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India's Twin Deficit Hypothesis: An Asymmetric ARDL Perspective

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Abstract

This study examines the relationship between fiscal deficit and trade deficit, known as 'twin deficits hypotheses, in the Indian economy between 1977-2022. This study's empirical results are derived using the Asymmetric cointegration technique (Nonlinear Autoregressive Distributed Lag model - NARDL) to estimate the long-run and short-run relationship. Zivot and Andrew's (ZA) unit root test determines structural breaks in the series of the twin deficit variables. The asymmetric NARDL results for the short-run and long-run confirm that the trade deficit hypothesis can decide India's fiscal deficit. Their relationship is healthier in the long-run.

Keywords: Budget Deficit; Trade Deficit; Asymmetric ARDL;Bound test; Twin Deficits; India

JEL: E2, F4

1. Introduction

The twin deficit hypothesis (TDH) suggests that an economy with a fiscal deficit (FD) will also likely have a current account deficit (CAD) (Salvatore, 2006). This relationship is indirect yet significant: a budget deficit generally leads to higher domestic interest rates, which attracts foreign capital. The influx of foreign capital appreciates the domestic currency, making exports costlier and imports cheaper, ultimately causing a CAD (Salvatore, 2006). According to the theory of Ricardian equivalence, fiscal deficits often stem from tax cuts that reduce public savings. However, this reduction is frequently offset by an increase in private savings, as individuals plan their consumption based on their lifetime income, rather than current income, which aligns with the Keynesian economic model (Alkswani, 2000). In India, the interconnection between fiscal and current account deficits has posed a continuous challenge for policymakers. These deficits have fluctuated significantly over the years. For example, India's fiscal deficit as a percentage of Gross Domestic Product (GDP) varied from 3.17% in 1970 to nearly 5% in 2013, while the CAD rose from approximately 1% of GDP in 1970 to over 5% in 2012. Despite some periods of improvement, such as in 2013 when the fiscal deficit fell below 4% and the CAD dropped under 1%, the averages between 2013 and 2016 showed the fiscal deficit at 4.3% and the CAD slightly above 1% (Santhosh, 2016). In the Indian context, the interplay between fiscal and current account deficits has presented an ongoing challenge for policymakers. Historical data reveals considerable fluctuations in these deficits:

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India's fiscal deficit as a percentage of Gross Domestic Product (GDP) ranged from 3.17% in 1970 to nearly 5% in 2013, while the CAD surged from approximately 1% of GDP in 1970 to over 5% in 2012. Despite improvements in certain years, such as 2013—when the fiscal deficit dipped below 4% and the CAD fell under 1%—the averages between 2013 and 2016 indicate persistent challenges, with the fiscal deficit averaging 4.3% and the CAD slightly exceeding 1% (Santhosh, 2016).

This study aims to address the following research questions:

- What is the nature of the short-run and long-run relationships between fiscal deficit and trade deficit in the Indian economy?
- How do asymmetric effects manifest among the variables in the context of the twin deficits hypothesis?

By employing the Nonlinear Autoregressive Distributed Lag model (NARDL), this research seeks to make a significant contribution to the existing literature in several key ways:

This study employs the Nonlinear Autoregressive Distributed Lag (NARDL) model to analyze the twin deficit phenomenon, an approach that captures both long-term and short-term dynamics while allowing for asymmetric responses. This innovative methodology offers a deeper understanding of the interdependencies between fiscal deficit (FD) and current account deficit (CAD), setting a precedent for future research on complex economic relationships. Focusing on the Indian context, this research addresses a gap in the existing literature, which has largely concentrated on developed economies. By examining India's unique fiscal and current account challenges, the study enhances the understanding of how twin deficits function in emerging markets. Moreover, the research identifies significant asymmetric effects between fiscal and current account deficits, challenging previous studies that have treated these relationships symmetrically. By revealing how fiscal policies affect trade balances differently during periods of economic expansion and contraction, the findings provide valuable insights for policymakers. Ultimately, by clarifying the short-run and long-run dynamics of twin deficits in India, this research offers practical implications for fiscal policy design, currency management, and trade strategies, contributing to more effective economic governance.

This paper investigates the short-run and long-run relationships between the fiscal deficit and the trade deficit (TD) and explores their causal interactions. By employing the Nonlinear Autoregressive Distributed Lag model (NARDL), this study aims to contribute to the existing literature by: (a) examining the connection between CAD and FD using an innovative methodological approach, and (b) identifying significant asymmetric effects among the variables. This comprehensive analysis will offer deeper insights into the twin deficits hypothesis within the context of the Indian economy.

