase in number of exports augments a higher rate of growth of GDP in Pakistan. Amjad Naveed and Ghulam Shabbir (2006) in "Trade Openness, FDI and Economic Growth: A Panel Study" analysed that trade openness affects positively to GDP growth rate for the developed countries. Moreover, there is a Granger causal relationship from trade openness to GDP growth rate. A panel of 23 developed countries, on average, shows that there is no relation between FDI inflows and GDP growth rate. Dani Rodrik (2008) in "The Real Exchange Rate and Economic Growth" stated that real depreciation of host country's currency leads to economic growth. Increase in profitability in the tradable items helps developing countries to carry out with a smooth development. Prabirjit Sarker(2008) in "Trade Openness and Growth: Is There Any Link?" discussed a Panel data analysis approach to determine a relationship between trade openness and GDP growth rate. His study shows that out of 51 countries, 11 rich and trade dominated countries are having a positive causal relationship from trade openness to GDP growth rate. But, for East Asian economies, the result is opposite for the period 1961-2002.The result of this analysis is proved same as with Xiangming Li (2003). Olusanya, Samuel Olumuyiwa (2013) ,in "Impact of Foreign Direct Investment Inflow on Economic Growth in a

Pre and Post Deregulated Nigeria Economy: A Granger Causality Test (1970-2010)" analysed about three time period by disaggregating the data from pre-deregulation era (1970 to 1986), post-deregulation era(1986 to 2010 and 1970 to 2010). The study enumerates that there is a causal relationship from GDP growth rate to FDI in the pre-deregulation era. That means, in those time, high growth rate of GDP used to attract for more FDI in the Nigerian Economy. This scenario is absent in the post liberalisation period where there was found no ultimate relationship between the variables over time.

Karnika Gupta and Ishu Garg (2015) in "Foreign Direct Investment and Economic Growth in India: An Econometric Approach" finds out the impact of FDI with past periods (lags) on GDP for India. The empirical study finds that FDI with lag period 3 years is prominent to keep a trace on GDP. The policy issues of this paper gave importance on further attracting FDI to India to acquire higher growth rate. Sangita Dutta Gupta and Vishal Talwar (2016) in their article "An Empirical Analysis into Relationship between FDI and Economic Growth for India and China (1991-2013)" discovered a bidirectional causal relationship between FDI and GDP growth rate between India and China. There exists a long term relationship between FDI and GDP growth rate in China, but for India, no such long run relationship exists.A short term granger causal relationship is found out of the study between these two variables in India.

The above-mentioned studies are related to two different variables taken together for separate analyses. This study is contributed taking three variables like GDP growth rate, real exchange rate and trade openness together. The purpose of the study is to determine a causal relationship of GDP growth rate, real exchange rate and trade openness by analysing short term and long-term relationship.

Materials & Methods

The data on Trade Openness is measured as the sum of exports and imports of goods and services measured as a share of gross domestic product. Data on Real Exchange Rate are calculated as weighted averages of bilateral exchange rates adjusted by relative consumer prices. Annual percentage growth rate of GDP per capita is based on constant local currency, Rupees. GDP per capita is gross domestic product divided by midyear population.

To detect causality between three variables, we have taken values of GDP growth rate, real exchange rate and trade openness during period 1994-2015.The determination of causality is examined by Auto Regressive Distributor Lag (ARDL) Model. Before running this model, data stationarity check is constructed because in time series, the data may be non-stationary. To check stationarity Augmented Dicky Fuller Test (ADF Test) is improvised. As it is detected that all the three data are stationary and non-stationary at level, i.e., mixed with I (0) and I (1), but not I (2), we were ascertained about the usage of ARDL model. We first take out a long run association ship between them by checking co- integration among them and then we furnish a short-term relationship by introducing Error Correction Term (ECT).

Result

Before applying ARDL test, the time series data are subjected through stationarity test. Augmented Dicky Fuller Test (ADF Test) are taken and found that GDP growth rate is stationary at level, and the other two variables, real exchange rate and trade openness are stationary at first difference. As the model is a mixture of I (0) and I (1), and no data are

integrated to order two, we can run ARDL model to check the causalities, the impact of real exchange rate and trade openness on GDP growth rate.

