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Manoranjan Sahoo, M. Suresh Babu, Umakant Dash

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Dynamic relationship between fiscal deficit and current account deficit in India: multivariate cointegration and causality analysis

Manoranjan Sahoo*

School of Humanities,
Kalinga Institute of Industrial Technology (KIIT)
Deemed to be University,
Bhubaneswar-751024, Odisha, India
Email: msahoo100@gmail.com
*Corresponding author

M. Suresh Babu

Department of Humanities and Social Sciences,
Indian Institute of Technology Madras
Chennai-600036, Tamil Nadu, India
Email: sureshbabum@iitm.ac.in

Umakant Dash

Institute of Rural Management Anand (IRMA),
Post Box No. 60, Anand-388001,
Gujarat, India
Email: umakant@irma.ac.in

Abstract: This study examines the dynamic relationship between fiscal balance and current account balance and also tests the 'twin deficit' hypotheses for India using quarterly data from 1996q1 to 2016q1. Empirical results support the existence of the twin deficit hypothesis and also suggest a reverse causality running from the current account balance to fiscal balance. These results have important policy implications for maintaining a lower current account deficit and fiscal deficit for India in the long run.

Keywords: fiscal deficits; current account deficits; CADs; Granger causality test; twin deficit hypothesis; India.

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Biographical notes: Manoranjan Sahoo is an Assistant Professor at the School of Humanities, Kalinga Institute of Industrial Technology Deemed to be University, Bhubaneswar, Odisha, India. His research interests are current account deficit, international capital mobility, oil price shocks and its linkages with other macroeconomic variables.

M. Suresh Babu is a Professor at the Department of Humanities and Social Sciences, Indian Institute of Technology Madras, India. His main research interests are applied macroeconomics, industrial economics, trade and development.

Umakant Dash is the Director of the Institute of Rural Management Anand (IRMA). Prior to joining IRMA, he was a Professor and the Head of the Department of H&SS, Indian Institute of Technology, Madras and an Adjunct Professor at the Indian Institute of Management Tiruchirappalli. He has been working in the areas of macroeconomics, financial economics, health economics, financial management, energy economics, and derivative markets.

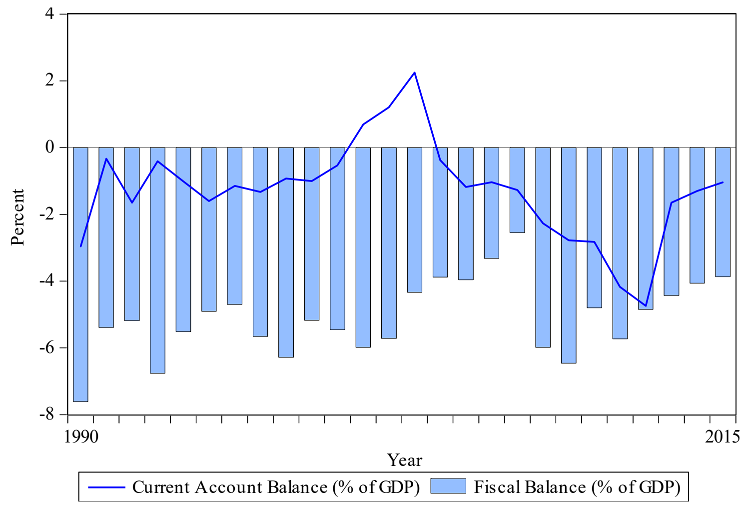
1 Introduction

Over the last few years, the Indian economy has experienced deterioration in its current account balance (CAB) and fiscal balance (FB). The global financial crisis of 2007–2008 contributed to the worsening of the current account deficit (CAD) and fiscal deficit (FD), as well as the depreciation of the Indian rupee and growing inflation in the domestic economy. Several measures have been tried to curb the rising FD, although they have not always been successful. Because of the continuous rise in the FD, the central government passed the fiscal responsibility and budget management (FRBM) act in 2003, with the goal of lowering the FD to 3% of GDP by March 2008. The target of such policy failed when the world economy faced the serious global financial crisis in the year 2007–2008 and then on, it has been a challenge for policymakers to keep FD low. As the Indian economy is facing continuous problems due to a rise in both the deficits, this motivates us to examine the linkages between the two variables.

The well-known twin deficit hypothesis argues that the increase in FD leads to an increase in the CAD. However, such an argument has refuted by several empirical studies which found that it is not FD that causes CAD; rather the reverse is more consistent (Anoruo and Ramchander, 1998; Kim and Kim, 2006; Bose and Jha, 2011). In this context, our main objective is to test the validity of the 'twin deficit hypotheses', and examine whether any instability in the external sector plays an important role in influencing the fiscal policy formulation in India.

The government sector in India comprises centre, state, and local governments. However, the government at the centre accounts for the bulk of public spending and revenue raising. In a federal set-up, fiscal deterioration of the state/sub-national governments spills over to the centre. Due to the intervention of the central government, the FB improved during early 2000, it again deteriorated to a greater extent since the global financial crisis in 2007–2008 (as shown in Figure 1). This was mainly because of the introduction of fiscal stimulus packages in order to tackle the severity of the crisis. Similarly, the CAB also started to widen at an increasing rate after the crisis mainly because of the fall in exports accompanied by high domestic inflation and depreciation of the domestic currency, which made import more costly.

Figure 1 The trends in CAB and FB, 1990–2015 (see online version for colours)



Source: Handbook of Statistics on Indian Economy, Reserve Bank of India

Figure 1 presents the trend in CAB and FB during the period of 1990 to 2015. After the balance of payment crisis in 1990–1991, several measures were undertaken to tackle the severity of the crisis. Such measures were an integral part of the new economic policy of 1991. After a series of policies during 1991, both CAB and FB started improving. The difference in the trends of both CAB and FB during the period from 1998 to 2003 was considerable. Surprisingly, the economy maintained a positive CAB (i.e., current account surplus) during the year 2001 to 2003 while FB was still having a negative balance (i.e., FD). During 2004 to 2007, CAB deteriorated while FB improved. Further, after the global financial crisis of 2007–2008 till 2012–2013, both CAB and FB deteriorated together. During 2012–2013, the CAD of India reached around 4.7% of GDP from 1.3% of GDP in 2007–2008. On the other hand, the FD also increases from 2.54% of GDP in 2007–2008 to 4.85% of GDP in 2012–2013. Recently, after 2012–2013, both CAB and FB improved sharply. The last phase could be because of the low international crude oil price. We might presume that changes in the external sector (positive or negative) may affect the government's fiscal policy based on the basic trend analysis, underlining the need of a more recent empirical investigation of the link between two variables.