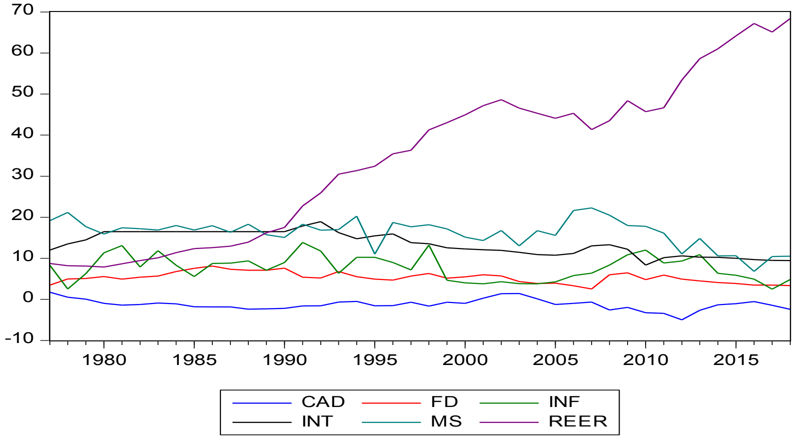

Figure 1. Variable plots

2. Theoretical framework and literature review

The following macroeconomic identity can represent the hypothetical linkage between fiscal deficit and current account deficit:

$$(S - I) + (M - X) = (G + TR - T) \quad (1)$$

'S' is Private saving, 'I' the real investments, 'M' imports, 'X' exports, 'G' government spending, 'TR' transfer payments, and 'T' taxes. The country has a CAD When $M > X$ and if $(G + TR - T) > 0$, the government is consecutively a budget deficit. The difference between budget deficit and current account deficit must equal the private savings and investments, represented below:

$$(S - I) = (G + TR - T) - (M - X) \quad (2)$$

Based on the Mundell–Fleming model, the twin deficit hypothesis posits that budget deficits can also cause trade deficits, causing twin deficits. Provided the economy is at potential output, savings and investments remain constant, and the economy is open with perfect capital mobility (Fleming, 1962) (Mundell, 1963). The twin deficit hypothesis is based on the Keynesian approach where consumption is based on the current income levels (Leachman & Francis, 2002) and contradicted by the Ricardian model where consumption is based on Modigliani Do's lifecycle model (Barro, 1989). The academic research investigating the twin deficit hypothesis has also treated the subject from both the Keynesian and Ricardian paradigms. The research results, best described mixed, supports the existence and non-existence of the twin deficit hypothesis. A study of the Chinese economy to understand the relationship between budget and current account deficit, using autoregressive distributed lag (ARDL), found evidence for long-term relationships between the variables, thus validating the Chinese's Keynesian hypothesis (Banday U. A., 2019). Using NARDL, a multi-nation East European study found evidence supporting the TDH for the Czech Republic, Hungary, and Slovakia but not for Croatia, Poland, Romania, and Slovenia (Turan, 2018). A multi-national study indicated that the relationship between the variables is stronger than emerging and low-income countries, which are more open to trade, upholding the twin deficit theory (Abbas, 2011). An Indian study found evidence for a long-run relationship between the variable (Bhat, 2018). There have also been other Indian studies supporting the twin deficit theory, using co-integration and Granger causality (Kulkarni, 2001). Abell (1990) found evidence for a relation between the US federal budget deficit and the current account deficit. A study of the GIIPS group (Greece, Ireland, Italy, Portugal & Spain), using the Granger test and Toda-Yamamoto approach, investigating the relationship between external and budget balance, returned support for the Ricardian course indicating no connection between the variables (Algieri, 2013). In a large study, using panel data from 73 countries from 1985 to 2012, a positive effect was observed between fiscal and current account balances (Badinger, 2017). The literature on the twin deficit hypothesis presents a spectrum of perspectives regarding the relationship between fiscal deficits and current account balances, largely influenced by the type of transmission mechanisms involved. Theoretical frameworks distinguish between intra-temporal and inter-temporal transmission mechanisms. The Mundell-Fleming model posits that fiscal expansion enhances domestic demand and interest rates, attracting capital inflows, which in turn appreciate the real exchange rate and subsequently deteriorate the current account balance. This model suggests that with high financial openness and exchange rate sensitivity to capital inflows, the transmission mechanism is effective. Conversely, the Swan-Salter model underscores the significance of exchange rate regulation, indicating that fiscal expansion induces real exchange rate appreciation, thereby worsening the trade balance. This appreciation redirects manufacturing from tradable to non-tradable goods and shifts spending from tradable goods, exacerbating the trade deficit. The inter-temporal approach, as articulated by Baxter (1995), suggests that national savings remain unaffected if private savings offset public dissavings. Forward-looking private agents, anticipating future tax burdens due to deficit financing, may increase their current savings and labor supply, ultimately improving the current account balance and mitigating the negative effects of fiscal deficits. The Keynesian absorption approach, on the other hand, argues that a higher budget deficit boosts disposable income, increasing domestic absorption and import demand, thereby worsening the current account balance (Mohanty, 2019). This view is contested by the Ricardian Equivalence Hypothesis (REH), which posits that fiscal policy will not impact the current account balance if the private sector is fully Ricardian, as government-induced tax cuts are offset by reduced private consumption due to anticipated future tax increases. Despite extensive investigation, the empirical validation of REH remains inconclusive, with findings both supporting and contesting the hypothesis (Becker, 1997; Wyplosz, 2002). Empirical studies on the twin deficit hypothesis yield mixed results. Some research supports the conventional view of a direct and linear relationship between fiscal deficits and current account balances, while other studies highlight reverse causality or no relationship at all. For instance, Baharumshah et al. (2019) and El-Khishin & El-Saeed (2021) affirm the conventional view, whereas Mohammadi & Moshref (2012) and Chunming & Ruo (2015) support REH. Other studies, such as Nikiforos et al. (2015) and Siddiqui (2010), identify reverse causality from current account balances to fiscal deficits. The phenomenon of "twin divergence," particularly observed in the US economy, suggests endogenous movements of fiscal and current account balances, influenced by investment sensitivity during recessions (Kim & Roubini, 2008).

