



Economic Growth, Domestic Investment, Real Exchange Rate and Trade Openness in India: A *multi-cointegration analysis*

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1. Introduction

The Indian economy is the tenth largest in the world in terms of nominal GDP and the third largest by purchasing power parity (PPP). The country is a member of the G-20 major economies and BRICS countries. According to the IMF, on the per capita income basis, India ranked 140th by nominal GDP and 129th by GDP (PPP) in 2011. Back in 1991, India saw itself facing its most critical economic and currency crisis ever. The government then did not have many options but to take up some radical reforms. Many barriers and restrictions were taken off. The new economic policy of 1991 was characterized by liberalization, privatization and globalization (LPG). What followed these radical changes is now history of the economy.

2. Indian Economic growth

After the two decades of reforms by the implementation of New Economic Policy of 1991, the problems of fiscal deficits and current account deficits was recur again. The fiscal deficit was at 5.39% of GDP in 1991-92. In 2011-12 it was at 6.9%. Similarly, the current account deficit was at 3% of GDP in 1991. The same stood tall at 4.3% in March 2012. Short term external debt has shot up from 10% of GDP in 1991 to 22% currently. 1990s and 2000s witnessed major changes in the Indian economy due to economic liberalization in India. This revitalization took place in the whip of balance-of-payment emergency. The government of India allowed private infusions in Indian market which facilitated monetary infusion from FDI and FII. As per the estimate by Ministry of Statistics and Programme Implementation, GDP of India in the year 1990 stood at 5,542,706 in comparison with 842,210 in 1975.

The Indian economy has indeed come a long way since then. Back in 1991, India had foreign exchange that wouldn't last beyond two weeks. With current reserves of about US\$ 290 bn, the economy can meet its import requirements of about 7 months. India's domestic savings rate has gone up from 20% of GDP to 31.6% during this intervening period. Even Indian companies are in much better financial health today than in 1991. But there are also several new challenges now that didn't exist back then.

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One very major difference is the state of the global economy. Back in 1991, the overall economic environment in the global arena was favourable. Now a day, we are quite integrated with the global economy. This has tremendously increased our vulnerability to external shocks.

As a fledgling democracy, India's economic policy of planned development was held out as an example to many aspiring low-income countries in the 1950s. While some countries raced ahead in the development process, India lagged behind. This is evident from the fact that it took 40 long years from 1950-51 for India's real per capita GDP to double by 1990-91. But, 1991-92 was a memorable moment in India's modern economic history for its severity position of balance of payments (BOP) prompted far reaching economic reforms, unlocking growth potential of the economy.

Economic Progress Post-1991

The implementation of economic reforms in the 1990s have seen India gradually breaking free of the low growth trap which was euphemistically called the "Hindu growth rate" of 3.5 per cent per annum. Real GDP growth averaged 5.7 per cent per annum in the 1990s, which accelerated further to 7.3 per cent per annum in 2000s. A feature of the growth acceleration during the period was that while the growth rate of industry and services increased that of agriculture fell. This was because there was no notable technological breakthrough after the "green revolution" of the mid-1960s which saw sharp increase in yields of cereal production particularly in northern part of India. By the 1990s, the momentum of "green revolution" had died down. Consequently, the yield increases in the 2000s were much lower than those experienced even in the 1990s. Notably, the decade of the 2000s encompassed the inflexion point in the growth trajectory with an annual average GDP growth of about 9 per cent for the 5-year period 2004-08. Growth in all the sub-sectors of the economy, including agriculture, accelerated during this period. However, this growth process was interrupted by the global financial crisis. Subsequently, the average growth slowed down to 7.8 per cent during 2009-11 with a noticeable slowdown in both agriculture and industry. The slowdown in GDP growth in 2012 can mainly be attributed to high interest rates, inflation and a significant contraction in industrial production.

The growth dynamics altered the structure of the Indian economy with a decline in the share of agriculture from 28.4 per cent in the 1990s to about 15 per cent in 2009-11. There was corresponding gain in the share of services, including construction, from 52 per cent to 65 per cent during the same period. What is, however, of concern is that the share of industry has remained unchanged at around 20 per cent of GDP. This suggests that India's growth acceleration during the last two decades has been dominated by the services sector. The pace of average annual industrial growth had nevertheless picked up from 5.7 per cent during the 1990s to 9 per cent during 2004-08 before being interrupted by the global financial crisis.

