Trends , Patterns and Determinants of Indian Current Account Deficit

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Abstract
India's current account experience deteriorated due to its large dependence on imports and un-competitiveness of exports. The relation between external and internal balances, with deficit in specific, deserves significant attention. Thus to understand the factors influencing current account is important for better designing the policies aiming at sustainable Current Account Deficit (CAD). In this direction, the present study is an endeavour to enrich the existing literature on the trends, patterns and determinants of current account deficit in India since 1996. The study adopts Johansen Cointegration approach to identify long-run relationship and uses Vector Error Correction Model (VECM) to identify short-run relationship. The results of Johansen Cointegration test indicates the existence of long-run equilibrium relationship between the current account and the variables of interest, implying that India's current account is influenced by these factors. On the basis of the empirical results, study concluded that continuously increasing Net Foreign Assets (NFAs) will lead to the betterment of the current account while, increase in imports encompassing exchange rate deterioration will keep on mounting pressure on CAD of India.

JEL Codes: F4, F10, F32
Key Words: Current Account Deficit, Trade, Cointegration, India.

1. Introduction

Amongst the enormous challenges faced by many developed and developing countries, the tremendous challenge, in growing globalized era, is to maintain balanced current account. As the layout pattern of global imbalances seems to be discrepant with the standard view that the developed industrial economies should be exporting capital to the developing countries. Because the marginal productivities of capital in developing countries is higher as compared to that of developed countries due to the higher labour/capital ratios of developing countries. This, on the one hand, provides an incentive for developing countries to borrow, as they expect higher income in future due to their catch-up to developed economies but on the other hand these countries experiencing large imbalances in their current account (Gruber and Kamin, 2007).

A country's ability to run imbalances in the current account is an important issue faced in the capital markets by lenders and borrowers and its analysis usually involves two questions. First is regarding the solvency of debtor country and second is the sustainability of its imbalances in the current account. Concerning these issues, an interesting case study is provided by India, as it has adopted various cautious external sector policies and used capital controls encompassing balance of payments adjustments and control. Nonetheless, its current account has been impinged by various shocks and regime shifts in the period following independence. In the late 1950s and early 1960s, strong growth in imports have been experienced due to heavy investments

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in capital goods and other materials indispensable for industrialization. Minuscule emphasis on promotion of exports combined with inefficiency of domestic industry engender by overvalued exchange rate and extensive protection, resulted in poor performance of exports and widened the trade deficit. However, the performance of exports was improved in the late 1960s and 1970s due to the rupee devaluation in 1966, followed by world trade expansion and the initiation of a series of export incentives, which led to a more supportive export environment. This released the pressure on the external position of India and conduced an improvement in the position of its current account by marking surplus for a number of years. While this position was temporarily overturned in the backwash of the oil price shocks of 1973, as the growth of imports was brought down by fastening import controls and restraining domestic expenditure (Callen & Cashin, 1999). In 1980s, current account position of India witnessed a gradual deterioration and unplumbed changes in its financing. The oil price shock of 1979 invested significant pressure on its balance of payments. In response to world wide recession and overvalued real exchange rate, the exports slowed, imports surge and the Current account actuated back to deficit. However, the current account position of this time had not followed a significant adjustment, unlike after first oil price shock.

Further, in the late 1980s, it experienced a large deficit in the current account due to the spillover of unrelenting expansion of fiscal deficit, that was 6.1 percent of gross domestic product (GDP) in 1980-81 increased to 8.4 percent of GDP in 1990-91, led the country to debt trap and culminated BoP crisis in 1991 (Bajpai, 1996). Since 1991, Indian economy has become more open and integrated with world economy. Following a series of external sector policies and credible macroeconomic structural stabilization program that underscored preference for non-debt creating capital flows, market based exchange rate regime, trade, industry, foreign investment, public finance, financial sector and betterment in competitiveness of exports, there was an improvement in the current account position and further reaching large surpluses in the early 2000s. Since 2004-05, the current account has been consistently in deficit. The sharp deterioration in the current account deficit (CAD) of India, especially in 2012-13, when it crossed the 5 per cent, twice the level that was considered as a safe threshold by the Reserve Bank of India (RBI), resulted from the sum total of a series of structural infirmities, viz., trade deficit, import surge and indifferent export performance of the economy, caused its external sector to tether on the verge of crisis (Dhar and Rao, 2014). Current account, a major indicator for a country's external performance, is typically used for the future behaviour of an economy. India's current account experience deteriorated due to its large dependence on imports and un-competitiveness of exports. The sharp deterioration in the CAD of India over the past few years caused its external sector to tether on the edge of crisis as it creates imbalances in the domestic market. So, the relation between external and internal balances, with deficit in specific, deserves significant attention. Thus to understand the factors influencing current account is important for better designing the policies aiming at sustainable CAD. In this direction, the present study is an endeavour to enrich the existing literature on the trends, patterns and determinants of current account deficit in India since 1996.

Accordingly to Guisan(2004) and (2007), and to Guisan, Aguayo and Exposito(2014), and other studies, imports have a positive role on development provided that exports

contribute to enough financing of the cost of imports, being domestic manufacturing very important to guarantee a sustainable development of exports and avoid unsustainable current account deficits. In spite of some degree of advancement in the last decades, it is important to emphasize that a great challenge of India is to increase the production of manufactured goods, both for domestic market and for exports.

2. Objectives of the study

- To study the trends and composition of imports and exports of India since 1996.
- To analyse the impact of various economic determinants on India's current account.
- To highlight some suggestions in view of reduction in CAD of India in the context of open economy environment.

3. Model, Data Source and Methodology

The study is entirely based on secondary data and belongs to the time period of 1996Q2 to 2013Q4. The data regarding current account, export, Gross Domestic Product (GDP), import and Real Effective Exchange Rate (REER) are collected from the Handbook of Statistics on Indian Economy, Reserve Bank of India. While, data regarding Net Foreign Assets (NFA) is taken from the International Monetary Fund's International Financial Statistics, for the given time period. For the data of Wholesale Price Index (WPI), official website of the office of the Economic Adviser, Ministry of Commerce and Industry, Government of India is consulted.