Research in developing nations reveals varied results. Studies on the Indian economy, for example, validate the traditional twin deficit hypothesis (Suresh & Tiwari, 2014; Parikh & Rao, 2006; Mohanty, 2019). Conversely, studies on the SAARC countries show conflicting outcomes, with evidence supporting both conventional and reverse causality views (Ravinthirakumaran et al., 2015). In contrast, studies on OECD nations emphasize the role of structural breaks and financial integration in understanding the twin deficit relationship (Bagnai, 2006). Research on BRICS countries further underscores the complexity, with some findings supporting twin deficits and others revealing no relationship or confirming the Ricardian effect (Mohammadi & Moshref, 2012; Chunming & Ruo, 2015). The literature also addresses the impact of fiscal policy measures and structural features on the twin deficit relationship. Fiscal policy, transmitted through various channels, produces differing outcomes in closed versus open economies (Hemming et al., 2002; Corsetti & Müller, 2006). The role of public debt in shaping the twin deficit relationship is also significant, as evidenced by studies on MENA countries (Bousnina & Gabsi, 2022) and South Asian nations (Rajakaruna et al., 2021). Furthermore, structural breaks due to regime shifts, trade openness, and international capital mobility contribute to the non-linear dynamics observed in the twin deficit relationship (Holmes, 2011; Nikiforos et al., 2015; Rafq, 2010; Xie & Chen, 2014). Despite the extensive body of empirical research, the conclusions on the twin deficit hypothesis remain inconclusive due to diverse methodologies and temporal contexts (Suresh & Tiwari, 2014). The recent literature on the twin deficit hypothesis offers new insights into the complex relationship between fiscal and current account deficits, particularly under different economic conditions. Bilman and Karaoğlan (2020) explore the twin deficit hypothesis in OECD countries, focusing on how the relationship varies under different real interest rate regimes. Their findings suggest that the twin deficit hypothesis does not hold uniformly, as different interest rate environments significantly influence the dynamics between fiscal and current account deficits. This highlights the need for policymakers to account for the prevailing interest rate conditions when designing fiscal and external balance management strategies. Ahmad and Aworinde (2020) revisit the twin deficit hypothesis using nonlinear tests. Their study reveals that the relationship between fiscal and current account deficits is not always linear, with non-linear behaviors becoming prominent during periods of economic fluctuation. This indicates that prior studies relying on linear models may have missed key aspects of the deficit relationship. Their research supports the need for adaptive fiscal and trade policies, especially in economies subject to volatility and external shocks. Akalpler and Panshak (2019) examine the dynamic relationship between budget and current account deficits in Nigeria, a country heavily reliant on commodity exports. They find that external factors, like oil price fluctuations, heavily influence the twin deficits, stressing the importance of sound fiscal policies to buffer against such shocks. This study is particularly relevant for resource-dependent economies, as it emphasizes the role of external factors in driving fiscal and trade imbalances.

The ongoing debate and contradictory findings underscore the need for further research to unravel the conditions under which fiscal deficits influence external balances and vice versa.