While the share of industry in GDP remained stagnant, there was noteworthy structural transformation in manufacturing over the period. As a process of

restructuring, while the gross value added in organized manufacturing increased by 8 per cent per annum at current prices, employment fell by 1.5 per cent per annum during 1995-2003. Subsequently, during 2004-09 gross value added growth accelerated to 20 per cent per annum at current prices; but significantly, employment also increased by 7.5 per cent per annum.

With work participation rate of 39.2 per cent, India had a workforce of 400 million in 2009-10. Of this, 53 per cent was in agriculture and the rest 47 per cent in non-agricultural activity. While the bulk of the employment is in agriculture despite its shrinking share, the noteworthy feature of the employment structure has been that for the first time the absolute workforce in agriculture declined in the latter half of the 2000s. The overall unemployment rate in the economy also declined from 8.3 per cent in 2004-05 to 6.6 per cent in 2009-10.

3. History of trade policy in India

India had a relatively open trade regime until the 1950s with low tariff rates; quantitative import restrictions were not onerous and there was no evidence of foreign-exchange controls. The foreign exchange crisis in 1957 led to imposition of quantitative restrictions on imports, industrial licensing and foreign exchange controls, and these were progressively increased until 1966. The Ministry of Finance prioritized the usage of available foreign exchange². An array of licensing agencies was involved in the allocation process of foreign exchange. Imports of raw materials were not permitted if domestic substitutes were available³. The Government of India introduced export subsidization schemes in 1962 but they were not very successful in boosting exports. One of the disadvantages of the requirement that domestically produced inputs be used when available was that Indian exporters were compelled to use inferior-quality domestic inputs and therefore could not compete with their international counterparts.

India went through a phase of economic liberalization during 1966-68 which included measures such as the devaluation of the rupee by 57.5 per cent, removal of some import licensing controls and cuts in import tariffs. The measures were unpopular because of the widespread belief that they were in response to the dictates of the World Bank and the liberalization process was soon reversed and the protectionist regime continued until the 1970s (Panagariya, 2004). As seen in Figure 1, India's trade share (as percentage of GDP) went on falling continuously from late 1950s till 1970.

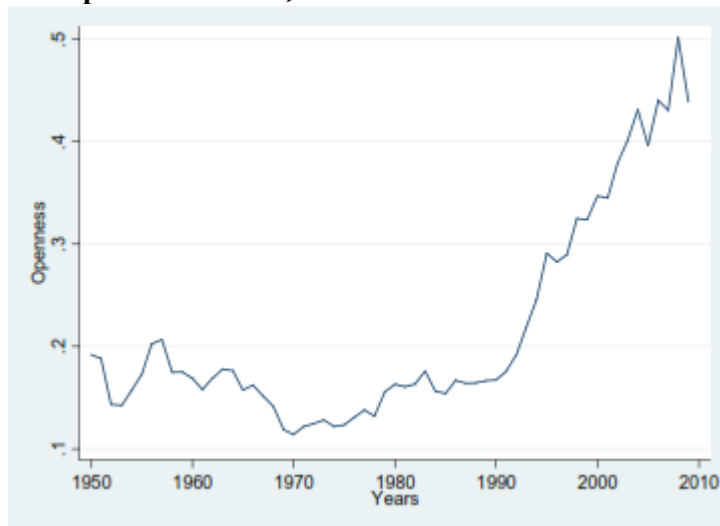
India undertook several liberalizing steps such partial liberalization of imports during the 1980s mainly to allow a more liberal flow of essential raw materials and machinery. It also expanded domestic demand through fiscal stimuli supported by large deficits. Consequently, India achieved a growth rate of above 5 per cent during the 1980s, though it also increased its foreign and domestic debt to unsustainable levels.

² First the foreign exchange requirements for debt repayment, Embassy expenditures, food, fertilizer, petroleum, oil and lubricant (POL) were met and after that allocations were made for private sector imports of raw materials and machinery.

³ See Panagariya (2003) and Panagariya (2004) for a detailed discussion on this.

The result was a major macroeconomic crisis in 1991, which prompted serious economic reforms including a systematic liberalization of trade. Within a decade, import licensing was entirely abolished and the highest tariff rate was brought down from 355 per cent to about 30 per cent (Bhat, 2011; Mukherjee and Mukherjee, 2012). Consequently, India experienced a sharp rise in its trade openness (see Figure 1).