A plethora of studies have examined the twin deficit hypothesis in the context of developed economies. However, in the context of developing economies, the literature is limited and the results are mixed. While some of the studies found that the budget deficit (BD) causes the trade deficit (TD) (Abell, 1990; Normandin, 1999), others found that TD causes the BD (Kim and Kim, 2006; Anoruo and Ramchander, 1998). Recently, Ravinthirakumaran et al. (2016) examined the validity of the twin deficit hypothesis in the context of SAARC economies for the period of 1980 to 2012. The authors report mixed results of causality between the BD and TD. Their results validated the existence of twin deficit hypothesis (i.e., BD causes TD) only in the case of Pakistan and Sri Lanka. Further, they found unidirectional reverse causality from TD to BD for India, Bangladesh, and Nepal, and showed that in the case of India, there is no long-run relationship between BD and TD.

Parikh and Rao (2006), Bose and Jha (2011) and Suresh and Tiwari (2014) examine the relationship between FD and CAD in India. Parikh and Rao (2006) have examined the twin deficit hypothesis for the period 1970–1971 to 1999–2000, using the Johansen maximum likelihood and error correction modelling framework. They find that a rise in the FD leads to upward pressure on the CAD in India. Suresh and Tiwari (2014) also find a similar result for an extended period of 1975–1976 to 2011–2012. On the other hand, Bose and Jha (2011) examined this relationship for the period 1998Q1 to 2001Q4, by using the VAR and VECM models. They find that FD does not cause CAD, rather the reverse causality exists for India. Further, Ratha (2012), by using monthly and quarterly data over 1998–2009, show that there is no long-run relationship between the FD and CAD, while FD causes CAD in the short run. However, it can be concluded that the results from the existing studies are mixed and inconclusive about the relation between the FB and CAB in the Indian context.

In this paper, therefore, we revisit the well-known 'twin deficit' hypothesis for India by employing more robust econometric techniques. We examine the long run as well as the short run relationship between FB and CAB in a multivariate framework rather than in a bivariate one. We depart from the existing literature in several aspects. *First*, we examine this hypothesis in the backdrop of the two crises, the Asian crisis of 1997/98 and the 2007/08 Global Financial Crisis. In our view, it provides an ideal time period for examining the issue as fiscal stimulus measures resorted during the crisis. Further, we use quarterly data for an extended period of time, i.e., from 1996Q1 to 2016Q1. Quarterly data, instead of annual data, is used mainly to avoid the problems associated with a high degree of temporal aggregation (Rossana and Seater, 1995). *Second*, we use autoregressive distributed lag (ARDL) bounds testing approach proposed by Pesaran et al. (2001) and the vector error correction model (VECM) to explore both the long run as well as the short run relationship between the variables. *Third*, we also use the dynamic OLS (DOLS) developed by Stock and Watson (1993) to test the robustness of the long run coefficient values obtained from the ARDL model.

The rest of the paper is organised as follows. Section 2 discusses the theoretical relationship between FD and CAD. Section 3 presents the econometric methodology. Section 4 describes the data and variables. Section 5 provides the results and discussions. The conclusions and policy implications are summarised in Section 6.

2 The theoretical relationship between fiscal and CADs

2.1 Theoretical overview

The relationship between FD and CAD has been explained by several theories. According to the Keynesian absorption approach, a rise in FD would lead to a rise in the income and hence the demand for imports and thereby, a deterioration in the CAB (or rise in the CAD). The Mundell-Fleming model (Fleming, 1962; Mundell, 1963), on the other hand, suggests that a rise in FD will worsen the CAB indirectly through the interest rate and exchange rate channels. They argue that a rise in FD will have upward pressure on the domestic interest rate, which will attract more capital inflows. A rise in capital inflow will lead to an appreciation of the domestic currency, and thereby making imports cheaper as compared to exports. So the volume of imports will increase and the exports will fall, and as a result, the CAB will deteriorate. Leachman and Francis (2002), Vamvoukas (1999) and Abell (1990) found unidirectional causality running from FD to CAD. Similarly, Suresh and Tiwari (2014) and Parikh and Rao (2006) found that FD significantly contributes to CAD in India.

However, the Ricardian equivalence hypothesis (REH) of Barro (1974, 1989) argues in a completely different way. It states that rise in the BD leads to an equal instantaneous increase in private savings with no effect on aggregate wealth, implying that there is no link between BD and CAD (Piersanti, 2000). Kim (1995) and Enders and Lee (1990) support the REH that BD does not have any impact on CAD.

Apart from the above discussed theoretical relationships between FD and CAD, there can be two more possible causal links between the two. First, there can be reverse causality running from CAD to FD. For example, a country experiencing financial or solvency crisis resulting from chronic, excessive CAD may face a situation in which large injections of public funds are required to rehabilitate troubled financial sector, to improve the corporate governance system, and to attenuate the recession (Kim and Kim, 2006). Marinheiro (2008) in the case of Egypt, and Anoruo and Ramchander (1998) and Bose and Jha (2011) in the Indian context found the evidence of reverse causality running from CAD to FD. Second, a feedback relationship might also be possible between the two deficits. In this case, it may not be possible for the government to reduce the external deficits by cutting down the BDs (Kearney and Monadjemi, 1990).