3. Data and Methodology

3.1. Data sources and characteristics

The study utilizes data spanning from 1977 to 2022. The period from 1977 to 2022 was chosen for this study on the twin deficits hypothesis in the Indian economy due to its encompassing significant economic changes and policy reforms, particularly the liberalization in the early 1990s, which impacted fiscal and trade policies. This timeframe allows for a comprehensive analysis of how these shifts influenced the relationship between fiscal deficit and trade deficit over time. Additionally, it enables the identification of structural breaks using Zivot and Andrew's unit root test, enhancing the robustness of the analysis. The extended period provides sufficient data points to apply the Nonlinear Autoregressive Distributed Lag (NARDL) model, facilitating the examination of both long-run and short-run relationships. Overall, this selection reflects the evolving nature of the Indian economy and contributes valuable insights to the literature on twin deficits, informing future economic policy decisions.Time series data on Fiscal Deficit (FD), Current Account Deficit (CAD), Real Effective Exchange Rate (REER), Money Supply (MS), Interest Rate (INT), and Inflation (INF) were sourced from the World Bank database, various editions of the Indian Economic Survey, publications from the Reserve Bank of India (RBI), and the International Monetary Fund (IMF). Detailed sources are presented in Table 1.

Table 1. Variables description & sources

1	CAD	Current account deficit	data.worldbank.org
2	FD.	Fiscal deficit	dbie.rbi.org.in
3	INF	Inflation (Consumer Price Index)	dbie.rbi.org.org
4	INT	Interest rate (Lending rates)	data.worldbank.org
5	MS.	Money supply	data.worldbank.org
6	REER	Real effective exchange rate	data.worldbank.org

Table 1. Descriptive statistics

	CAD	FD	INF	INT	MS	REER
Mean	-1.2488	5.2933	7.75122	13.5247	16.2297	34.3505
Median	-1.2984	5.29	8.09911	13.4063	16.8852	38.7863
Maximum	1.74442	8.13	13.8703	18.9167	22.2715	68.3895
Minimum	-5.0049	2.54	2.49089	8.33335	6.80095	7.86295
Std. Dev.	1.28896	1.33509	3.09232	2.8312	3.36731	19.2823
Skewness	-0.0369	0.11731	0.15853	-0.0084	-0.7526	0.02814
Kurtosis	4.10179	2.40631	2.04921	1.71398	3.35723	1.76675
Jarque-Bera	2.13393	0.71315	1.75793	2.89472	4.18791	2.66714
Probability	0.34405	0.70007	0.41521	0.23519	0.1232	0.26354
Sum	-52.449	222.318	325.551	568.039	681.648	1442.72
Sum Sq. Dev.	68.118	73.0814	392.06	328.644	464.889	15244.1
Observations	42	42	42	42	42	42

Descriptive statistics establish non-normal and asymmetric distributions of the time series (Table 2). Application of the linear and nonlinear ARDL depends on the integration of variable to order 0 or 1[(I(0) or I (1)] but not 2 [I(2)] ((Pesaran & Shin, 1998); (Pesaran & Smith, 2001); (Shin & Greenwood-Nimmo, 2014)).

The correlation matrix reveals significant interrelationships among key economic indicators related to the twin deficits hypothesis in the Indian economy. The Current Account Deficit (CAD) exhibits a positive correlation with the Fiscal Deficit (FD) and Money Supply (MS), while showing strong negative correlations with Inflation (INF) and Gross Fixed Capital Formation (GFCF). Fiscal Deficit is notably linked to higher Interest Rates (INT) and has negative correlations with Real Effective Exchange Rate (REER), GDP, and Employment (EMPL), suggesting that rising fiscal deficits may be associated with adverse effects on economic growth and employment. Conversely, Inflation has a positive correlation with Interest Rates but a negative correlation with CAD, indicating a complex interaction. Overall, these relationships underscore the intricate dynamics influencing fiscal and current account deficits, emphasizing the need for careful policy consideration to address these interdependencies in the Indian context.

PP (Phillips & Perron) test was applied to ascertain the time series variables’ stationarity feature both with and without an unknown structural break (considering intercept only and both intercept and trend) (Phillips & Perron, 1988). The time-series’ structural breaks were ascertained through the ZA test (Zivot & Andrews, 1992). The null hypothesis for the unit root test of a variable is rejected when the ZA test statistic value is less than the critical values (set *p* values) or when the absolute value of the t-statistic is more significant than critical values. The unit root test indicates a structural break for the twin deficits in 2008 due to the global financial crisis (Table 3).