Figure 1: Trade openness of India, 1950-2010



Note: Data obtained from Penn World Table 7.0. Trade Openness defined as exports plus imports as % of GDP (at 2005 constant prices).

Thus, the main focus of this study is to determine whether trade openness, gross domestic investment and real exchange rate (RER) affect the economic growth of India. Theoretically, all these variables are important determinants of growth, both in developed and developing countries. The specific objectives of this study are:

1. to investigate the relationships among trade openness, gross domestic investment, RER and economic growth;
2. to examine the direction of causality between trade openness, gross domestic investment, exchange rate and economic growth; and
3. to suggest policy actions to improve the performance of Indian economy.

4. Theoretical Literature

Trade openness promotes economic growth through economic gains from resource allocation and specialisation, as explained by the concepts of absolute advantage and comparative advantage. The Heckscher–Ohlin model explains further that trade openness may achieve higher levels of economic growth through comparative

advantages in factor endowment and the efficient allocation of resources. Solow (1956) purports that trade openness that results in a more efficient allocation of resources will generate a steady-state level of income that will produce faster economic growth. Meanwhile, the endogenous growth theory introduced by Romer (1986) and Lucas (1988) argues that there is a positive relationship between trade openness and economic growth. Trade openness promotes growth through international diffusion of ideas or technology and dynamic learning from abroad.

Economic theories also suggest that investment or gross fixed capital formation plays an important role in determining the medium-term and long-term growth of a country. Gross capital formation affects economic growth directly by boosting the physical capital stock in the domestic economy (Plossner, 1992), or indirectly through enhancing technology (Levine and Renelt, 1992). An increase in investment as an input in production processes leads to an expansion in output and, therefore, it is expected that there will be a positive relationship between gross fixed capital formation and economic growth. Bakare (2011) uses the Harrod–Domar model to explain the mechanism through which more investment promotes higher growth. He argues that for a country to grow, it must sacrifice a part of its resources from present consumption and invest it in capital formation. The Harrod–Domar model postulates that saving and capital formations are important ingredients in economic growth.

The role of the exchange rate in promoting economic growth through the trade channel has been discussed extensively in several studies, such as, Dollar (1992), Polterovich and Popov (2002), Krueger (1978), Ito, Isard and Symansky (1997) and Rodrik (2008). It has been also recognised that exports provide the foreign exchange needed to import capital goods for use in the production of goods and services in the domestic economy which further contributes to economic growth. Therefore, many countries maintain disequilibrium RER, which is either an overvalued or undervalued domestic currency. An undervalued domestic currency has been employed as an export oriented development strategy in many developing countries; and an undervalued RER causes an increase in international price competitiveness of domestic tradable goods which results in export expansion that finally promotes economic growth.

The analysis is based on the role of the RER, which is a relative price defined as the price of traded goods in terms of non-traded goods. In this case, an increase in the RER increases the relative profitability of the traded goods sector; as a result the trade sector expands while the non-traded sector contracts. Changes in the composition of the structure of the economy are an important driving force that promotes economic growth (Rodrik, 2008). Specifically, undervaluation has positive effects on the relative size of the traded goods sector, especially of industrial economic activities and, therefore, countries where undervaluation is able to induce resources to move into the traded goods sector would be able to grow faster.

An appreciation of the RER is considered a negative exchange rate shock that can be harmful to trade performances, since it slows down aggregate demand which in turn adversely affects exports. In addition, the overvalued RER causes an increase in the

domestic cost of producing tradable goods if there is no change in the relative prices of trading partners. Easterly (2001) argues that a massive revaluation of currencies has an unfavourable effect on growth due to the Balassa–Samuelson hypothesis which states that rapid productivity growth happens faster in the traded goods sector than in the non-traded goods sector, which is mainly services, as the prices of traded goods tend to fall more, relative to the price of non-traded goods. The slow rate of growth is due to the higher price of traded goods.