The identified model consists of six variables which hypothesize current account (CA) as a function of Gross Domestic Product (GDP), Net Foreign Assets (NFA), Trade Openness $(OPEN)$, Real Effective Exchange Rate $(REER)$ and Wholesale Price Index (WPI).

$$CA = f\,(GDP, NFA, OPEN, REER, WPI\,) \ldots . 1$$

Table 1: Description of Variables

Variable	Description	Units
CA	Current Account	Real current account volume (US$ billions)
GDP	Gross Domestic Product	Real GDP volume at factor cost (at constant prices). (Base: 2004-05)
NFA	Net Foreign Assets	Ratio to GDP
OPEN	Trade Openness: sum of exports and imports	Ratio to GDP
REER	Real Effective Exchange Rate: trade based	Index number (Base: 2004-05)
WPI	Wholesale Price Index: all commodities	Index number (Base: 2004-05)

I) Gross Domestic Product (GDP): Current account balance can be affected by the domestic output level. Firstly, according to elasticity approach, imports are positively associated with the domestic output, while exports are independent of domestic output. Because, the countries with higher levels of domestic output are more certain to attract flows of capital from foreign and thus, these countries create a positive association of domestic output with capital account while, a negative link to the current account (Aristovnik, 2006). Secondly, the absorption approach states that favourable or

unfavourable balance in the current account depends also on the absorption level rather than only on the domestic output level. For example, if the growth of domestic output is faster than that of the domestic absorption then the economy still exports to the other countries. Thus, this situation creates a positive link of domestic output with the current account.

II) Net Foreign Assets (NFA): In order to avoid the problem of endogeneity, NFA is measured as a ratio of GDP. Both approaches, i.e. absorption and inter-temporal, considered the stock of NFA as an important initial term. Because, the return on an economy's NFA stock along with the sum of the trade balance constitutes the current account. However, the current account can be influenced by the level of NFA in two ways. Firstly, there is a positive relationship between NFA and the current account balance from the saving–investment perspective. As, investment income from abroad, of a high level, has a positive effect on the balance of current account. Secondly, in a flexible exchange rate regime the sum of the current account and capital account must be equal to zero as, an economy can afford a higher trade deficit up to an extended period with a high level of NFA and still remains solvent (Yang, 2011). This leads to a negative relationship between the NFA and the current account. However, the standard open economy macroeconomic models also predict the positive relationship and empirically also, this relationship would be expected to dominate (Chinn and Prasad, 2003).

IV) Trade Openness (OPEN): The trade openness is expressed as the sum of imports and exports of goods and services to GDP ratio. It not only measures an economy's degree of openness to trade, but also gives the indication of liberalization of trade, receptivity of transfers related technology and ability of a country to afford external debt with export earnings. Trade openness is likely to be negatively related to the current account, because an economy, opened more to international trade with less trade restrictions, tends to be more foreign capital attractive, relatively (Chinn and Prasad, 2003). Usually, the available empirical literature found trade openness as negatively associated with the current account.

III) Real Effective Exchange Rate (REER): There are two ways in which exchange rate can affect the current account. One is the saving-investment perspective, as the exchange rate increases, the economy's overall saving ratio decreases. Because, it increases the domestic currency's purchasing power on foreign goods and services and encourages domestic residents to purchase more imported goods and services (Yang, 2011). This increased spending on foreign goods and services, on the one hand, tend to raise real consumption relative to output, lowers the saving ratio and decrease in saving ratio will lead to a reduction in the current account balance of an economy. On the other hand, the current account titled as a buffer to smooth consumption as suggested by the consumption smoothing hypothesis (i.e. output less investment). An open economy runs a current account surplus in response to the appreciation of the exchange rate and invests abroad rather letting consumption to increase. As a result, the appreciation of home currency results in the betterment of current account.

V) Wholesale price Index (WPI): In some sense, inflation is not as fundamental as the explanation of other variables reviewed above. However, in case of India, according to Chakravarty, (2013) high inflation increases the gap between savings and investment. Because, the ability of households to save is eroded by high inflation, as they invest much of their savings into unproductive investments in order to preserve

the value of their assets and pernicious effects of inflation on CAD are clear. In this study WPI is considered as a measure of inflation rather than the consumer price index (CPI), as prices of services are not covered under WPI. Its availability at high frequency, facilitate better analysis of inflation (Mohanty, 2011).

Methodology: We applied the following tests and estimations, accordingly to the procedures described in the Annex: I) Stationary Testing Procedures. II) Cointegration Procedure. III) Vector Error Correction Model. IV) Granger Causality Test. V) Diagnostic Statistics: V. a) The Breusch-Godfrey Test. V. b) ARCH Test

4. India's Balance of Payment

The current account of India remained in deficit over the time period of study except the period of 2001-02 to 2003-04. Deficit in this account increased to US$ 88.2 billion in 2012-13 from US$ 4.6 billion in 1996-97 but moderated in 2013-14 with a substantial decrease and reached at US$ 32.4 billion. However, the capital account remained in surplus, i.e. US$ 12.0 billion in 1996-97 and increased to US$ 48.8 billion in 2013-14. Surplus in this account increased over the years only due to the increasing contribution of foreign investment (Foreign Direct Investment and Foreign Portfolio Investment) inflows, and taken overall BoP in surplus. The surplus in overall BOP continuously increased to US$ 15.5 billion in 2013-14 from US$ 6.8 billion in 1996-97and was a record high in 2007-08, i.e. US$ 92.2 billion, except for the year 2008-09 (US$ -20.1 billion) and 2011-12 (US$ -12.8 billion). In these exceptional years, either the low magnitude of the capital account surplus or higher extent of current account deficit is responsible for the deficit in the overall BoP.

4.1 Composition of Current Account of India

4.1.1. Merchandise Trade: The component responsible for almost the entire deficit is the merchandise trade and is the most important variable which accounted most of the fluctuations in the current account over the time. The data obtained from the Reserve Bank of India (RBI) in Table 2, in the Annex, shows that the merchandise exports increased at a rate of 16.8 percent, i.e. from US$ 34.1 billion in 1996-97 to US$ 318.6 billion in 2013-14 at an average percentage change of 14.8 percent. While, imports increased at a rate of 18.1 percent to US$ 466.2 billion in 2013-14 from US$ 50 billion in 1996-97, with an average percentage change of 16.5 percent, for the period 1996-97 to 2013-14. Table 2 shows that merchandise trade remained in deficit throughout the period, as the imports always exceeded exports. The deficit was moderate between 1996-97 and 2003-04, as the deficit in it was valued at US$ 14.8 billion in 1996- 97 increased to US$ 17.8 billion in 1999-00 and then declined to US$ 13.7 billion in 2003-04. But in 2004-05 deficit in merchandise trade increased to US$ 33.7 billion and consistently went on increasing and was a record high in 2012-13, i.e. US$ 195.6 billion, which led the CAD to cross 5 percent (percentage of GDP) level, twice the level that is considered as a safe threshold by the RBI (Dhar and Rao, 2014). In 2013-14, the Government has taken a series of measures to boost exports and to curb imports to reduce the deficit in trade and thereby CAD. Mainly, extension of Focus Market Scheme (FMS) and Special FMS Scheme, extension of interest subvention, extension of Export Promotion Capital Goods (EPCG) Scheme, increased coverage Focus Product Scheme, under the Annual Supplement 2012-13 to the Foreign Trade Policy 2009-14 (GOI, 2013). This resulted in negative 7.2 percent growth in imports and

positive 3.9 percent growth in exports and led the deficit in merchandise trade to US$147.6 billion in 2013-14 from a record high of US$ 195.7 billion in 2012-13.