3.2. Methodology

The Nonlinear Autoregressive Distributed Lag (NARDL) model facilitates the incorporation of potential asymmetric effects of both positive and negative changes in explanatory variables on the dependent variable. This contrasts with

Table 3. Correlation Matrix

	CAD	FD	INF	INT	MS	REER	GDP	EMPL
CAD								
FD	0.19							
INF	-0.58	0.12						
INT	0.27	0.72	0.24					
MS	0.31	0.43	0.15	0.52				
REER	-0.35	-0.81	-0.12	-0.89	-0.63			
GDP	-0.50	-0.75	-0.05	-0.90	-0.57	0.92		
EMPL	-0.18	-0.69	-0.16	-0.77	-0.46	0.87	0.77	
GFCF	-0.51	-0.62	0.027	-0.56	-0.69	0.73	0.70	0.41

Table 2. Unit root without and with structural break results

		PP	ZA	Break Year		PP	ZA	Break Year	Decision
REER	Intercept	0.2883	-3.762	[2003]	Intercept &Trend	-2.252	-3.3918	[1991]	I (1)
MS		-3.0663	-4.179	[2012]		-3.8305	-6.43	[2006]	I (0)
CAD		-2.9067	-3.902	[2008]		-6.2441	-4.0526	[2008]	I (1)
FD		-2.5371	-4.3716	[1984]		-3.6716	-4.479	[1991]	I (1)
INF		-3.6248	-4.6274	[1999]		-3.7868	-4.5185	[1999]	I (0)
INT		-0.9185	-4.8491	[1997]		-4.606	-5.1377	[1997]	I (0)
		PP	ZA	Break Year		PP	ZA	Break Year	
DREER	Intercept	-5.2024	-6.0553	[2002]	Intercept &Trend	-5.2126	-6.2225	[2003]	
DMS		-11.102	-12.192	[2008]		-11.055	-12.172	[2008]	
DCAD		-6.2441	-6.9505	[2004]		-6.1143	-6.9153	[2004]	
DFD		-7.3233	-7.349	[2008]		-7.4068	-8.0538	[2008]	
DINF		-8.4713	-7.5024	[2002]		-8.4853	-7.5303	[1986]	
DINT		-6.7361	-6.4209	[1993]		-8.418	-6.449	[1993]	

the standard Autoregressive Distributed Lag (ARDL) model, where the impact of explanatory variables is presumed to be symmetrical. If, however, the segmented components of an explanatory variable exhibit identical effects, the NARDL model converges to the conventional symmetric ARDL model. One significant advantage of the NARDL approach is its ability to produce graphs of cumulative dynamic multipliers, which illustrate the adjustment patterns in response to positive and negative shocks to explanatory variables. This model is notably straightforward and versatile, allowing for asymmetry transitions between short-run and long-run periods, a phenomenon known as 'hidden co-integration.' Granger and Yoon (2002) posited that co-integration could be discerned between the positive and negative components of underlying variables. Following this, Schorderet (2003) proposed an asymmetric co-integrating regression model that integrates only one element from each series into the co-integration relationship. Building on these developments, Shin and Greenwood-Nimmo (2014) introduced the NARDL framework, employing negative and positive partial sum decompositions of the predetermined independent variables. This model is instrumental in identifying asymmetric relationships between variables in both the short and long term. To explore asymmetric co-integration relationships among variables such as Current Account Deficit (CAD), Fiscal Deficit (FD), Real Effective Exchange Rate (REER), Inflation (INF), Interest Rate (INT), and Money Supply (MS), regression equations were formulated. The notation Δ represents the first difference of the selected variables. The NARDL co-integrating regression was applied due to the presence of nonlinear data, as indicated by descriptive statistics. The general form of the NARDL equation is presented as follows:

$$y_t = \beta^+ x_T^+ + \beta^- x_T^- + \mu_t \quad (3)$$

Where: y_t, X_t represents CAD, FD, REER, INF, MS, and INT. β^+, β^- represents the associated long-run parameters. The NARDL model employs the decomposition of the exogenous variables into their negative and positive partial sums for decreases and increases as follows;

$$For\ positive\ partial\ sums x_T^+ = \sum_{i=0}^{t} \Delta x_t{}^+$$

$$= \sum_{i=0}^{t} max \Delta x_t, 0 \quad (4)$$

$$For\ negative\ partial\ sums x_T^- = \sum_{i=0}^{t} \Delta x_t{}^-$$

$$= \sum_{i=0}^{t} min \Delta x_t, 0 \quad (5)$$

The stretched form of ARDL including asymmetries (NARDL) are indicated in the equation (6) and (7)