2.2 *Accounting identity for twin deficits*

The national income identity provides the basis of the relationship between the FD and CAD. The model starts with the national income identity for an open economy that can be represented as follows:

$$Y = C + I + G + X - M \tag{1}$$

where Y = gross domestic product (GDP), C = consumption, I = investment, G = government expenditure, X = exports and M = imports. The exports and imports gap is CAB. Rearranging (1), we get

$$CAB = Y - (C + I + G) = S - I \tag{2}$$

where S is the gross domestic saving ($Y - C - G$). Further, ($C + I + G$) is the domestic absorption which is the sum of government consumption, private consumption, and gross domestic investment. The relationship derived from equation (2) means that the external account balance has to equal the difference in gross domestic savings and investment. This implies that the fluctuations in the CAB are closely linked to the savings and investment decision in the domestic economy.

However, the domestic investment can be financed through domestic saving as well as foreign saving (i.e., external borrowing). That is, a country having domestic investment greater than domestic saving has to go for international borrowing. From a policy point of view, policies that encourage investments have a negative impact whereas the policies that discourage consumption (both private and public) have a positive impact on the country's CAB.

Domestic savings can be decomposed further into private savings (S_p) and government savings (S_g). Substituting S_p and S_g ($S_p = Y - T - C$; $S_g = T - G$ and T is the government revenue) into equation (2) yields

$$CAB = (S_p + S_g) - I \tag{3}$$

This can be further written as:

$$CAB = S_p + (T - G) - I \tag{4}$$

where $(T - G)$ represents the government budget balance. Thus, from equation (4) we can find that, given S_p and I, there is a positive relationship between the government budget balance and the *CAB* of an economy. In other words, in an open economy, both the external balance and the government budget balance are interrelated.

3 Econometric methodology

We use the ARDL bounds testing approach of Pesaran et al. (2001) to test the long-run equilibrium relationship between CAB, FB, real interest rate (IR) and real exchange rate (ER) for India.[1] The DOLS is used to test the robustness of the long run coefficient values obtained from the ARDL model. The short run and long-run causality between the variables are investigated by the VECM, while the modified WALD (MWALD) test developed by Toda and Yamamoto (1995) is used to verify the robustness of the short run causality results.

3.1 The ARDL cointegration model

An ARDL model is a general dynamic specification. This uses the lags of the dependent variable and the lagged as well as the contemporaneous values of the independent variables. The basic ARDL model can be presented by the following unrestricted error correction model:

$$\begin{aligned}\Delta CAB_t = \alpha_0 &+ \sum_{i=1}^{n} a_{1i}\Delta CAB_{t-i} + \sum_{i=0}^{n} a_{2i}\Delta FB_{t-i} + \sum_{i=0}^{n} a_{3i}\Delta IR_{t-i} + \sum_{i=0}^{n} a_{4i}\Delta ER_{t-i} \\ &+ \varpi_1 CAB_{t-1} + \varpi_2 FB_{t-1} + \varpi_3 IR_{t-1} + \varpi_4 ER_{t-1} + \varepsilon_{1t}\end{aligned} \tag{5}$$

where Δ is the difference operator. CAB_t is the dependent variable. FB_t, IR_t and ER_t are the explanatory variables. ε_t is the white noise error term. The coefficients of the lagged-level terms (ϖ_1, ϖ_2, ϖ_2 and ϖ_4) represent the long run dynamics, while the coefficients following the summation signs show the short run dynamics among the variables of interest.

Prior to estimating the above ARDL model, first, it is important to ensure that all the variables are $I(0)$ or $I(1)$ and none of the variables is $I(2)$ to satisfy the bounds test assumption. In the second step, the Akaike information criterion (AIC) is used to select the lag of each variable in the model and then estimate the equation (5) by the ordinary least square (OLS). The F-test or the WALD test is conducted to investigate the long run relationship between the variables. The calculated F-statistics value is compared with the upper and the lower bound critical values of Narayan (2005).

If the calculated F-statistics value exceeds the upper bound critical value then the null hypothesis of no cointegration is rejected, and we can conclude that cointegration exists among the variables. On the other hand, if the F-statistics value falls below the lower bound critical value or within the critical band, the inference is that of no cointegration or inconclusive, respectively. After estimation of the ARDL model, diagnostic tests are employed to ensure the goodness of fit for the chosen ARDL model which includes serial correlation, heteroscedasticity, functional form, normality test, and stability test. The stability test includes the cumulative sum of recursive residuals (CUSUM) test and the cumulative sum of the square of recursive residual (CUSUMSQ) test. After the cointegration between the variables has been confirmed, in the next step the DOLS is used to estimate the long run estimators. In the final step, the VECM is estimated to obtain the short run and the long run Granger causality between the variables.

3.2 The DOLS model

In order to test the robustness of the long run coefficient values obtained from the ARDL model, we further used the DOLS estimator. There are two important estimators generally used in the literature such as fully modified ordinary least square (FMOLS) and DOLS. However, Kao and Chiang (2001) showed that FMOLS exhibit the small sample bias and the DOLS outperforms the FMOLS estimator. As our sample size is small, in this study we use the DOLS to get the long run estimators for our model.

3.3 The VECM Granger causality

The VECM tests for both the short and long run dynamics of the variables. It helps in testing the causal relationship between the variables in the short run as well as in the long run. If cointegration is found among the variables, the following VECM model can be estimated.