4.1.2. Invisible Trade: The second component of the current account is invisibles and it placed an impressive role in covering the trade deficit. The exports of invisibles have increased at a rate of 17.6 percent, i.e. from US$ 21.4 billion in 1996-97 to US$ 233.2 billion in 2013-14. While, the imports of invisibles have also shown substantial increase, i.e. increased at a rate of 16.3 percent from US$ 11.2 billion in 1996-97 to US$ 118 billion in 2013-14, but remained less than the exports. Due to sharp rise in exports of invisibles, there has been surplus in trade balance, throughout the study period reported in Table 2. In 1996-97, surplus in it valued at US$ 10.2 billion, increased to US$ 115.2 billion in 2013-14. The favorable balance in invisible account moderated the deficit in trade. Further, invisibles are sub-divided into three categories, i.e. services, transfers and income, shown in Table 3 in the Annex.

4.1.2. a) Services: A major boost has been witnessed in the Indian economy, chiefly attributed to the growth in exports as well as imports of services, occurred due to the opening up of this sector to both domestic and foreign private participation, since the introduction of reforms in 1991 (Bhat, 2011). Table 3 shows that the exports of services valued at US$ 151.5 billion in 2013-14 increased from US$ 7.5 billion in 1996-97. While, services imports increased to US$ 78.5 billion in 2013-14, increased from US$ 6.7 billion in 1996-97. However, this component remained continuously in surplus due to higher exports and comparatively less imports. Surplus in it valued at US$ 72.96 billion in 2013-14 from US$ 0.73 billion in 1996-97. For this period, services exports have grown 21.1 percent, while imports have registered 17.2 percent growth which was less than that of exports.

4.1.2. b) Transfers: The trade in transfer also had shown substantial increase, since exports increased at a rate of 13.3 percent during the study period, i.e. from US$ 12.9 billion in 1996-97 to US$ 70.4 billion in 2013-14. While, imports of services increased at a rate of 33.9 percent and valued at US$ 5.1 billion in 2013-14, increased from US$ 0.08 billion in 1996-97, reported in Table 3. However, overall trade balance was in surplus throughout the period. Surplus in it valued at US$ 65.28 billion in 2013-14, increased from US$ 12.78 billion of 1996-97.

4.1.2. c) Income: It is the only component of invisibles remained in deficit. Since, the exports of income valued at US$ 11.3 billion in 2013-14 increased from US$ 1.1 billion in 1996-97, the imports valued at US$ 34.4 billion in 2013-14 increased from US$ 4.4 billion in 1996-97, shown in Table 3. Even, the exports have shown more growth, i.e. 15.8 percent compared to 13.7 percent growth of imports, its trade balance remained in deficit, i.e. US$ 3.3 billion in 1996-97, moderately increased to US$ 4.5 billion in 2003-04 but, thereafter it went on increasing and valued at US$ 23.0 billion in 2013-14.

5. Empirical Results

The results of the ADF test, reported in Table 4, which shows that all the variables are non-stationary at level. However, after first difference, the variables are stationary. Hence, all the variables are integrated of order one, i.e. I(1). The numbers of augmenting lags are determined by minimizing on the basis of Schwartz Bayesian Information Criterion (SBIC).

5.1 Cointegration Test: First, the VECM lag length is selected on the basis of five alternate tests, viz. LR, FPE, AIC, SC and HQ, and all the five tests suggest that appropriate lag length must be equal to one. The study has selected the model with linear intercept and no trend. To know the cointegrated vectors among the multivariate system, Johansen proposed two statistics, i.e. Trace Statistic and Maximum Eigen Statistic and the results of these two statistics, reported in Table 5 and Table 6, determine that there are two cointegration equations in the system at five percent level of significance. This implies that GDP, NFA, OPEN, REER, and WPI influence the current account of India in the long-run.

Table 4: Results of Augmented Dickey Fuller Test (At level)

Variables	T-statistic	Critical values at 5%	Probability	Remarks
CA	-2.794519	-2.903566	0.0642	Non-Stationary
GDP	-0.463326	-2.904848	0.8912	Non-Stationary
NFA	-1.072025	-2.906210	0.7220	Non-Stationary
OPEN	0.504980	-2.904848	0.9858	Non-Stationary
REER	-2.498999	-2.903566	0.1201	Non-Stationary
WPI	4.520379	-2.904848	1.0000	Non-Stationary
At first difference				
ΔCA	-10.85257	-2.904198	**0.0001***	**Stationary**
ΔGDP	-15.18472	-2.904848	**0.0001***	**Stationary**
ΔNFA	-3.044381	-2.906210	**0.0360***	**Stationary**
ΔOPEN	-10.36865	-2.904848	**0.0001***	**Stationary**
ΔREER	-8.765192	-2.904198	**0.0000***	**Stationary**
ΔWPI	-6.305075	-2.904848	**0.0000***	**Stationary**

Source: *Author's calculations from the data given in Appendix*

Long-run Estimate of the Model

Table 5: Results of Johansen Cointegration Test (Trace statistic)

No. of Cointegrated Equations		Eigen Value	Trace Statistic	Critical Value at 5% level	Prob.**
Null Hypothesis	Alternate Hypothesis				
r =0*	r ≥ 1	0.662080	170.3874	95.75366	**0.0000**
r ≤ 1*	r ≥ 2	0.501806	95.52617	69.81889	**0.0001**
r ≤ 2	r ≥ 3	0.323998	47.44927	47.85613	0.0546
r ≤ 3	r ≥ 4	0.168756	20.43170	29.79707	0.3940
r ≤ 4	r ≥ 5	0.060671	70678275	15.49471	0.5004
r ≤ 5	r = 6	0.047524	3.359634	3.841466	0.0668

Source: *Author's calculations from the data given in Appendi.* ***Note:*** *'*' indicates rejection of the Null hypothesis at the 5% level and '**' indicates MacKinnon-Haug-Michelis (1999) p-values.*

Table 6: Results of Johansen Cointegration Test (Max Eigen statistics)

No. of Cointegrated Equations		Eigen Value	Max Eigen Statistic	Critical Value at 5% level	Prob.**
Null Hypothesis	Alternate Hypothesis				
r =0*	r ≥ 1	0.662080	74.86121	40.07757	**0.0000**
r ≤ 1*	r ≥ 2	0.501806	48.07690	33.87687	**0.0006**
r ≤ 2	r ≥ 3	0.323998	27.01757	27.58434	0.0590
r ≤ 3	r ≥ 4	0.168756	12.75343	12.13162	0.4752
r ≤ 4	r ≥ 5	0.060671	4.318641	14.26460	0.8243
r ≤ 5	r = 6	0.047524	3.359634	3.841466	0.0668

Source: *Author's calculations from the data given in Appendix.* ***Note:*** *'*' indicates rejection of the Null hypothesis at the 5% level and '**' indicates MacKinnon-Haug-Michelis (1999) p-values.*

The cointegrating vector is expressed in the equation below:

$$CA = 31.85 + 32.87\ x\ NFA - 0.77\ x\ REER - 1.91\ x\ OPEN + 1.35\ x\ WPI \ldots\ldots(9)$$

The signs of the estimated coefficients, reported in Table 7, of the variables need to be reversed while normalizing the cointegrationg coefficients, except that of the variable which is normalized.