$$\begin{aligned} \Delta CAD_t = {} & \emptyset CAD_{t-1} + \omega_1{}^+ FD^+ + \omega_2{}^+ FD_{t-1}{}^+ \\ & + \omega_3{}^+ FD_{t-2}{}^+ + \omega_4{}^- FD^- \\ & + \omega_5{}^- FD_{t-1}{}^1 + \omega_6{}^- FD_{t-2}{}^1 \\ & + \varphi_1{}^+ INF^+ + \varphi_2{}^+ INF_{t-1}{}^+ \\ & + \varphi_3{}^- INF^- + \varphi_4{}^- INF_{t-1}{}^- \\ & + \varphi_5{}^- INF_{t-2}{}^- + \gamma_1{}^+ INT^+ \\ & + \gamma_2{}^+ INT_{t-1}{}^+ + \gamma_3{}^+ INT_{t-2}{}^+ \\ & + \gamma_4{}^- INT^- + \gamma_5{}^- INT_{t-1}{}^- \\ & + \gamma_6{}^- INT_{t-2}{}^- + \vartheta_1{}^+ MS^+ \\ & + \vartheta_2{}^+ MS_{t-1}{}^+ + \vartheta_3{}^+ MS_{t-2}{}^+ \\ & + \vartheta_4{}^- MS^1 + \vartheta_5{}^- MS_{t-1}{}^- \\ & + \vartheta_6{}^- MS_{t-2}{}^- + \tau_1{}^+ REER^+ \\ & + \tau_2{}^+ REER_{t-1}{}^+ \\ & + \tau_3{}^+ REER_{t-2}{}^+ + \tau_4{}^- REER^- \\ & + \tau_5{}^- REER_{t-1}{}^- \\ & + \tau_6{}^- REER_{t-2}{}^- + \mu_t \end{aligned} \quad (6)$$

$$\begin{aligned} \Delta FD_t = {} & \emptyset FD_{t-1} + \delta_2 FD_{t-2} \\ & + \delta_3 FD_{t-3} + \omega_1{}^+ CAD^+ \\ & + \omega_2{}^+ CAD_{t-1}{}^+ \\ & + \omega_3{}^+ CAD_{t-2}{}^+ + \omega_4{}^- CAD^- \\ & + \omega_5{}^- CAD_{t-1}{}^- \\ & + \omega_6{}^- CAD_{t-2}{}^- + \varphi_1{}^+ INF^+ \\ & + \varphi_2{}^+ INF_{t-1}{}^+ + \varphi_3{}^- INF^- \\ & + \varphi_4{}^- INF_{t-1}{}^- + \varphi_5{}^- INF_{t-2}{}^- \\ & + \gamma_1{}^+ INT^+ + \gamma_2{}^+ INT_{t-1}{}^+ \\ & + \gamma_3{}^+ INT_{t-2}{}^+ + \gamma_4{}^- INT^- \\ & + \gamma_5{}^- INT_{t-1}{}^- + \gamma_6{}^- INT_{t-2}{}^- \\ & + \vartheta_1{}^+ MS^+ + \vartheta_2{}^+ MS_{t-1}{}^+ \\ & + \vartheta_3{}^+ MS_{t-2}{}^+ + \vartheta_4{}^- MS^- \\ & + \vartheta_5{}^- MS_{t-1}{}^- + \vartheta_6{}^- MS_{t-2}{}^- \\ & + \tau_1{}^+ REER^+ + \tau_2{}^+ REER_{t-1}{}^+ \\ & + \tau_3{}^+ REER_{t-2}{}^+ + \tau_4{}^- REER^- \\ & + \tau_5{}^- REER_{t-1}{}^- \\ & + \tau_6{}^- REER_{t-2}{}^- + \mu_t \end{aligned} \quad (7)$$

Like the ARDL model, at first, we employ the F-statistic to test the null hypothesis of no asymmetric co-integration relationship that $\emptyset = \omega_1{}^+ = \omega_2{}^+ = \omega_3 \dots \dots \dots = 0$. Standard Wald test has been used to test short run and long run asymmetry. To test the existence of long-run nonlinearities, we tested the null hypothesis of long-run symmetry that is $\beta^+ = \beta^-$. The significant finding of these models is discussed in the following sections:

3. Empirical Results and Discussions

The findings from the Phillips-Perron (PP) test indicate that three out of six variables exhibit non-stationarity at their levels, while the remaining three are stationary (refer to Table 3). However, since PP tests do not detect structural breaks, the Zivot-Andrews (ZA) test was employed to identify any structural changes within the series. The ZA test results revealed a structural break in 2008 for Current Account Deficit (CAD), Fiscal Deficit (FD), and Money Supply (MS), which aligns with the financial crisis, corroborating previous research by Behera and Yadav (2019). The Nonlinear Autoregressive Distributed Lag (NARDL) model results demonstrate a significant asymmetric impact of the explanatory variables on CAD and FD in both the short and long term.