The unrestricted Error Correction Model (particular to ARDL Model) is defined here as:

$$\Delta Y_t = \alpha + \sum_{i=1}^{n} \beta_i \, \Delta Y_{t-i} + \sum_{j=1}^{n} \beta_j \, \Delta X_{t-j} + \sum_{k=1}^{n} \beta_k \, \Delta Z_{t-k} + \beta_4 \, X_{t-1} + \beta_5 \, Y_{t-1} + \beta_6 \, Z_{t-1} + e_t$$

Equation (1)

Where Y = GDP growth rate,

X= Trade Openness

Z= Real Exchange Rate, β_1, β_2 and β_3 measure long run relationship of the Equation (1), whereas, β_4, β_5 and β_6 are the measure of short run adjustments to this equation. We found out optimal lag length of this equation by using Akaike Information Criteria (AIC) and Schwarz Information Criteria (SIC). The value of the two came lowest while taking lag length as 2 periods.

Table - 1: Optimum Lag Period by AIC and SIC criteria

Lag Period	AIC Value	SIC Value
2	4.33	4.83
3	4.42	5.03
4	4.53	4.9

Source: Authors' calculations

So, lowest value of AIC and SIC are with lag period 2. So, here optimum lag period is 2.

In the next phase, we check the serial independence of the data. The errors with lagged terms should not be serially correlated to each other. For checking this, we conducted Breusch - Godfrey Serial Correlation LM Test. Null hypothesis is: There is no serial correlation among the error terms, against Alternative hypothesis: There is serial correlation among the error terms.

The result of the test shows as follows:

**Table -2:** Breusch- Godfrey Serial Correlation LM Test

F Statistic	0.005210	Probability.F(2,7)	0.9948
Observed R Squared	0.028241	Probability.Chi-Square(2)	0.9860

Source: Authors' calculations through Eviews Software

The probabilistic value shows 0.9948 which is more than .05. It completely gives us confidence to accept null hypothesis and reject alternative hypothesis and conclude that there is no serial correlation among the error terms.

The stability of the data is to be checked for authenticity of the model. For this, CUSUM test is implemented and the result shows that the model is stable.
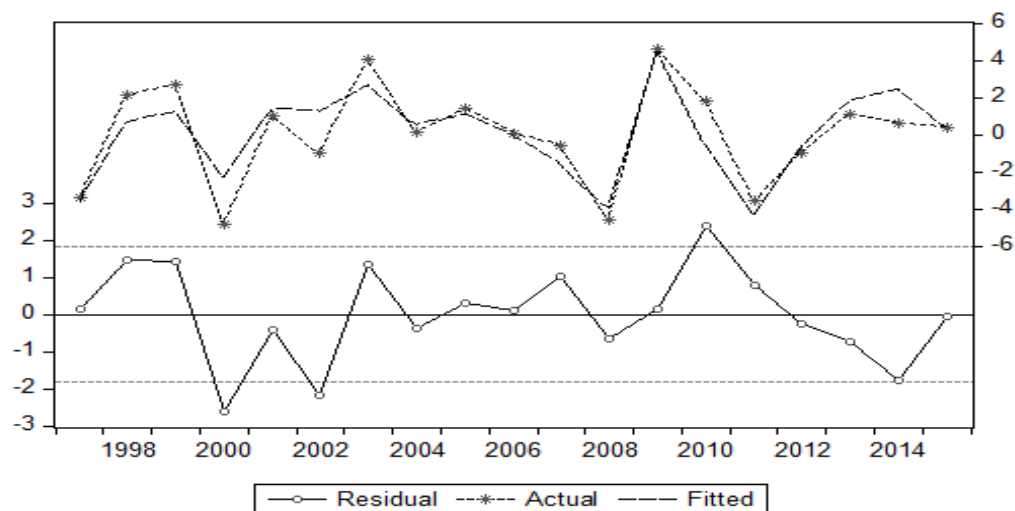
Figure- 1 : CUSUM Test for stability diagnosis
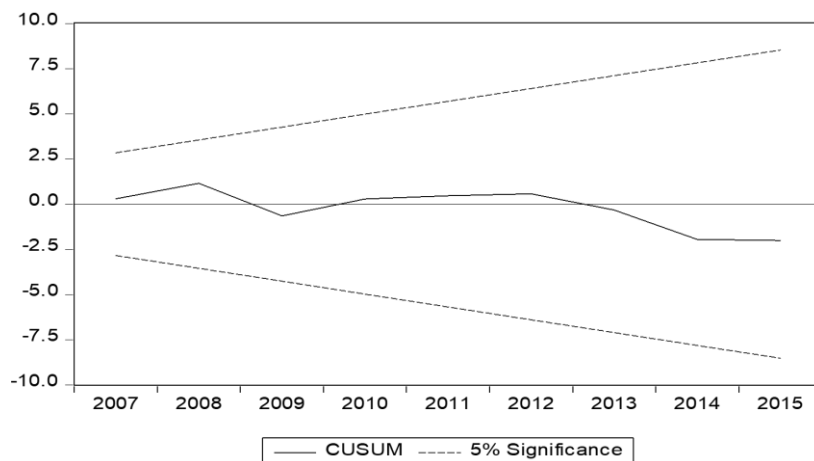
Source: Authors' calculation