Table 7: Long-run Relationship with respect to Current Account (Cointegrating Equation I)

Dependent Variable; Current Account				
Variables	**Coefficients**	**t-statistic**	**Probability**	**Remarks**
Current Account	1.0			
GDP	0.0			
NFA	-32.87636	-7.07	**0.000***	**Significant**
OPEN	1.918091	9.24	**0.000***	**Significant**
REER	0.7761361	3.87	**0.000***	**Significant**
WPI	-1.350001	-7.07	**0.000***	**Significant**
Constant	31.85794			

Source: *Author's calculations from the data given in Appendix.* ***Note:'*'*** *significant at the 5 % level*

The coefficients of NFA and WPI are positive and statistically significant in the equation (9). However, the value of the coefficient of NFA is greater than the coefficient value of WPI, i.e. the response of the current account to change in NFA is higher than the corresponding response of current account to change in WPI. Similar relationship between NFA and current account are found by Chinn and Prasad (2003) for industrial and developing countries. But, contradicts the results of Yang (2011) who found no long-run relationship between these two variables in context of India. Regarding the relationship of WPI to the current account, similar results were obtained by Sobrino (2010), who found a negative relationship between inflation targeting policies and the current account. However, trade openness and REER have a significant negative relationship with the current account. But the coefficient value of trade openness is greater than that of the REER's coefficient value. Similar findings were observed by Chinn and Prasad (2003) for developing countries and by Yang (2011) for India and also coincide with the results of Chinn, Eichengreen and Ito (2012) that the degree of trade openness among developing countries is negatively related to the current account. Sarkar (1994) also observed the same, in context of India.

5.2 Results of Vector Error Correction Model (Short-run)

The results of VECM in Table 8 show that the coefficient of the ECT is correctly signed, i.e. negative and also statistically significant at the 5 percent level of significance.

Table 8: Results of Short-Run Relationship. Dependent Variable: Current Account

Variables	**Coefficient**	**St. error**	**t-statistic**	**Probability**	**Significant**
ECT-1	-0.346305	0.148623	-2.330083	**0.0232***	**Yes**
ECT-2	-0.112023	0.036890	-3.036671	**0.0035***	**Yes**
D (GDP)	0.113172	0.059224	1.910899	**0.0608****	**Yes**
D (NFA)	-0.137355	0.101669	-1.351004	0.1818	Not
D (OPEN)	0.056879	0.151607	0.375173	0.7089	Not
D (REER)	0.670592	0.267678	2.505223	**0.0150***	**Yes**
D (WPI)	-0.436777	0.389873	-1.120306	0.2670	Not

Source: *Author's calculations from the data given in Appendix.* ***Note:*** *'*' significant at the 5 % level and '**' significant at the 10 % level.*

This also indicates that there exists a long-run relationship among the variables. The estimated ECT-1 is -0.34 and ECT-2 is -0.11, indicates the speed of convergence, of the current account and GDP towards their long-run equilibrium.
However, the overshooting of adjustment for the current account is slightly greater than that of the GDP. Empirical result of VECM indicates that NFA, OPEN and WPI are not statistically significant. Only REER (at the 5 percent) and GDP (at the ten percent) are statistically significant and both have a positive relation with the current account.

5.3 Granger Causality Test

The results reported in Table 9 shows that there is bidirectional causality between CA and GDP, NFA and GDP, and OPEN and GDP. But, between NFA and CA, OPEN and CA, WPI and CA, and CA and REER there is unidirectional causality.

Table 9: Results of Granger Causality Test

Null Hypothesis:	F-Statistic	Prob.	Remarks
GDP does not Granger Cause CA	9.48940	**0.0030***	**Bidirectional**
CA does not Granger Cause GDP	4.46547	**0.0383***	
NFA does not Granger Cause CA	6.49580	**0.0131***	**Unidirectional**
CA does not Granger Cause NFA	0.94065	0.3356	
OPEN does not Granger Cause CA	13.2528	**0.0005***	**Unidirectional**
CA does not Granger Cause OPEN	0.19690	0.6587	
REER does not Granger Cause CA	0.1375	0.9070	**Unidirectional**
CA does not Granger Cause REER	2.91032	**0.0926****	
WPI does not Granger Cause CA	11.4124	**0.0012***	**Unidirectional**
CA does not Granger Cause WPI	2.11588	0.1504	
NFA does not Granger Cause GDP	25.0928	**0.0000***	**Bidirectional**
GDP does not Granger Cause NFA	12.8164	**0.0006***	
WPI does not Granger Cause GDP	12.0072	**0.0009***	**Unidirectional**
GDP does not Granger Cause WPI	0.28149	0.5975	
OPEN does not Granger Cause GDP	20.4876	**0.0000***	**Bidirectional**
GDP does not Granger Cause OPEN	38.6455	**0.0000***	
REER does not Granger Cause GDP	2.36558	0.1287	**Unidirectional**
GDP does not Granger Cause REER	3.90119	**0.0524****	
WPI does not Granger Cause NFA	0.39944	0.5295	None
NFA does not Granger Cause WPI	0.05104	0.8219	
OPEN does not Granger Cause NFA	0.02208	0.8823	None
NFA does not Granger Cause OPEN	0.86041	0.3570	
REER does not Granger Cause NFA	1.22832	0.2717	None
NFA does not Granger Cause REER	0.58379	0.4475	
OPEN does not Granger Cause WPI	1.43961	0.2344	**Unidirectional**
WPI does not Granger Cause OPEN	19.57437	**0.0000***	
REER does not Granger Cause WPI	0.00077	0.9780	None
WPI does not Granger Cause REER	2.57437	0.1133	
REER does not Granger Cause OPEN	2.17966	0.1445	None
OPEN does not Granger Cause REER	0.84225	0.3620	

Source: *Author's calculations from the data given in Appendix.* ***Note:*** *ER is the exchange rate,'*' indicates rejection of the null hypothesis at the 5 per cent level of significance and'**' indicates rejection of the null hypothesis at the 10 per cent level of significance.*

Uz (2010) also found a positive relationship between exchange rate and current account in the case of Turkey, and Aristovnik (2006) also founded a similar relationship in the case of Eastern Europe and the Former Soviet Union.This result of the study contradicts the Sarkar (1994), who found no relationship between exchange rate and balance of trade and payments. But it supports the standpoint of the Mirchandani (2013), Rajwade (2013) Satsang and Sangar (2013) in context of India. Further, similar results were found in the case of other developing countries, as reflected in Joshi and Little (1993) that manipulations in the exchange rate cause the balance of trade and payments, and is also justified by Nicita (2013), as she mentioned that if the exchange rate accompanied by misalignments will lead to inverse relationship rather than positive. Further, between WPI and CA, and WPI and OPEN there exists a unidirectional causality. However, GDP Granger causes REER at the 10 percent level of significance. The results in Table 10 indicate that there is no problem of serial correlation and heteroscedasticity.