5. Review of literature

Several studies attempt to show the linkages between trade openness and economic growth. It is argued that trade openness has a robust positive impact on growth, based on the notion that trade expansion leads to an increase in the exports sector and capacity utilisation, which leads to positive externalities in the non-exports sector (Edwards, 1993). Chang, Kaltani and Loayza (2005) conclude that trade openness generates efficient allocation of resources through comparative advantage, allowing the transmission of knowledge and technological progress, and stimulates competition in both national and international markets. Meanwhile, Edwards (1992) argues that openness will boost the spread of technological knowledge from developed countries, which will ultimately promote economic growth of a country. Fontagne and Freudenberg (2001) state that the benefit gained from international trade will increase efficiency and economies of scale for the country's trade relations.

Romer (1990) provides evidence for the existence of a large positive impact of trade openness on growth. The evidence shows that trade openness may speed up growth through productivity differentials in the exports sector that will generate positive externalities for the economy. The finding indicates that a 1 per cent increase in the ratio of trade to the GDP may raise per capita income by 1.5 to 2 per cent. The evidence from a study by Yanikkaya (2003) supports the hypothesis of the new growth theory where trade encourages growth through improvement in technology. The study was carried out based on 100 developed and developing countries. He concludes that the larger a developing country's trade is with the United States, the higher is its economic growth.

Therefore, it is not surprising to see that the hypothesis that a country which is more open to trade tends to experience more rapid growth, has been widely accepted in academic circles. Studies by Wacziarg and Welch (2001) and Dollar and Kraay (2004) find evidence of a positive relationship between openness and economic growth. A study by Sachs and Warner (1995) to determine the effects of trade on growth using a binary variable across 122 countries finds that the open economies are better off due to a higher growth rate compared to the closed economies.

There have been some disagreements about the relationship between trade openness and growth. Specifically, Chang, Kaltani and Loayza (2005) find that the effects of trade on growth might not be identical across countries. Trade has a positive effect only under certain conditions in the domestic economy, such as, flexibility of labour markets. Calderon, Loayza and Schmidt-Hebbel (2004) conclude that there is no

effect on the growth rate when there are low levels of per capita income and a positive effect is experienced only for countries with higher levels of per capita income.

Shirazi and Manap (2004) investigate the short-run and long-run relationships among real exports, real imports and economic growth for Pakistan for the 1960–2003 periods. They employ a cointegration technique and VAR model and then apply multivariate Granger causality proposed by Toda and Yamamoto (1995). The study shows the evidence of a long-run relationship among the three variables, with unidirectional causality running from exports to output. The results also indicate causality running from imports to output, while they do not support any causality between imports and exports.

Many studies have been conducted to determine the impact of imports on productivity in developing countries. The inclusion of imports in the model will allow us to test the imports led growth hypothesis, which states that the imports of intermediate and capital goods can contribute to economic growth by enhancing productivity. According to McKinnon (1964) and Findlay (1973), when a country opens up its imports, to allow imports such as high-quality goods and services, productivity can expand to promote growth. Such imports can be enforced through successful export promotion, which may relieve a binding foreign exchange constraint, to ultimately increase the imports of capital and intermediate goods.

Imports place competitive pressure on domestic products, and tend to promote productivity through the absorption of new technologies from other countries. Krugman and Helpman (1988) argue that in developing countries, imports may be beneficial in terms of providing massive product variety for domestic consumers. Several studies have shown that without including imports into the model, the causal relationship between exports and growth is merely a spurious link and thus may be misleading. Esfahani (1991), Riezman, Whiteman and Summers (1996) and Thangavelu and Rajaguru (2004) argue that the omission of imports, as an explanatory variable, will overstate the relationship between exports and growth. They also emphasise that the finding of no cointegration between exports and GDP is because of the exclusion of imports. On the other hand, the inclusion of imports, as an additional appropriate variable in the model, will provide a better understanding of the effects of exports on economic growth, particularly when exports, imports and economic growth of a country have the tendency to reinforce each other. Therefore, the inclusion of imports as a relevant variable in the study of export led growth is important.

There are many empirical studies to determine the relationship between the RER and economic performance of a country. A study by Edward (1993) suggests that successful trade liberalisation during the 1970s and 1980s was due to a robust depreciated exchange rates. It concludes that RER depreciations provide a growth promoting effect in developing countries, while appreciation hurts economic growth. A study by Musila and Newark (2003) finds a positive impact from devaluation on export performance, which in turn has a positive impact on growth. Faria and Ledesma (2003) examine the Balassa–Samuelson effects on growth by employing the Pesaran bounds

testing for the period from 1960:Q1 to 1996:Q4. Their findings indicate that the devaluation of the RER has a strong impact on economic growth.