Before going for Bound Test of long run relationship, the "fit" of unrestricted ARDL model explains the extent of actual relationship as:

Figure- 2: Actual, Residual, and Fitted Data

Source: Authors' calculation

So, the actual data are matching with the Fitted data. It seems that the model is reliable.

Now we performed a Bound Test for checking a long run relationship between the variables. We will test whether there is a long run relationship among the variables or not. Null hypothesis, here, is: $\beta_4 = \beta_5 = \beta_6 = 0$, against Alternative hypothesis : $\beta_4 \neq \beta_5 \neq \beta_6 \neq 0$ by using Wald Statistics.

Table-3: Bound Test and Wald Statistics

Test Statistic	Value	df	Probability
F Statistic	3.937303	(3,9)	0.0478
Chi Square	11.81191	3	0.0081

Source: Authors' calculations through Eviews Software

Here, F statistic value is F = 3.937303. It should be compared with Pesaran et al (2001) critical value. [Table CI (iii); Case (III)]. At 10 % level of significance, the upper band F value is 3.52. Hence, our calculated F statistic is more than the tabular one. It tells us a definite relationship

which is positive. So, we reject null hypothesis and accept alternative hypothesis concluding that there is a long run association ship between the three variables. All the three variables move together in the long run.

When the above Bound Test shows that there is a long run relationship between all three variables. The long run equation between the variables can be written as:

$Y_t = a_0 + a_1 X + a_2 Y + V_t$.   Equation (2)

The unrestricted Model of ARDL (as specified in equation (1):

$$\Delta Y_t = \alpha + \sum_{i=1}^{n} \beta_i \, \Delta Y_{t-i} + \sum_{j=1}^{n} \beta_j \, \Delta X_{t-j} + \sum_{k=1}^{n} \beta_k \, \Delta Z_{t-k} + \beta_4 X_{t-1} + \beta_5 Y_{t-1} + \beta_6 Z_{t-1} + e_t$$

Table-4: Unrestricted ARDL Model

Variables	Coefficients	Standard Errors	t Statistic	Probability
C	72.48361	32.99894	2.196544	0.0557
D(GDP GRoWTH(-1))	0.0596220	0.483970	1.231936	0.2492
D(GDP GRoWTH(-2))	-0.131107	0.463755	-0.282707	0.7838
D(TRADE OPENNESS(-1))	.389730	0.235061	1.657993	0.1317
D(TRADE OPENNESS(-2))	0.142213	0.215531	0.659827	0.5259
D(REAL EXCHANGE RATE(-1))	0.499826	0.287020	1.741435	0.1156
D(REAL EXCHANGE RATE(-2))	0.132766	0.192711	0.688940	0.5082
GDP GROWTH(-1)	-1.572201	0.675216	-2.328440	0.0449
TRADE OPENNESS(-1)	0.248488	0.082202	3.022909	0.0144
REAL EXCHANGE RATE(-1)	-0.805315	0.387997	-2.075969	0.0678

Source: Authors' calculations through Eviews Software

The long run effects are gained from long run multiplier values in the model. The long-run multiplier between Trade Openness and GDP growth Rate is -(0.248488 / (-1.572201)) = 0.1581. In the long run, an increase of 1 unit in Trade Openness will lead to an increase of 0.1581 units in GDP Growth Rate. On the other hand, the long-run multiplier between Real Exchange Rate and GDP growth Rate is -((-.805315) / (-1.572201)) = - 0.5122. In the long run, an increase of 1 unit in Real Exchange Rate (Depreciation in Rupees) will lead to a decrease of 0.5122 units in GDP Growth Rate.

We estimate the levels model and restricted ECM (Error Correction Model) as equation (2) follows:

$Y_t = a_0 + a_1 X + a_2 Y + V_t$.