$$\begin{bmatrix} \Delta CAB \\ \Delta FB \\ \Delta IR \\ \Delta ER \end{bmatrix} = \begin{bmatrix} b_1 \\ b_2 \\ b_3 \\ b_4 \end{bmatrix} + \begin{bmatrix} B_{11,1}, B_{12,1}, B_{13,1}, B_{14,1} \\ B_{21,1}, B_{22,1}, B_{23,1}, B_{24,1} \\ B_{31,1}, B_{32,1}, B_{33,1}, B_{34,1} \\ B_{41,1}, B_{42,1}, B_{43,1}, B_{44,1} \end{bmatrix} \times \begin{bmatrix} \Delta CAB_{t-1} \\ \Delta FB_{t-1} \\ \Delta IR_{t-1} \\ \Delta ER_{t-1} \end{bmatrix}$$
$$+ \ldots + \begin{bmatrix} B_{11,m}, B_{12,m}, B_{13,m}, B_{14,m} \\ B_{21,m}, B_{22,m}, B_{23,m}, B_{24,m} \\ B_{31,m}, B_{32,m}, B_{33,m}, B_{34,m} \\ B_{41,m}, B_{42,m}, B_{43,m}, B_{44,m} \end{bmatrix} \times \begin{bmatrix} \Delta CAB_{t-m} \\ \Delta FB_{t-m} \\ \Delta IR_{t-m} \\ \Delta ER_{t-m} \end{bmatrix} \tag{6}$$
$$+ \begin{bmatrix} \zeta_1 \\ \zeta_2 \\ \zeta_3 \\ \zeta_4 \end{bmatrix} \times \left(ECM_{t-1} \right) + \begin{bmatrix} \mu_{1t} \\ \mu_{2t} \\ \mu_{3t} \\ \mu_{4t} \end{bmatrix}$$

where Δ represents difference operator and ECM_{t-1} denotes the lagged error correction term. The long-run causality can be obtained from the coefficient of the lagged error correction term. The joint χ^2 statistic for the first-differenced lagged independent variable is used to investigate the short run causality between the variables.

3.4 MWALD causality test

Further, in order to examine the robustness of the short run causality results, we use the MWALD Granger causality test as proposed by Toda and Yamamoto (1995). The advantage of using this method as compared to simple unrestricted VAR is that the MWALD test is applicable even if the VAR is stationary, integrated of arbitrary order, or cointegrated of arbitrary order (Toda and Yamamoto, 1995).

The MWALD test estimates a (k + $d_{\max}$)th-order VAR model where $d_{\max}$ is the maximal order of integration of the variables included in the system. It imposes restrictions on the first k coefficients matrices ignoring the last $d_{\max}$ lagged vectors in the model. The statistical inference of the null hypothesis follows a χ^2 distribution and uses k degrees of freedom, instead of $k + d_{\max}$. The MWALD test also requires that the maximum order of integration does not exceed the true lag length of the model. Zapata and Rambaldi (1997) based on Monte Carlo simulation experiments show that the sample size should be at least 50 observations for applying the MWALD test, which our sample qualifies.

So given the variables such as CAB, FB, IR and ER, the following four equations augmented VAR model is employed:

$$CAB = B_0 + \sum_{i=1}^{k+d\max} \beta_{1i} CAB_{t-i} + \sum_{i=1}^{k+d\max} \gamma_{1i} FB_{t-i} + \sum_{i=1}^{k+d_{\max}} \delta_{1i} IR_{t-i} + \sum_{i=1}^{k+d\max} \theta_{1i} ER_{t-i} + \varepsilon_{1t} \quad (7)$$

$$FB = A_0 + \sum_{i=1}^{k+d\max} \beta_{2i} FB_{t-i} + \sum_{i=1}^{k+d_{\max}} \gamma_{2i} CAB_{t-i} + \sum_{i=1}^{k+d_{\max}} \delta_{2i} IR_{t-i} + \sum_{i=1}^{k+d\max} \theta_{2i} ER_{t-i} + \varepsilon_{2t} \quad (8)$$

$$IR = C_0 + \sum_{i=1}^{k+d\max} \beta_{3i} IR_{t-i} + \sum_{i=1}^{k+d\max} \gamma_{3i} FB_{t-i} + \sum_{i=1}^{k+d\max} \delta_{3i} CAB_{t-i} + \sum_{i=1}^{k+d_{\max}} \theta_{3i} ER_{t-i} + \varepsilon_{3t} \quad (9)$$

$$ER = D_0 + \sum_{i=1}^{k+d_{\max}} \beta_{4i} ER_{t-i} + \sum_{i=1}^{k+d\max} \gamma_{4i} FB_{t-i} + \sum_{i=1}^{k+d\max} \delta_{4i} CAB_{t-i} + \sum_{i=1}^{k+d_{\max}} \theta_{4i} IR_{t-i} + \varepsilon_{4t} \quad (10)$$

4 Data and variables

Following Kim and Kim (2006), we have used a multivariate framework rather than a bi-variate one, and the variables include FB, CAB, IR and ER (real effective exchange rate, a 36-currency trade based weight). Call/notice money rate is being used for the interest rate. The CAB and FB are expressed as a percentage of GDP; the interest rate is converted to real terms adjusting for the price effects. The data are collected from the Handbook of Statistics on Indian Economy published by the Reserve Bank of India (RBI). The data period constitutes of 1996Q1 to 2016Q1.

Further, as our data consists of the quarterly series, this is important to control for the seasonal component in the series. Ghysels and Perron (1993) showed that there is a considerable reduction in the power of the usual Dickey and Fuller (1979) and Phillips and Perron (1988) unit root test statistics in the presence of the seasonal component in the series. To account for the seasonal component in our data, we apply the time series regression with ARIMA noise, missing values, and outliers (TRAMO) and signal extraction in ARIMA time series (SEATS) (Gómez and Maravall, 1996) seasonality test to control for the seasonal component in our data. There are also other methods for seasonality tests such as Census X-11/12/13 filter. TRAMO-SEATS method is preferable than the Census X-11/12/13 filters when some/all of the values of any data series consist of negative values (Maravall, 2006). This is because the Census X methods use log transformation. As some of our variables such as FB and CAB carry negative values in the series, it is advisable to use the TRAMO-SEATS method. Figures A1–A4 presents the original and seasonally adjusted series (estimated by TRAMO-SEATS filter) for all the variables.

5 Results and discussion

5.1 Unit root test results

For testing the cointegrating relationship between the variables, it is necessary to test the unit root properties of the variables in order to understand the order of integration. We apply the augmented Dickey-Fuller (ADF) unit root test developed by Dickey and Fuller (1979) and the KPSS test (Kwiatkowski et al., 1992) to examine the unit root properties of the variables. The unit root test results for both original and seasonally adjusted data are reported in Table 1. The results show that the variables of our study (both original and seasonally adjusted) are mixed order integrated. In other words, while some variables are integrated order zero (i.e., stationary at their levels), others are integrated of order one (i.e., stationary at first difference). The results also show that neither of our variables is integrated of order two or of a higher order.