Upadhyaya and Dhakal (1997) conduct an empirical study to examine the relationship between the RER and GDP of six Asian countries for 1963–93 period by employing the ARDL model. The finding indicates that these countries experience positive growth in the long run when currencies are undervalued, except for Pakistan and Thailand. It has been observed that the appreciation of the currency can impede economic growth. Dollar (1992) and Polterovich and Popov (2002) argue that an overvalued currency is harmful for economic growth of developing countries.

6. Model and Methodology

The discussion in the literature review suggests that there are several variables that influence economic growth. In this study, we postulate that GDP depends on trade openness, gross domestic investment and the exchange rate. The equation is expressed in log form as:

$$gdp_t = \alpha_0 + \alpha_1 open_t + \alpha_2 gdi_t + \alpha_3 rer_t + \varepsilon_t \quad (1)$$

where OPEN is trade openness, GDI is gross domestic investment, RER is the real exchange rate, L is the natural logarithm, α ($i = 0, 1, 2, 3$) are the parameters to be estimated which are assumed to be positive, ε_t is the disturbance term and the subscript t is the time period. A priori $\alpha_{21} > 0$ indicating that an increase in trade openness will lead to an increase in GDP; $\alpha_{31} > 0$ implies that an increase in GDI will positively affect GDP; and $\alpha_{41} > 0$ suggests that a change in RER will positively affect GDP.

Equation (1) can be written in a vector error correction form as

$$\begin{bmatrix} \Delta gdp_t \\ \Delta open_t \\ \Delta gdi_t \\ \Delta rer_t \end{bmatrix} = \begin{bmatrix} \alpha_0 \\ \beta_0 \\ \gamma_0 \\ \delta_0 \end{bmatrix} + \sum_{i=1}^m \begin{bmatrix} \alpha_{1i} & \alpha_{2i} & \alpha_{3i} & \alpha_{4i} \\ \beta_{1i} & \beta_{2i} & \beta_{3i} & \beta_{4i} \\ \gamma_{1i} & \gamma_{2i} & \gamma_{3i} & \gamma_{4i} \\ \delta_{1i} & \delta_{2i} & \delta_{3i} & \delta_{4i} \end{bmatrix} \begin{bmatrix} gdp_{t-i} \\ open_{t-i} \\ gdi_{t-i} \\ rer_{t-i} \end{bmatrix} + \begin{bmatrix} \alpha_1 \\ \beta_2 \\ \gamma_3 \\ \delta_4 \end{bmatrix} [ECT_{t-1}] + \begin{bmatrix} \varepsilon_t \\ \theta_t \\ \vartheta_t \\ \mu_t \end{bmatrix} \quad (2)$$

where u are residuals in period t , with zero mean and constant variance, Δ is the first difference operator, $\alpha, \beta, \gamma, \delta$ are the short run parameters, and m is the lag length chosen on the basis of minimising Akaike's information criteria. ECTs are the error correction terms which are the stationary residuals generated from the long run cointegrating regression of Johansen multivariate process representing a disequilibrium position in period t .

In other words, the error correction terms represent the adjustment of variables towards a long run equilibrium value. The coefficients $\alpha_{11}, \beta_{11}, \gamma_{11}$, and δ_{11} , are the short run adjustment coefficients showing how fast the dependent variables move towards the long run equilibrium value.

6.1. Sources of Data and Definition of Variables

This study employs annual time series data from 1970 to 2012, as data prior to 1970 are not available. The data were collected from various sources, notably from the Hand Book of Statistics on the Indian Economy 2013-14. The definitions of selected variables for the study are given in table 1 and their descriptive statistics are given in table 2.