Table 3. NARDL Estimation results (Dependent variable: ΔCAD)

Panel A: Estimated coefficients (Adjusted R-squared: 0.78, F statistics:5.60)				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.***
$CAD(t{-}1)$	-0.536525	0.382351	-1.403229	0.1981
$FD+$	1.391276	0.694768	2.002505	0.0802
$FD(t{-}1)+$	1.063643	0.600123	1.772375	0.1143
$FD(t{-}2)+$	-0.436486	0.316005	-1.381262	0.2045
FD-	-0.118741	0.53516	-0.221879	0.83
$FD(t{-}1)$-	-0.668483	0.495782	-1.348341	0.2145
$FD(t{-}2)$-	-1.527242	0.692525	-2.205325	0.0585
$INF+$	-0.550619	0.217802	-2.528073	0.0354
$INF(t{-}1)+$	0.448502	0.240041	1.86844	0.0986
INF-	0.744204	0.263284	2.826625	0.0223
$INF\_(t{-}1)$-	0.025247	0.103486	0.243964	0.8134
$INF\_(t{-}2)$-	0.320096	0.181874	1.759987	0.1164
$INT+$	0.393421	0.59315	0.663273	0.5258
$INT(t{-}1)+$	-2.422448	0.745697	-3.248569	0.0117
$INT(t{-}2)+$	1.301513	0.398867	3.263026	0.0115
INT-	0.97877	0.370078	2.644769	0.0295
$INT(t{-}1)$-	0.743667	0.414284	1.795068	0.1104
$INT(t{-}2)$-	-1.487016	0.500848	-2.968994	0.0179
$MS+$	0.105457	0.151648	0.695407	0.5065
$MS(t{-}1)+$	-0.40772	0.200412	-2.034408	0.0763
$MS(t{-}2)+$	0.245197	0.139275	1.760518	0.1164
MS-	0.423512	0.140059	3.023807	0.0165
$MS(t{-}1)$-	0.570123	0.241916	2.356702	0.0462
$MS(t{-}2)$-	-0.448341	0.173806	-2.57955	0.0326
$REER+$	0.009226	0.174256	0.052947	0.9591
$REER(t{-}1)+$	0.498578	0.144358	3.453773	0.0086
$REER(t{-}2)+$	0.166516	0.200026	0.832474	0.4293
$REER$-	-0.666589	0.424903	-1.568802	0.1553
$REER(t{-}1)$-	0.943744	0.44785	2.107278	0.0682
$REER(t{-}2)$-	1.405878	0.69592	2.020171	0.078
c	12.12987	4.765882	2.545146	0.0344

*Note: p-values and any subsequent tests do not account for model selection.

Table 4. Long run coefficients and result of symmetric tests

Panel B: Long run coefficients and result of symmetric tests			
$FD+$	0.905469	INT-	-1.112205
$REER+$	-0.415152	MS-	0.637002
$INF+$	-0.361352	INF-	-1.787373
$INT+$	0.792667	$REER$-	-0.265352
$MS+$	0.84705	FD-	0.692239
Wald Test (+)	14.01145	Wald Test (-)	17.19867

Table 5. Residual & stability diagnostics

Breusch-Godfrey Serial Correlation LM Test:				
Obs*R-squared (Chi-Square)		24.62538	There is no evidence of autocorrelation	
Heteroskedasticity Test: ARCH				
F-statistic	0.286135	There is no evidence of Heteroscedasticity		
Ramsey RESET Test		(Model specification has done)		
	Value	df	Probability	
t-statistic	0.481304	7	0.645	
F-statistic	0.231653	(1, 7)	0.645	

Table 6. NARDL Estimation results (Dependent variable: ΔFD.

Panel A: Estimated Coefficients (Adjusted R-squared: 0.94, F statistics 22.64)				
Variable	**Coefficient**	**Std. Error**	**t Statistic**	**Prob.***
$FD(t{-}1)$	0.065149	0.166142	0.392126	0.7085
$FD(t{-}2)$	0.562933	0.211677	2.659391	0.0376
$FD(t{-}3)$	-0.67105	0.143962	-4.6613	0.0035
$CAD+$	0.820755	0.371963	2.206548	0.0695
$CAD(t{-}1)+$	-0.40671	0.42107	-0.96589	0.3714
$CAD(t{-}2)+$	-0.71706	0.257895	-2.78042	0.032
CAD-	0.656274	0.392997	1.669921	0.146
$CAD(t{-}1)$-	0.658796	0.424344	1.552504	0.1715
$CAD(t{-}2)$-	0.22667	0.21541	1.052271	0.3332
$INF+$	0.106516	0.109669	0.971252	0.3689
$INF(t{-}1)+$	-0.40216	0.094908	-4.23736	0.0055
$INF(t{-}2)+$	0.137094	0.108222	1.266793	0.2522