The ARDL model (restricted Error Correction Model) is specified by:

Table-4: Restricted ARDL Model

Variables	Coefficients	Standard Errors	t Statistic	Probability
C	-0.712871	0.735159	-0.969683	0.3530
D(GDP GRoWTH(-1))	0.695788	0.527402	1.319273	0.2139
D(GDP GRoWTH(-2))	0.150680	0.499435	0.301700	0.7685
D(TRADE OPENNESS(-1))	0.260402	0.261886	0.994333	0.3414

D(TRADE OPENNESS(-2))	0.111162	0.247260	0.449576	0.6617
D(REAL EXCHANGE RATE(-1))	-.092773	0.149251	-0.621593	0.5469
D(REAL EXCHANGE RATE(-2))	-0.099740	0.188432	-0.529316	0.6071
ECT (-1)	-1.601881	0.745753	-2.148003	0.0548

Source: Authors' calculations through Eviews Software

The short-term model signifies that the Error Correction Term (ECT) is negative and the value is -1.60. This leads to the conclusion that 100 % of the disequilibrium will be corrected in the next period.

Discussion

The empirical data shows that there is a short run as well as long run association among the three variables GDP Growth Rate, Trade Openness and Real Exchange Rate. All the variables are cointegrated and they move together. The impact of trade openness is contributing positively to GDP Growth Rate (0.1581). On the other hand, the impact of real exchange rate on GDP growth rate is negative (-0.5122). It signifies that a depreciation in exchange rate slows down the growth of an economy. In short run, if there remains a disequilibrium in Economy, it gets corrected fully within the next period and the economy reaches to its equilibrium level.

Conclusion

The devaluation in exchange rate brings down the growth of Indian economy. Having been able to correct disequilibrium within the next period fully is an opportunity for Indian Economy. The errors get easily rectified and the economy can be able to achieve its growth rate within stipulated time. Thus, correct fiscal and monetary policies are to be taken to improve the status of Indian currency. Appreciation in Rupees can bring back the growth of Indian Economy along with proper channel of Foreign Direct Investment Inflows into required sectors of Indian Economy. Hence, relationship with FDI inflow and growth rate of Indian economy are further future research area.

Conflict of Interest: There is no conflict of interest regarding the publication of this paper.

References
1. Amjad Naveed and Ghulam Shabbir (2006) ,Trade Openness, FDI and Economic Growth :A Panel Study, Pakistan Economic and Social Review, Vol. 44, No. 1 (Summer 2006), pp. 137-154
2. Dani Rodrik(2008) , The Real Exchange Rate and Economic Growth, Brookings Papers on Economic Activity.pp-365-412

3. Karnika Gupta and Ishu Garg (2015) ,Foreign Direct Investment and Economic Growth in India: An Econometric Approach, Gupta & Garg, Apeejay - Journal of Management Sciences and Technology 2 (3),(ISSN -2347-5005)

4. Muhammad A. Quddus and Ikram Saeed(2005),An Analysis of Exports and Growth in Pakistan, The Pakistan Development Review, Vol. 44, No. 4, Papers and Proceedings PART IITwenty-first Annual General Meeting and Conference of the Pakistan Society ofDevelopment Economists Islamabad, December 19-21, 2005 (Winter 2005), pp. 921-937

5. Olusanya, Samuel Olumuyiwa (2013) ,Impact of Foreign Direct Investment Inflow on Economic Growth in a Pre and Post Deregulated Nigeria Economy: A Granger Causality Test (1970-2010), European Scientific Journal September 2013 edition vol.9, No.25 ISSN: 1857 – 7881 (Print) e - ISSN 1857- 7431

6. Prabirjit Sarkar and Brototi Bhattacharyya (2005), Trade Liberalisation and Growth Case Studies of India and Korea, Economic and Political Weekly, Vol. 40, No. 53, pp.5635-5641

7. Prabirjit Sarker(2008) ,Trade Openness and Growth: Is There Any Link?, Journal of Economic Issues, Vol. 42, No. 3, pp. 763-785

8. Ravindra H Dholakia and Raveendra Saradhi(2000), Exchange Rate Pass-Through and Volatility: Impact on Indian Foreign TradeEconomic and Political Weekly, Vol. 35, No. 47 , pp. 4109-4116

9. Sangita Dutta Gupta and Vishal Talwar (2016) ,An Empirical Analysis into Relationship between FDI and Economic Growth for India and China (1991-2013), IJEMR –Vol 6 Issue 02 - Online - ISSN 2249–2585 Print - ISSN 2249-8672

10. Xiangming Li (2003), Trade Liberalization and Exchange Rate Movement,IMF Working Paper,WP/03/124