Table 1: Definition of the variables selected

Variables	Definition
LGDP	Log of real GDP
LGDI	Log of Gross Domestic Investment(GDI)
LOPEN	Log of trade openness ⁴
LRER	Log of real exchange rate (RER)

Table 2: Descriptive statistics of the variables

Descriptive statistics	Variables			
	LGDP	LGDI	LOPEN	LRER
Mean	8.850813	7.408714	-1.832273	3.309679
Median	8.885245	7.408626	-1.940992	3.562132
Maximum	11.24820	10.20064	-0.932782	4.300455
Minimum	6.528250	4.775588	-2.524925	1.890594
Std. Dev.	1.432539	1.650284	0.433326	0.821358
Skewness	-0.023925	0.043362	0.616665	-0.205527
Kurtosis	1.729857	1.786078	2.268953	1.349120
Jarque-Bera	2.557959	2.345120	3.254596	4.582754
Probability	0.278321	0.309573	0.196460	0.101127
Sum	336.3309	281.5311	-69.62639	125.7678
Sum Sq. Dev.	75.93021	100.7672	6.947553	24.96127
Observations	38	38	38	38

6.2 Empirical Analysis

Appropriate tests were first conducted to identify the characteristics of the time series. First, the unit root test was applied to examine whether the series contained a unit root. If unit roots are present, the results of the regression may be spurious. This test ensures that the pairs of the series do not have a tendency to drift too far apart or move

⁴ Trade openness is defined as the ratio of sum of exports and imports to GDP i.e. $\text{Openness} = (\text{exports} + \text{imports}) / \text{GDP}$

too close together. The series could drift apart in the short run, but may move close together in the long run. In this study, we test for the unit root in level and first differences using the familiar Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) statistics. If the series are found to be nonstationary in level, the unit root test is applied to their first differences. When all the series are stationary in first differences then the series are said to be integrated of order one or $I(1)$ and cointegration test can be conducted.

We then proceeded to determine the long run relationships among the series—LGDP, LGDI, LRER and LOPEN—by employing the Johansen cointegration test, consisting of two likelihood ratio (LR) tests, namely, the trace statistic and the max-eigen statistic. For small sample data, the likelihood ratio tests can be biased in finding the number of cointegrations; to deal with such a problem, Reinsel and Ahn (1988) suggest an adjustment for the degrees of freedom, by replacing T in equation (1) by $(T - nk)$, where T is the sample size, n is the number of variables included in the model, and k is the number of lags. Granger (1988) states that the existence of cointegration implies that there is a cause and effect relationship among the variables at least in one direction.

7. Results and Discussion

7.1 Unit root test

The result of the unit root tests is reported in table 3. From the results we noticed that in all cases both the ADF test and the PP test cannot reject the null hypothesis of a unit root. Thus, all variables—*GDP*, *GDI*, *OPEN* and *RER* — are non-stationary in level. But the null hypothesis of non-stationarity in the first difference is rejected for all variables at the 1 per cent level of significance, which provide evidence that all variables are integrated of order one $I(1)$.

Table 3: Result of unit root test for the variables in level and first difference.

Variables		ADF		P-P	
		constant	constant and trend	constant	constant and trend
lgdp	level	0.07838	-2.36991	0.68755	-2.17459
	1 st diff	-4.50371*	-4.43085*	-4.55424*	-4.48725*
lopen	level	0.53277	-0.97650	0.47720	-1.14184
	1 st diff	-5.51160*	-5.75803*	-5.50976*	-5.76691*
lgdi	level	0.18685	-3.37315***	0.80119	-3.4494***
	1 st diff	-7.40050*	-7.32002*	-9.40876*	-9.67932*
lrer	level	-0.62860	-1038217	-0.616058	-1.58430
	1 st diff	-3.23555**	-9.44854*	-8.08238*	-8.23097*

7.2 Cointegration test

Optimal lag length in VAR model was investigated by Akaike Information Criteria (AIC), Bayesian information criteria (BIC) and Hannan and Quinn Criterion (HQC) using maximum 8 lags, since Johansen-Juselius cointegration test is sensitive to lag length. Results of AIC, BIC and HQC tests are shown in Table 4. Appropriate order of VAR was chosen as 1(one) lag according to results for model.

Table 4: VAR lag order selection criteria

Lag order	LR	FPE	AIC	SIC	HQC
0	NA	9.68e-06	-0.1939	-0.0162	-0.1326
1	381.6019*	7.28e-11*	-11.9997*	-11.1109*	-11.6924*
2	12.30175	1.18e-10	-11.5586	-9.9588	-11.0063
3	15.44861	1.61e-10	-11.3465	-9.0357	-10.5488

* indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error, AIC: Akaike information criterion

SC: Schwarz information criterion, HQ: Hannan-Quinn information criterion

After the determination of optimal lag length, Johansen and Juselius (J-J) cointegration test is used to investigate the existence of long run relationships between the variables. The results of the J-J cointegration test are given in Table 5. The unadjusted maximum eigen value and the trace statistics reveal that the variables included in the model are cointegrated.