Table 10: Results of Diagnostic Tests

Serial Correlation Test Breusch-Godfrey serial correlation LM test	F-statistic = 2.507103	Probability = 0.1187
Autoregressive Heteroscedasticity Test (ARCHTest)	F-statistic = 0.857880	Probability = 0.3577

Source: *Author's calculations from the data given in Appendix.* ***Note:*** *'*'rejection of the null hypothesis*

6. Conclusion

The analysis of current account indicates that there was a significant increase in trade, during the study period, but remained in deficit. There are mainly two reasons behind this increasing deficit in trade. First is the rising level of imports due to the broad based tariff reduction exercise undertaken by India with abolishment of import licensing in 1991 on all intermediate inputs and capital goods. Though, it resulted in upheaval of capital flows accompanied by a rapid built up of foreign exchange due to ease restrictions on foreign direct investment (FDI) and portfolio investment, but at the same time raised the overall levels of imports. Secondly, India was unable to provide momentum to its export growth. However, the contributions of services exports and transfers have kept the CAD from assuming the unmanageable proportions and provide the life line for the current account of India. Empirical results shows that the application of Johansen Cointegration test indicate the existence of long-run equilibrium relationship between the current account and GDP, NFA, OPEN, REER, and WPI, implying that India's current account is influenced by these factors. The results of VECM test validated the existence of long-run equilibrium relationship, as its error term is correctly signed (i.e. negative) and statistically significant. Results of the present study regarding the behavior of the determinants of current account are primarily coherent with the theoretical as well as previous empirical analysis.

7. Suggestions

The study suggests that in order to reduce the deficit in the current account, earnings from invisibles trade should be further increased as the trends of the invisibles trade indicate enormous improvement, especially in services and transfers, throughout the study period. Therefore, the government should invest more in the development of transportation industry, tourism and miscellaneous services. As, adequate infrastructural facilities create a positive environment for making a country more attractive destination accenting its miscellanea and competitiveness.

The study found a negative relationship between exchange rate and current account in the long-run. It implies that despite the depreciation of Indian exchange rate, its exports are not taking advantage in the market, indicating misalignment of exchange rate. Thus, in order to mitigate this misalignment, competitiveness of exports is certainly required.The present study found a positive relationship between WPI and the current account of India and thus, suggests that increase in CAD should not lead to an inflation targeting. Because such targeting leads to fall in domestic real interest rates, output growth and inflation (as found by Sobrino, 2010) which further leads to fall in private savings and increase in investment and as a result of this, the current account further worsens.On the basis of the empirical results of this study, it can be concluded that continuously increasing NFAs will lead to the betterment of the current account while, increase in imports encompassing exchange rate deterioration will keep on mounting pressure on CAD of India.

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APPENDIX

Table 1. Determinants of the Current Account Deficit

Year	OPEN (% of GDP)	Current Account (US$ Bn)	GDP (US$ Bn)	REER	WPI	NFA (% of GDP)
1996Q2	22.71	-2.3	124.1	36.51	66.8	14.48
1996Q3	23.95	-1	114.7	36.73	69	17.29
1996Q4	19.27	-1.3	146.5	35.75	70	14.87
1997Q1	22.11	-0.1	144	35.58	70.4	16.55
1997Q2	24.6	-1.4	122.2	36.65	70.8	20.6
1997Q3	25.45	0.2	119.2	34.51	71.6	23
1997Q4	21.17	-1.8	147.5	35.73	73	18.76
1998Q1	23	-2.6	138	39.85	74.1	19.81
1998Q2	26.14	-2.1	115.6	44.12	75.5	22.13
1998Q3	28.58	-1	109.2	45.63	77.6	25.14
1998Q4	21.63	-1.2	137.2	44.82	78.5	21.41
1999Q1	24.48	0.3	135.1	45.68	77.8	23.24
1999Q2	25.77	-1.6	120.9	46.04	78.3	26.53
1999Q3	30.21	-1	113.7	46.2	79.5	28.29
1999Q4	25.36	-1	138.7	45.39	80.7	24.92
2000Q1	28.37	-1.2	140.1	45.07	80.2	26.59
2000Q2	31.89	-2.6	118.3	46.85	81.2	29.1
2000Q3	33.16	-1.6	115.8	45.91	82.1	30.26
2000Q4	28.92	0.8	140.8	43.67	84.4	29.55
2001Q1	30.9	0.8	133.4	46.61	84.7	31
2001Q2	34.76	1.1	120.3	47.62	85.6	34.81
2001Q3	33.29	-1	117.2	47.34	86.2	38.03
2001Q4	26.99	0.5	141.4	47.33	86.6	34.46
2002Q1	29.78	2.8	136.1	49.05	86.1	38.74
2002Q2	33.85	1.1	125.6	50.68	87.1	46.05
2002Q3	37.47	1.8	120.2	51.43	89	51.17
2002Q4	33.49	1.4	137.7	51.5	89.4	49.48
2003Q1	35.83	2	143.5	50.64	90.5	50.72
2003Q2	34.62	-0.4	140.4	48.26	92.5	59.14
2003Q3	38.77	3.2	138.4	47.2	93	63.56
2003Q4	36.96	4	159.4	48.7	94.3	60.87
2004Q1	39.26	7.4	163.8	46.99	95.8	66.84
2004Q2	42.3	3.6	153.9	45.94	97.5	78.02
2004Q3	47.79	-4.4	148.1	47.33	100.4	78.18
2004Q4	46.66	-5.8	175.9	45.72	101	71.68
2005Q1	50.85	4.1	184.8	43.37	100.8	75.87
2005Q2	54.58	-4.8	166.3	44.57	102.6	79.04
2005Q3	54.52	-4.7	170.4	41.71	104.5	83.44
2005Q4	51.54	-4.9	198.6	42.21	105.5	74.16
2006Q1	56.59	4.5	200.7	42.21	104.9	74.89
2006Q2	61.75	-4.4	184	45.79	107.4	89.13
2006Q3	68.35	-5.7	176.9	47.54	109.8	91.44
2006Q4	59.82	-3.6	208.4	44.26	111.4	81.9