Table 1 Unit root test results, 1996q1 to 2016Q1

Variables	*ADF test (H0: Unit root)*		*KPSS test (H0: Stationary)*	
	Level	*1st difference*	*Level*	*1st difference*
Original series				
CABt	–4.794*	-	0.464**	0.148
FBt	–2.682	–17.353*	0.109	-
IRt	–4.898*	-	0.227	-
ERt	–1.807	–7.994*	0.984*	0.034
Seasonally adjusted series				
CABt	–3.203**	-	0.478**	0.100
FBt	–5.454*	-	0.129	-
IRt	–4.621*	-	0.234	-
ERt	–1.218	–6.695*	0.984*	0.032

Note: *, **represent significance at 1% and 5% levels respectively.

However, as shown by Perron (1989) and Zivot and Andrews (1992), the presence of structural breaks biases the ADF test against the rejection of the null hypothesis of a unit root. This is because the ADF test does not accommodate the information about the unknown structural break dates which weakens the stationarity hypothesis. In order to overcome such problem, the study has used the unit root test developed by Zivot and

Andrews (ZA) (1992) which accommodates the information about a single unknown structural break present in the series.

Table 2 Zivot-Andrew's unit root test, 1996q1 to 2016Q1

Variables	*Level*		*1st difference*		
	T-Stat.	*Break*	*T-stat.*	*Break*	*Decision*
Original series					
CABt	–2.451	2012Q4	–9.992*	2010Q1	I(1)
FBt	–5.114**	2008Q3	-	-	I(0)
IRt	–3.543	2011Q1	–8.458*	2010Q1	I(1)
ERt	–5.473*	2009Q3	-	-	I(0)
Seasonally adjusted series					
CABt	–4.517	2004Q2	–8.765*	2004Q2	I(1)
FBt	–7.509*	2008Q3	-	-	I(0)
IRt	–6.304*	2011Q1	-	-	I(0)
ERt	–5.725*	2009Q3	-	-	I(0)

Notes: *, **represent significance at 1% and 5% levels, respectively.
The values –5.34 and –4.93 are the tabulated t-statistic values at 1% and 5% levels for ZA test, respectively.

The Zivot-Andrews test results, shown in Table 2, suggests that CAB and IR are the first difference stationary in the original series, while FB and ER are level stationary. The only CAB is the first difference stationary in the seasonally adjusted series, whereas FB, IR, and ER are level stationary. However, none of the unit root tests (including ADF, KPSS, and ZA) indicate that any variable is second-order integrated, i.e., (2). Our dependent variable CAB is likewise found to be *I*(1) in three out of four unit root tests. As a result, CAB can be defined as the first difference stationary, i.e., (1). Furthermore, the ZA test indicates that structural breaks in the variables occur primarily during the post-global financial crisis of 2007–2008, and hence can be considered an outcome of the crisis.

5.2 Cointegration test results

As the unit root tests results suggest that the variables are integrated of mixed order, so we applied the ARDL bounds testing approach of Pesaran et al. (2001) for both the original and seasonally adjusted series to test the existence of long-run equilibrium relationship between the variables. It is, further, suggested that unlike the conventional cointegration tests such as Engle and Granger (1987) and Johansen and Juselius (1990), ARDL model is applicable even if the variables are integrated of mixed order. Further, the ARDL model produces robust results for small sample sizes and also it solves the issue of endogeneity in the model estimation due to the incorporation of lagged values of a dependent variable in the model.

The results of the ARDL model are presented in Table 3. As the ARDL model is sensitive to lag length, so we use the AIC criteria to select the appropriate lag order. Lütkepohl (2006) showed that appropriate lag length is important to capture the dynamic linkages between the series. Column 2 of Table 3 presents the optimal lag length results. The critical bounds statistics from Narayan (2005) are used to determine the existence of cointegration in the different models. We found that the calculated F-statistic is greater than the upper bounds critical values when CAB is used as the dependent variable in the case of both original and seasonally adjusted series. This shows that the ARDL bounds test results confirm the existence of the cointegration among the variables. This entails a long run equilibrium relationship between CAB, FB, IR and ER in case of India, over the period of 1996Q1 to 2016Q1.

Table 3 The results of ARDL cointegration test 1996q1-2016q1

Estimated equations	*Optimal lag*	*Structural break*	*F-statistic*
Original series			
CABt = f(FBt, IRt, ERt)	(1, 1, 0, 0)	2012Q4	7.756*
Seasonally adjusted series			
CABt = f(FBt, IRt, ERt)	(1, 0, 0, 0)	2004Q2	4.800***
	Critical values (T = 81)[a]		
	Lower bound I(0)	Upper bound I(1)	
	5.620	6.908	
	4.203	5.320	
	3.588	4.605	

Notes: The optimal lag length is determined by AIC. T is the total number of observations used in the empirical analysis.
*, ** and ***denotes significance at 1%, 5% and 10% levels, respectively.
[a]Critical lower and upper bounds values are collected from Narayan (2005) including unrestricted intercept and unrestricted time trend.

The existence of cointegration relationships between the variables leads us to examine the long run impact of FB, IR, and ER on the CAB of India.[2] The long-run results reported in Table 4 show that there is a positive and statistically significant relationship between FB and CAB. It can be noted that a 1% improvement in the FB leads to a 0.045% improvement in the CAB in India, keeping other things constant. In other words, this implies that an increase and decrease in FB will lead to an increase and decrease in CAB, respectively. This result supports the findings of Abell (1990) and Leachman and Francis (2002) in the USA, Vamvoukas (1999) in Greece and Suresh and Tiwari (2014) and Parikh and Rao (2006) in India, who found that FD is positively (directly) and significantly related to CAD. Further, we do not find any significant impact of real interest rate and real exchange rate on the CAB. Finally, we have incorporated a dummy variable in the ARDL model to account for the impact of the structural break on the dependent variable. The results show that the structural break has a positive and significant impact on India's CAB.