Table 5: Results of the Cointegration Tests

Cointegration LR Test Based on Maximal Eigenvalue				
No of hypothesised CE(s)	Eigenvalues	Trace Statistics	95% critical	Prob**
None*	0.6726	76.8424	63.8761	0.002
At most 1	0.3868	36.6421	42.9152	0.183
At most 2	0.3395	19.0323	25.8721	0.278
At most 3	0.1075	4.0969	12.5179	0.728
Cointegration LR Test Based on trace statistic				
No of hypothesised CE(s)	Eigenvalues	Max-Eigen Statistics	95% critical	Prob**
None*	0.6726	40.2003	32.1183	0.004
At most 1	0.3868	17.6097	25.8232	0.407
At most 2	0.3395	14.9353	19.3870	0.197
At most 3	0.1075	4.09698	12.5179	0.728

Maximum eigenvalue and Trace statistic indicates one cointegrated equation at 5% level of significance.

* indicates the statistic is significant at 5%.

** indicates MacKinnon-Haug-Michellis(1999) p-values.

Long run equation

$$lgdp = 0.066 \lgdi + 0.0821lopen + 0.265 lrer + 0.0989 TREND$$

(0.092)b* (0.050) b* (0.033)b* (0.012)b*

b* denotes the values in parenthesis are standard errors

From the cointegrated equation given in table 5, we see that economic growth; Gross Domestic Investment, trade openness and real exchange rate are cointegrated indicating that there is a long run equilibrium relationship between the variables. A 1% increase in GDI increases 0.066% in economic growth. Similarly, 1% increase in trade openness leads to 0.082% increase in economic growth and a 1% increase in real exchange rate leads to 0.26% increase in economic growth. Thus, in the long run, GDI, trade openness and real exchange rate have cointegrated positively to economic growth

Table 6: Results of the VEC Granger Causality Tests

VEC Granger Causality/Block Exogeneity Wald Tests

Dependent variable: D(LGDP)			
Excluded	Chi-sq	df	Prob.
D(LGDI)	0.580555	2	0.7481
D(LOPEN)	0.493382	2	0.7814
D(LRER)	3.099783	2	0.2123
All	4.684107	6	0.5849
Dependent variable: D(LGDI)			
Excluded	Chi-sq	df	Prob.
D(LGDP)	6.195740**	2	0.0451
D(LOPEN)	0.742548	2	0.6899
D(LRER)	2.988305	2	0.2244
All	8.543557	6	0.2009
Dependent variable: D(LOPEN)			
Excluded	Chi-sq	df	Prob.
D(LGDP)	4.181031	2	0.1236
D(LGDI)	1.415981	2	0.4926
D(LRER)	0.122249	2	0.9407
All	6.806373	6	0.3391

Dependent variable: D(LRER)			
Excluded	Chi-sq	df	Prob.
D(LGDP)	2.602750	2	0.2722
D(LGDI)	3.713126	2	0.1562
D(LOPEN)	0.401013	2	0.8183
All	5.193079	6	0.5193

*and ** indicate significance at the 1 per cent and 5 per cent levels, respectively.

The short run causality between the variables is investigated using VEC Granger causality/ Block Exogeneity Wald test. The results of the VEC Granger causality/ Block Exogeneity Wald test is presented in table 6. From the result of the short run causality we noticed that only economic growth has short run impact on Gross Domestic Investment (GDI). The other variables have no short run impact on each other. Thus, there is a unidirectional causality from economic growth to GDI, but there is no feedback effect.

8. Conclusion and Policy Implications

The main objective of this study is to determine the short run and long run relationships among economic growth, gross domestic investment, real exchange rate and trade openness in India. The results suggest the existence of a long run relationship among these variables. All the variables have contributed positively to the long term economic growth of India economy. The findings further show that economic growth granger cause gross domestic investment (GDI) in the short run but there is no feedback effect. Thus, in order to sustain long term economic growth gross domestic investment (GDI) must be enhanced and promotion of India's foreign trade is needed.

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