Contd…

Year	OPEN (% of GDP)	Current Account (US$ Bn)	GDP (US$ Bn)	REER	WPI	NFA (% of GDP)
2007Q1	61.98	4.2	221.5	43.03	111.6	87.73
2007Q2	60.08	-4.5	229	36.35	113.2	94.72
2007Q3	68	-4.3	220.6	36.96	114.3	109.07
2007Q4	66.8	-3.5	251.1	37.76	115.2	103.25
2008Q1	71.39	-3.4	266.9	37.3	118	115.38
2008Q2	99.25	-3.4	199.8	47.56	124	136.57
2008Q3	96.97	-12.3	220	43.51	128.6	139.18
2008Q4	66.77	-11.9	263	43.51	125.1	108.26
2009Q1	68.35	-0.4	225.8	53.28	121.8	113.06
2009Q2	72.14	-4.2	221.7	50.44	124.7	121.45
2009Q3	79.89	-9.2	221.5	52.11	128.5	121.73
2009Q4	78.31	-12.2	239.5	50.64	131.3	107.84
2010Q1	77.68	-12.6	264.6	45.5	134.2	98.45
2010Q2	81.96	-13.4	257.8	42.92	138.6	104.41
2010Q3	86.85	-17.2	249.7	45.72	141.2	108.54
2010Q4	88.81	-11.2	278.3	43.73	144.2	99.22
2011Q1	90.45	-6.2	294.1	43.04	148.5	96.76
2011Q2	114.16	-17.5	244.4	48.17	152.5	105.97
2011Q3	104.01	-18.9	271.4	43.84	155.1	117.14
2011Q4	91.39	-20	302.5	46.29	157.2	110.08
2012Q1	106.56	-21.8	280.1	50.9	159.7	100.78
2012Q2	115.73	-17.1	240.1	52.59	164	118.54
2012Q3	117.22	-21.1	235.3	52.83	167.3	115.61
2012Q4	112.39	-31.8	260.9	50.56	168.7	114.2
2013Q1	111.39	-18.2	271.5	50.26	170.4	108.28
2013Q2	129.37	-21.8	219.3	58.31	172	130.51
2013Q3	128.4	-5.2	219.5	61.67	178.4	130.72
2013Q4	106.16	-4.1	263.9	54.38	180.6	108.9

Source: (*GDP, OPEN and REER) Handbook of Statistics on Indian Economy, RBI, 2014, (NFA) International Monetary Fund's International Financial Statistics and (WPI) Official Website of the Economic Advisor, Ministry of Commerce and Industry, Government of India.*

Table 2: India's Merchandise Trade and Invisibles Trade (US$ Billions current)

Year	Merchandise						Invisibles					
	Exports	Growth %	Imports	Growth %	Trade Balance	Growth %	Exports	Growth %	Imports	Growth %	Trade balance	Growth %
1996-97	34.13	-	48.95	-	-14.82	-	21.41	-	11.21	-	10.20	-
1997-98	35.68	4.53	51.19	4.57	-15.51	4.7	23.24	8.6	13.24	18.1	10.01	-1.8
1998-99	34.30	-3.87	47.54	-7.12	-13.25	-14.6	25.77	10.9	16.56	25.1	9.21	-8.0
1999-00	37.54	9.46	55.38	16.49	-17.84	34.7	30.31	17.6	17.17	3.7	13.14	42.7
2000-01	45.45	21.07	57.91	4.57	-12.46	-30.2	32.27	6.4	22.47	30.9	9.79	-25.5
2001-02	44.70	-1.65	56.28	-2.82	-11.57	-7.1	36.74	13.9	21.76	-3.2	14.97	52.9
2002-03	53.77	20.29	64.46	14.55	-10.69	-7.6	41.93	14.1	24.89	14.4	17.04	13.8
2003-04	66.29	23.27	80.00	24.10	-13.72	28.3	53.51	27.6	25.71	3.3	27.80	63.2
2004-05	85.21	28.54	118.91	48.63	-33.70	145.7	69.53	29.9	38.30	49.0	31.23	12.3
2005-06	105.15	23.41	157.06	32.08	-51.90	54.0	89.69	29.0	47.69	24.5	42.00	34.5
2006-07	128.89	22.57	190.67	21.40	-61.78	19.0	114.56	27.7	62.34	30.7	52.22	24.3
2007-08	166.16	28.92	257.63	35.12	-91.47	48.0	148.88	30.0	73.15	17.3	75.73	45.0
2008-09	189.00	13.74	308.52	19.75	-119.52	30.7	167.82	12.7	76.21	4.2	91.60	21.0
2009-10	182.44	-3.47	300.64	-2.55	-118.20	-1.1	163.43	-2.6	83.41	9.4	80.02	-12.6
2010-11	256.16	40.41	383.48	27.55	-127.32	7.7	190.49	16.6	111.22	33.3	79.27	-0.9
2011-12	309.77	20.93	499.53	30.26	-189.76	49.0	219.23	15.1	107.63	-3.2	111.60	40.8
2012-13	306.58	-1.03	502.24	0.54	-195.66	3.1	224.04	2.2	116.55	8.3	107.49	-3.7
2013-14	318.61	3.92	466.22	-7.17	-147.61	-24.6	233.23	4.1	118.02	1.3	115.21	7.2
Compound Growth Rate	**16.8**	**(14.8)***	**18.1**	**(15.3)***	-	**(20.0)***	**17.6**	**(15.5)***	**16.3**	**(15.7)***	**19.2**	**(17.9)***

Source: *Handbook of Statistics on Indian Economy, RBI, 2014.*

Note: *Figures in parentheses with '*' indicate average of percentage changes.*

Table 3: Components of Invisibles Trade (US$ Billions)