Although the study emphasises the importance of the long run estimates for the policy implications, nevertheless, the short run results are also estimated to examine the short-run impact of the explanatory variables on the dependent variable. The results are reported in the lower segment of Table 4. It shows that the explanatory variables do not have any significant impact on CAB in the short run.

Furthermore, the error correction term's coefficient is negative (–0.505) and significant, confirming cointegration in the model and indicating that if any disequilibrium occurs, approximately half of it will be corrected in the following quarter to restore long-run equilibrium. To put it another way, the complete disequilibrium dissipates within two quarters. Moreover, like the long run, the structural break dummy variable has a positive and significant impact in the short run. The results of diagnostic tests of the model (see Table 4) show that the probability values for RESET, LM, ARCH, and JB tests are above 0.05. It indicates that the model is free from the issues of model misspecifications, serial correlation, heteroscedasticity, and non-normality.

Table 4 Long run and Short run results from ARDL model, 1996q1-2016q1

Variables	*Coefficient*	*T-statistics*
Long run analysis		
FBt	0.045***	1.827
IRt	–0.032	–0.167
ERt	–0.059	–0.608
Dt	2.713***	1.962
Constant	8.497	0.878365
Short run analysis		
FBt	0.213	1.166
IRt	–0.016	–0.165
ERt	–0.030	–0.610
Dt	1.369***	1.838
ECMt-1	–0.505*	–4.776
Diagnostic tests		
Test	*F-statistic*	*Prob. value*
χ^2 *SERIAL*	1.001	0.373
χ^2 *NORMAL*	4.078	0.130
χ^2 *ARCH*	0.331	0.567
χ^2 *RESET*	0.367	0.546

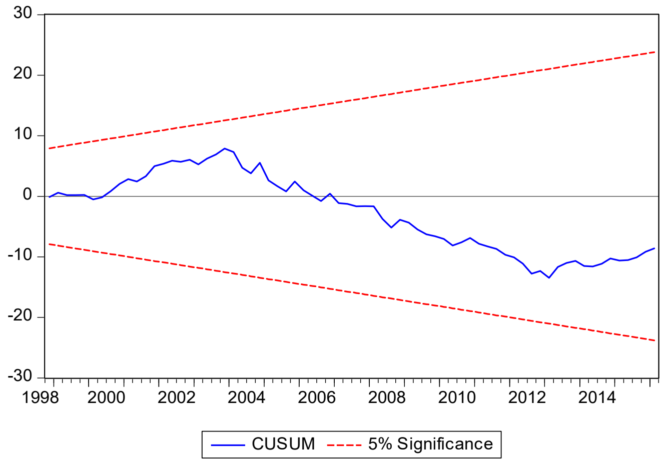
Note: *, ** and ***denote significance at 1%, 5% and 10% levels, respectively. Dt represents a structural break in the dependent variable.

In addition, the stability of the ARDL model is investigated by employing the CUSUM and the CUSUM of the square (CUSUMSQ) suggested by Brown et al. (1975). It is important to check for the stability of the model because model misspecification can also lead to biased coefficient estimates that might influence the explanatory power of the results. Furthermore, Brown et al. (1975) showed that CUSUM and CUSUMSQ tests help in testing the dynamics of parameters. Figures 2–3 presents the plots for both CUSUM and CUSUMSQ at 5% level of significance. The results show that the plots for both the tests are moving within the critical bounds of 5% level of significance. This indicates that our estimated ARDL model is stable.

5.3 Results of DOLS

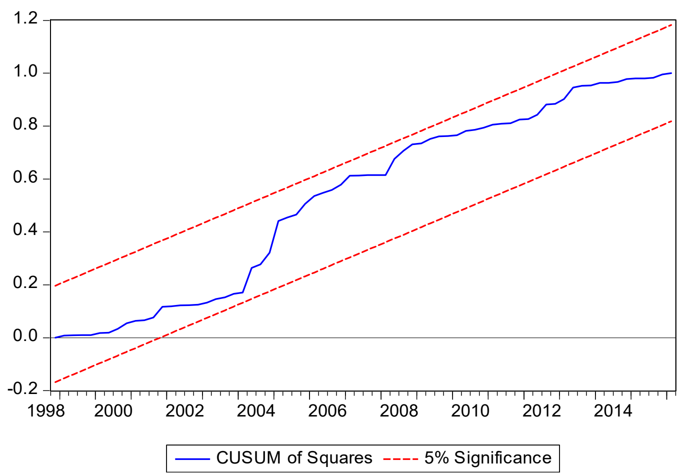
Further, in order to test the robustness of our long run estimation results we use the DOLS estimator of Stock and Watson (1993). Kao and Chiang (2001) show that the DOLS estimator is superior over the conventional OLS and the FMOLS estimators. The results of the DOLS estimator are presented in Table 5.

Figure 2 The plot of the CUSUM (see online version for colours)



Note: Straight lines represent critical bounds at 5% significance level.

Figure 3 The plot of the cumulative sum of squares of recursive residuals (see online version for colours)



Note: Straight lines represent critical bounds at 5% significance level.

Table 5 Results of DOLS

Variables	*CAB as the dependent variable*	
	Coefficient	*T-statistics*
FBt	0.367**	2.018
IRt	–0.115	–0.867
ERt	0.006	0.082
Dt	–2.425*	–3.333
Constant	2.334	0.302

Note: * and **denote significance level at 1% and 5% levels, respectively.

The result from Table 5 shows that FB significantly and positively related to the CAB in the long run. In other words, an increase (decrease) in the FB will lead to an increase (decrease) in CAB in the long run. It is also noted that the real interest rate and the real exchange rate do not significantly affect the CAB. This demonstrates that the long run results from DOLS are consistent with the long run results derived from the ARDL bounds testing approach.