Year	Services				Transfers				Income			
	Exports	Growth %	Imports	Growth %	Exports	Growth %	Imports	Growth %	Exports	Growth %	Imports	Growth %
1996-97	7.47	-	6.75	-	12.86	-	0.08	-	1.07	-	4.38	-
1997-98	9.43	26.2	8.11	20.2	12.25	-4.7	0.05	-44.4	1.56	45.5	5.08	16.0
1998-99	13.19	39.8	11.02	35.9	10.65	-13.1	0.06	37.8	1.94	24.0	5.48	7.8
1999-00	15.71	19.1	11.65	5.7	12.67	19.0	0.03	-45.2	1.93	-0.2	5.49	0.2
2000-01	16.27	3.6	14.58	25.2	13.32	5.1	0.21	520.6	2.68	38.9	7.69	40.0
2001-02	17.14	5.4	13.82	-5.2	16.22	21.8	0.36	71.6	3.38	26.0	7.59	-1.3
2002-03	20.76	21.1	17.12	23.9	17.64	8.8	0.80	121.5	3.52	4.2	6.97	-8.1
2003-04	26.87	29.4	16.72	-2.3	22.74	28.9	0.57	-28.4	3.90	10.8	8.41	20.7
2004-05	43.25	61.0	27.82	66.4	21.69	-4.6	0.91	57.8	4.59	17.6	9.57	13.8
2005-06	57.66	33.3	34.49	24.0	25.62	18.1	0.93	3.0	6.41	39.5	12.26	28.1
2006-07	73.78	28.0	44.31	28.5	31.47	22.8	1.39	49.1	9.31	45.3	16.64	35.7
2007-08	90.34	22.4	51.49	16.2	44.26	40.6	2.32	66.4	14.27	53.3	19.34	16.2
2008-09	105.96	17.3	52.05	1.1	47.55	7.4	2.75	18.7	14.31	0.3	21.42	10.7
2009-10	96.05	-9.4	60.03	15.3	54.36	14.3	2.32	-15.7	13.02	-9.0	21.06	-1.7
2010-11	124.64	29.8	80.55	34.2	56.27	3.5	3.12	34.8	9.59	-26.4	27.54	30.8
2011-12	142.32	14.2	78.23	-2.9	66.76	18.7	3.27	4.5	10.14	5.8	26.13	-5.1
2012-13	145.68	2.4	80.76	3.2	68.09	2.0	4.06	24.2	10.28	1.3	31.73	21.4
2013-14	151.48	4.0	78.51	-2.8	70.40	3.4	5.13	26.4	11.35	10.5	34.38	8.3
Compound Growth Rate	**21.1**	**(20.4)***	**17.2**	**(16.9)***	**13.3**	**(11.3)***	**33.9**	**(19.5)***	**15.8**	**(16.9)***	**13.7**	**(13.7)***

Source: *Handbook of Statistics on Indian Economy, RBI, 2014.*

Note: *Figures in parenthesis s with '*' indicates an average percentage change.*

Methodology

I) Stationary Testing Procedures

The objective of the study is to examine the causal relationship among the variables of interest and for this purpose, the cointegration and error correction regression among the time series quarterly data is applied. But, before applying cointegration test, the Augmented Dickey Fuller (ADF) test (Dickey and Fuller, 1979) is applied to avert the problem of specious regression, which shows a significant relationship between the variables among which no relationship is expected. For this, Y_t (Dependent variable) is regressed on y_{t-1} after taking the differences. If, the slope coefficient, estimated in this regression$(= \hat{\delta})$, is zero then Y_t is non-stationary and if it is negative then it is concluded that Y_t is stationary. The general framework of the ADF test consists of the following equation:

$$\Delta Y_t = \beta_0 + \beta_{1,t} + \delta Y_{t-1} + \sum_{i=1}^{q} \beta_i \Delta Y_{t-i} + \varepsilon_t \ldots\ldots(2)$$

Where, $\Delta Y_t = Y_t - Y_{t-1}$, β_0 is the constant or drift, t is the time or trend value and ε_t is the white noise error term. While $\Delta Y_{t-1} = (Y_{t-1} - Y_{t-2})$, $\Delta Y_{t-2} = (Y_{t-2} - Y_{t-3})$. This test is estimated in three different forms due to the possibilities that a random walk process may have.

Y_t is a random walk: $\Delta Y_t = \delta Y_{t-1} + \varepsilon_t \ldots\ldots\ldots(2.1)$

Y_t is a random walk with drift (intercept):

$$\Delta Y_t = \beta_t + \delta Y_{t-1} + \sum_{i=1}^{q} \beta_i \Delta Y_{t-i} + \varepsilon_t \ldots\ldots\ldots(2.2)$$

Y_t is a random walk with drift around a deterministic trend

$\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + \varepsilon_t \ldots\ldots\ldots(2.3)$

$H_0: \delta = 0$ (i.e. the time series is non-stationary), $H_1: \delta < 0$ (i.e. the time series is stationary).

II) Cointegration Procedure

For testing the cointegration, two broad based approaches have been developed. The first approach, on assessing whether the single equation estimates of the equilibrium error appear to be stationary, developed by Engle and Granger (1987). Second is Vector Auto-Regression (VAR) approach developed by Johansen (1988). Johansen test simultaneously determine the number of co-integrated equations in the system in the long-run and provide coefficients of the long run causality (Gujarati et al 2012). In the VAR of order p, its starting point is given by

$$Y_t = \mu + \prod_1 Y_{t-1} + \prod_2 Y_{t-2} + \ldots\ldots + \prod_p Y_{t-p} + \varepsilon_t \ldots\ldots(3)$$

In equation (3) $Y_t = (CA_t, GDP_t, NFA_t, OPEN_t, REER_t, WPI_t)$ and is a $6\ X\ 1$ vector of variables, integrated of order one, i.e. I(1) and ε_t is an $6\ X\ 1$ matrix of Gaussian errors.

While, $\prod_1$ through $\prod_p$ are $6\ X\ 6$ coefficient matrices and μ is a constant term. The

equation (3) contains unit root and can be parameterized by subtracting both sides with Y_{t-1} and the equation will be;

$$\Delta Y_t = \mu + \Gamma_1 \Delta Y_{t-1} + \Gamma_2 \Delta Y_{t-2} + \ldots\ldots + \Gamma_p \Delta Y_{t-p} - \prod_p Y_{t-p} + \varepsilon_t \ldots\ldots (3.1)$$

In equation (3.1) ΔY_t indicates the first differenced Y_t $(i.e., \Delta Y_t = Y_t - Y_{t-1})$, $\Gamma_1 = \prod_1 - I, \Gamma_2 = \prod_1 - \Gamma_1, \Gamma_3 = \prod_2 - \Gamma_2$ and $\prod = I - \prod_1 - \prod_2 - \ldots\ldots - \prod_p$, where I is identity matrix. The matrix $\prod$ is called the impact matrix and determines the extent to which the system is cointegrated. By rearranging the equation (3.1) we get;

$$\Delta Y_t = \mu + \prod_{t-p} Y_{t-p} + \sum_{i=1}^{m-1} \Gamma_i \Delta Y_{t-i} + \beta \mu_t + \varepsilon_t \ldots\ldots (3.2)$$

Where, Y is a p-dimensional process and $\prod, \Gamma i's$ are $p \; X \; p$ parametric matrices. While μ_t contains a linear trend, constant and seasonal dummies which are deterministic terms and β contains the parameters associated with μ_t (Johansen, 1991). The vector process Y_t is stationary, if Rank $\left(\prod\right) = n$. If, Rank $\left(\prod\right) = 0$, then there is no cointegration among the variables and if, $0 <$ rank $\left(\prod\right) = r < n$, this implies that there are $n \; X \; r$ cointegrating vectors.