5.4 VECM Granger causality results

The existence of a cointegration relationship between the variables leads us to examine the long run and short run causality between them in order to test the validity of the twin deficit hypothesis for India. We examine this link within the VECM framework with the inclusion of a dummy variable to capture the structural breaks in the series. The direction of causality both in the long run and short run is explained in Table 6. The results suggest that there exist feedback/bidirectional causal relationship between the FB and CAB in the long run. In other words, this implies that while FB Granger causes CAB, at the same time, CAB also Granger causes FB in the long run. This finding not only validates the existence of 'twin deficit' hypotheses for India but also proves the possibility of reverse causality from CAB to FB. One of the implications of this result is that any policy which improves the FB (i.e., the deterioration in FD) will also improve the CAB and vice versa. Such a finding is consistent with Parikh and Rao (2006) and Suresh and Tiwari (2014), while it contradicts the findings of Kim (1995) and Enders and Lee (1990) who supports the Ricardian equivalence hypothesis of Barro (1974, 1989) by showing that FB does not Granger cause CAB.

Table 6 VECM Granger causality analysis

Dependent variable	*Types of causality*					
	Short run					*Long run*
	ΔCAB	*ΔFB*	*ΔIR*	*ΔER*	*Break year*	*ECMt-1*
ΔCAB	--	–0.017	0.095	0.061	2012q4	–0.127**
		(0.381)	(0.507)	(0.516)		(0.041)
ΔFB	0.057	--	–0.020	0.008	2008Q3	–0.787*
	(0.430)		(0.597)	(0.676)		(0.005)
ΔIR	0.071	–0.216	--	0.121	2011Q1	–0.349*
	(0.595)	(0.362)		(0.224)		(0.001)
ΔER	0.159	–1.193	0.048	--	2009Q3	–0.386*
	(0.502)	(0.113)	(0.629)			(0.001)

Notes: Values in the parenthesis represent the P-values.
*, ** and ***show statistical significance at the 1%, 5% and 10% levels, respectively. Lag selection is presented in Table A2.

Further, the reverse causality from the CAB to FB also suggests that any rising imbalances in the external sector may also adversely affect the FB for India. The results also show that there exists a bi-directional causal relationship between the other variables which is consistent with the findings of Kim and Kim (2006). However, contrary to long-run results, the short run results reveal that there is no causal relationship between the variables in the short run.

5.5 MWALD Granger causality results

In order to test the robustness of the short run causality results, we further employed the MWALD test of Toda and Yamamoto (1995). Since it is a pre-requisite to find the maximum order of integration for the MWALD test, the following standard unit root tests such as the ADF, KPSS, and ZA are used, and the results (reported in Tables 1 and 2) show that the maximum order of integration is one, *I*(1). Further, in order to apply the MWALD test, we use the AIC, Schwarz information criteria (SC) and Hannan-Quinn information criteria (HQ), the results of which are presented in Table A2. On the basis of SC and HQ criteria, we select the optimal lag to be one, $k = 1$. Given *I*(1) and $k = 1$, we estimated the augmented VAR model and then applied the MWALD test to identify whether there is any causal relationship between FB and CAB.

Table 7 MWALD Granger causality results

Lagged variables	*Dependent variables*			
	CAB	*FB*	*IR*	*ER*
CAB	--	3.70 (0.05)***	3.05 (0.08)***	0.47 (0.49)
FB	4.04 (0.04)**	--	8.38 (0.003)*	0.53 (0.46)
IR	0.46 (0.49)	0.63 (0.42)	--	0.47 (0.48)
ER	0.29 (0.58)	0.3 2(0.57)	0.09 (0.75)	--

Notes: 1. The test results are based on $m = 1$ and $d_{\max} = 1$. The numbers in the parentheses beside the MWALD test are the p-values.
2. *, **, and ***denote significance at 1%, 5%, and 10%, respectively.

The results of MWALD test presented in Table 7, shows that there exists a bi-directional causal relationship between FB and CAB in the short run. We can also find that while there exist unidirectional causality running from CAB and FB to IR, no causality is found between ER and other variables. Our results are consistent with the findings of Ratha (2012), who found that the twin deficit hypothesis hold for India in the short run (validating the Keynesian channel). The reverse causality, that is, from CAB to FB, can be explained by the fact that, as the external deficit increased during the last decade, the Central government allowed the FD to increase in order to create a favourable macroeconomic environment by providing high fiscal stimulus in terms of reduction of taxes and duties, incentives to export sectors, and extending subsidies to the import of crude oil. The higher government expenditure on the import of defence equipment can also be one of the important reasons for reverse causality. Further, a plausible explanation for the causality from FB to IR can be explained by the Mundell-Fleming model, which argued that an increase in FDs will lead to a rise in the interest rate. Whereas the causality from the CAB to IR can be explained by the fact that when the CAD increases the government borrows more to finance the deficit, which leads to a rise in the interest rate (explained by crowding out theory).

6 Conclusions and policy implications

The present study examines the validity of the twin deficit hypothesis for India in a multivariate model by using the quarterly data from 1996Q1 to 2016Q1. It is found that the 'twin deficit' hypothesis exists for India, implying that there is a direct and significant impact of a change (positive or negative) in the FB on the CAB in the long run as well as in the short run. A reverse causality from CAB to FB also found with Indian data.

However, the findings emanating from this study offers some tentative policy insights. The observed bidirectional causality between FB and CAB, in the long run, suggests that it might not be possible to manage the external imbalances just only by reducing the FD, rather an emphasis can be given for increasing the growth of exports which will help in improving the external sector balances and thereby the domestic balances in the long run.

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Notes

1 The ARDL bound testing approach is more preferable here over the alternative traditional cointegration models such as Engle and Granger (1987) and Johansen and Juselius (1990) for the following reasons:

   a This model is applicable in the case when the variables are integrated of mixed order.

   b This gives robust results in case of small sample sizes; Further, Narayan (2005) created tables with critical F-values for small sample sizes ranging from 30 to 80. As our sample size falls in this range, we use the critical bounds values provided by Narayan (2005).

   c The ARDL technique solves the issue of endogeneity in the model estimation due to the incorporation of lagged values of the dependent variable in the model (Shahbaz et al., 2016).