The procedure of Johansen cointegration is to decompose $\prod$ into two matrices α and β both of which are $n \; X \; r$, such that $\prod = \alpha\beta$. The rows of α, also known as the adjustment coefficients, show how this cointegrating vector is loaded into each equation in the system and the rows of β may be defined as the r distinct cointegrating vector. There may be $0 < r < n$ linearly independent cointegrating vectors so that $n \; X \; 1$ vector Y_t is cointegrated. This test employs two likelihood ratios (LR) test statistics to know the number of cointegrating vectors and the two statistics are:

One is trace test (J_{trace}) and the other is maximum eigenvalue (λ_{max}) test.

$$J_{trace} = -T \sum_{i=r+1}^{N} In\left(1 - \hat{\lambda}_i\right) \ldots\ldots (3.3)$$

$$\lambda_{max} = TIn\left(1 - \hat{\lambda}_{r+1}\right) \ldots\ldots (3.4)$$

Where $\hat{\lambda}_i$ is the estimated value for the *i*thordered eigenvalue from the matrix $\prod$ and T is the number of effective observations. Trace test is marked as a joint test where, the null hypothesis, (i.e. the number of cointegrating vectors is less than or equal to r), against the alternative hypothesis, (i.e. there are more than r) is tested. Whereas, separate tests are conducted by the maximum Eigen value test on the individual Eigen values. Under this test, the null hypothesis is that the number of cointegrating vectors is r , against the alternative one of $(r+1)$.

III) Vector Error Correction Model

Sargan (1984) firstly used Error Correction Mechanism (ECM) and then popularized by Engle and Granger (1987). The purpose of the VECM is to focus on the short-run dynamics of the endogenous variables and reveal information beyond the long-run relationship. The basic structure of an error correction model systems as follows:

$$\Delta Y_t = \alpha + \beta_0 \Delta X_{t-1} + \beta_1 ECT_{t-1} + \varepsilon_t \ldots\ldots (4)$$

Where, the first difference is denoted by Δ , ε_t is random error and ECT is the model's error correction term which measures the speed of correcting prior deviations from equilibrium (Ahmed and Singla, 2014).

$$[\Delta CA]_t = \alpha_0 + \sum_{i=1}^{m} [\beta_{1i}(1,i)\,[\Delta CA]_{t-i}] + \sum_{i=1}^{n} [\beta_{2i}(2,i)\,[\Delta GDP]_{t-i}] + \sum_{i=1}^{o} [\beta_{3i}(3,i)\,[\Delta NFA]_{t-i}] + \sum_{i=1}^{p} [\beta_{4i}(4,i)\,[\Delta OPEN]_{t-i}] + \sum_{i=1}^{q} [\beta_{5i}(5,$$

Δ is lag operator, estimated coefficients are α_0, $\beta's$ while, m, n, o, p, q and r, are the optimal lags of the series CA, $OPEN$, NFA , GDP , $REER$, and WPI . Since, ε_{1t} is uncorrelated random error terms, dependent variable's single period response is measured by μ_1 to deviate from equilibrium.

Where, ECT_{t-1} is the error correction term and

$$ECT_{t-1} = CA_{t-1} - \beta_1 CA - \beta_2 GDP - \beta_3 NFA - \beta_4 OPEN - \beta_5 REER - \beta_6 WPI$$

IV) Granger Causality Test

Granger (1969) and Sims (1972) introduced the Granger Causality test to the question, i.e. whether *X* causes *Y* and then to see whether the explanation can be improved by adding lagged values of *X*. If the coefficients are statistically significant on the lagged *X's* or *X* assists in the prediction of *Y*, then *Y* is said to be granger caused by *X*. The frequent case is the two-way causation, i.e. '*Y* Granger causes *X*' and '*X* Granger causes *Y*. The test estimates the following pair of equations:

$$Y_t = \sum_{i=1}^{n} \alpha_i X_{t-i} + \sum_{j=1}^{n} \beta_j Y_{t-j} + u_{1t} \ldots\ldots (5)$$

$$X_t = \sum_{i=1}^{n} \pi_i Y_{t-i} + \sum_{j=1}^{n} \delta_j Y_{t-j} + u_{2t} \ldots\ldots (6)$$

Where, disturbances u_{1t} and u_{2t} are assumed to be uncorrelated. In the above equations, since two variables, viz., *X* and *Y* have been taken for instance, shows dealing with bilateral causality. Equation (5) postulates the relation of *Y* to the past values of itself as well as that of *X*, and a similar behavior of *X* is postulated by equation (6).

V) Diagnostic Statistics

V. a) The Breusch-Godfrey Test

This test is used to check the presence of serial dependence that has not been included in a proposed model structure and presence of which, results in misleading inferences (Belsley, 1997). The study makes use of the residuals from regression analysis and derived the test statistics, in order to perform this test.

$$CA_t = \alpha + \beta_1 GDP + \beta_2 NFA + \beta_3 OPEN + \beta_4 REER + \beta_5 WPI + \varepsilon_t \ldots\ldots(7)$$

Assuming that ε_t follows the *p*th-order autoregressive AR (*p*), schemes as follows:

$$\varepsilon_t = \alpha + \mu_1 \varepsilon_{t-1} + \mu_2 \varepsilon_{t-2} + \ldots\ldots + \mu_p \varepsilon_{t-p} + v_t \ldots\ldots(7.1)$$

Substituting the expression for ε_t into the regression equation (7), we get

$$CA_t = \alpha + \beta_1 GDP + \beta_2 NFA + \beta_3 OPEN + \beta_4 REER + \beta_5 WPI + \mu_1 \varepsilon_{t-1} + \mu_2 \varepsilon_{t-2} + \ldots\ldots +$$

v_t is white noise error term. To test autocorrelation in ε_t, the hypotheses are;

$H_0 = \mu_1 + \mu_2 + \ldots\ldots + \mu_p = 0$ (i.e. all coefficients of ε_t are equal to zero)

$H_1 = \mu_1 + \mu_2 + \ldots\ldots + \mu_p \neq 0$ (i.e. all coefficients of ε_t are not equal to zero)

V. b) ARCH Test

Engle (1982) devised the test for an Auto Regressive Conditional Heteroscedasticity (ARCH) effect. It is also a residual based test and used to check the heteroscedasticity that has not been included in a proposed model structure.

$$\varepsilon_t = \alpha_1 \varepsilon_{t-1} + \alpha_2 \varepsilon_{t-2} + \ldots\ldots + \alpha_p \varepsilon_{t-p} \ldots\ldots(8)$$

Where ε_t is residual from the model and P lags are included in this secondary regression.

$H_0 = \alpha_1 + \alpha_2 + \ldots\ldots + \alpha_p = 0$ (The variances of disturbances are constant).

$H_0 = \alpha_1 + \alpha_2 + \ldots\ldots + \alpha_p \neq 0$ (The variances of disturbances are not constant).