2 The results are consistent for both the original as well as seasonally adjusted series. However, for the sake of brevity, only the results with the original series are reported hereafter.

Appendix

Figure A1 Original and seasonally adjusted CAB (see online version for colours)

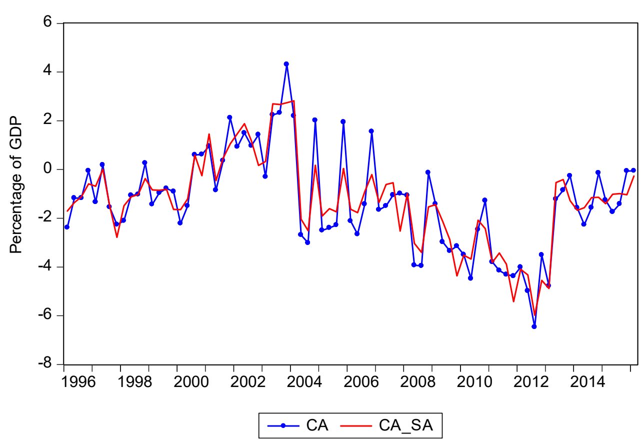

Figure A2 Original and seasonally adjusted (see online version for colours)

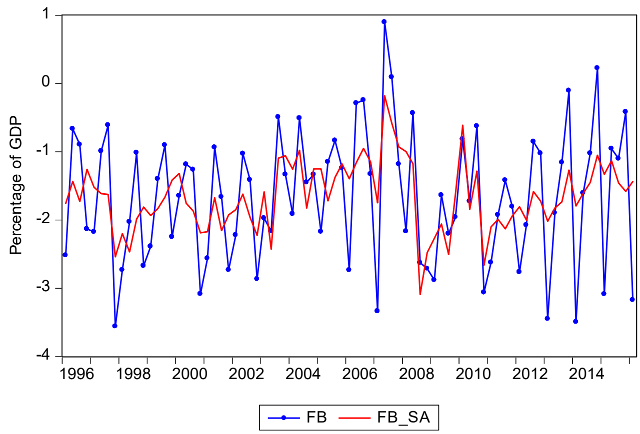

Figure A3 Original and seasonally adjusted real interest (see online version for colours)

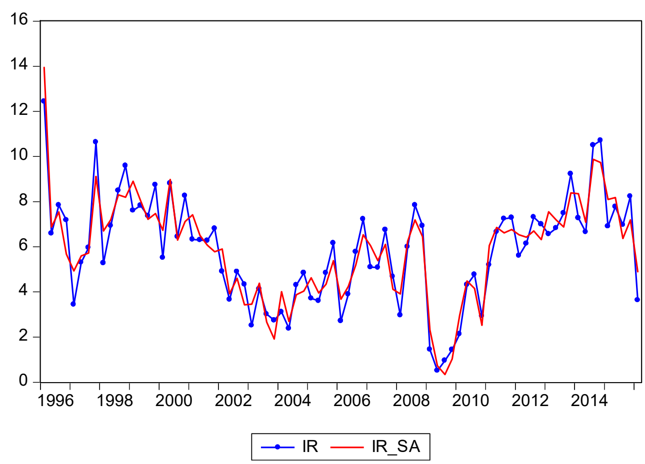

Figure A4 Original and seasonally adjusted real exchange rate (see online version for colours)

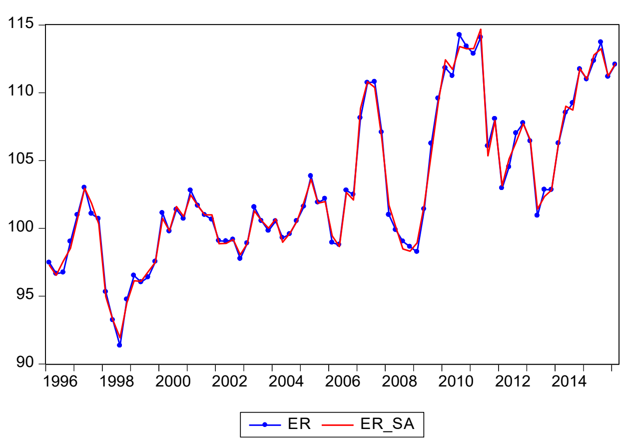

Table A1 Summary statistics, 1996q1 to 2016Q1

Variables	*Mean*	*Std. dev.*	*Max.*	*Min.*
Original series				
CABt	–1.299365	2.003583	4.311718	–6.472366
FBt	–1.663341	0.966551	0.899940	–3.561309
IRt	5.849044	2.366877	12.43850	0.511825
ERt	103.0675	5.518819	114.2533	91.34274
Seasonally adjusted series				
CABt	–1.300673	1.822723	2.820135	–5.984032
FBt	–1.655847	0.502258	–0.179671	–3.089669
IRt	5.867225	2.249767	13.94796	0.344690
ERt	103.0671	5.508731	114.6890	91.92235
Pair-wise correlation				
	CABt	*FBt*	*IRt*	*ERt*
CABt	1			
FBt	0.032	1		
IRt	–0.025	0.044	1	1
ERt	–0.322	0.116	–0.068	1.000

Table A2 Lag length criteria for VECM Granger causality analysis

Lag	*LogL*	*LR*	*FPE*	*AIC*	*SC*	*HQ*
0	–643.636	NA	597.026	17.743	17.869	17.793
1	–531.301	209.283	42.669	15.104	15.732*	15.354*
2	–519.330	20.991	47.849	15.215	16.344	15.665
3	–504.634	24.157	50.104	15.250	16.882	15.900
4	–480.781	36.596	41.199*	15.035*	17.169	15.885
5	–467.266	19.255	45.535	15.103	17.739	16.154
6	–456.011	14.800	54.435	15.233	18.371	16.484
7	–444.187	14.254	65.439	15.348	18.987	16.798
8	–419.026	27.573*	56.086	15.097	19.238	16.747

Note: *Represents significance at 1% level