Panel A: Estimated Coefficients (Adjusted R-squared: 0.94, F statistics 22.64)				
Variable	Coefficient	Std. Error	t Statistic	Prob.*
INF-	-0.60218	0.08901	-6.76533	0.0005
$INF(t{-}1)$-	0.072868	0.09319	0.781923	0.464
$INF(t{-}2)$-	-0.21131	0.06099	-3.46472	0.0134
$INT+$	-0.49807	0.446583	-1.11528	0.3074
$INT(t{-}1)+$	1.806521	0.356838	5.062582	0.0023
$INT(t{-}2)+$	-1.01802	0.301855	-3.37253	0.015
INT-	0.251464	0.216294	1.162604	0.2891
$INT(t{-}1)$-	-0.62557	0.225373	-2.77571	0.0322
$INT(t{-}2)$-	0.978195	0.220567	4.434909	0.0044
$MS+$	-0.38694	0.06955	-5.56343	0.0014
$MS(t{-}1)+$	0.188033	0.070866	2.653344	0.0379
MS-	-0.14014	0.078728	-1.78	0.1254
$MS(t{-}1)$-	-0.57704	0.081805	-7.0538	0.0004
$MS(t{-}2)$-	0.093383	0.065215	1.431928	0.2021
$REER+$	-0.19756	0.095095	-2.07748	0.083
$REER(t{-}1)+$	-0.44002	0.131318	-3.35078	0.0154
$REER(t{-}2)+$	0.179827	0.119894	1.499881	0.1843
$REER$-	0.364542	0.156572	2.328275	0.0588
$REER(t{-}1)$-	-0.62375	0.207514	-3.00581	0.0238
$REER(t{-}2)$-	-0.94691	0.370979	-2.55246	0.0433
c	0.519907	2.74522	0.189386	0.856

*Note: p-values and any subsequent tests do not account for model selection.

Table 7. Long run coefficients and result of symmetric tests

Panel B: Long run coefficients and result of symmetric tests		
CAD-	1.478223	
$REER$-	-1.156425	
INF-	-0.710115	
INT-	0.579201	
MS-	-0.598088	
Wald Test (-)	11.19279	Results indicate that the model is stable

Table 8. Residual & stability diagnostics

Residual & stability diagnostics			Remarks	
Breusch-Godfrey Serial Correlation LM Test:				
Obs*R-squared	31.8702	There is no evidence of autocorrelation		
Heteroskedasticity Test: ARCH				
F-statistic	5.008135	There is no evidence of Heteroscedasticity		
Ramsey RESET Test				
t-statistic	0.021307	5	0.9838	(Model specification has done)
F-statistic	0.000454	(1, 5)	0.9838	

The Nonlinear Autoregressive Distributed Lag (NARDL) model estimation results provide valuable insights into the dynamics of the dependent variable, ΔFD (Fiscal Deficit), in relation to various macroeconomic factors. The analysis includes the estimated coefficients, standard errors, t-statistics, and p-values for both positive and negative changes in the independent variables. The adjusted R-squared value of 0.94 and F-statistic of 22.64 indicate a strong model fit. The lagged effects of the fiscal deficit (FD) show that FD_{t-1} has an insignificant impact with a coefficient of 0.065149 (p = 0.7085). However, FD_{t-2} has a significant positive coefficient of 0.562933 (p = 0.0376), suggesting a substantial positive influence on the fiscal deficit, while FD_{t-3} shows a significant negative effect with a coefficient of -0.67105 (p = 0.0035), implying a reversal in the fiscal deficit trend in the third lag. For the current account deficit (CAD), positive changes (CAD^+) indicate a marginally significant positive impact with a coefficient of 0.820755 (p = 0.0695). However, $CAD_{t-2}+$ shows a significant negative coefficient of -0.71706 (p = 0.032), suggesting that previous positive changes in CAD negatively affect the current fiscal deficit. Negative changes in CAD (CAD^-) generally do not show significant coefficients, with CAD_{t-1}^- and CAD_{t-2}^- indicating non-significant positive impacts. Inflation (INF) shows mixed effects. Positive changes (INFˆ+) exhibit a significant negative coefficient of -0.40216 for INF_{t-1}^+ (p = 0.0055), while INF_{t-2}^+ does not significantly impact the fiscal deficit. Negative changes (INF^-) show a highly significant and negative coefficient of -0.60218 (p = 0.0005), indicating that decreases in inflation substantially reduce the fiscal deficit. The interest rate (INT) results demonstrate significant impacts from both positive and negative changes. INT_{t-1}^+ has a significant positive coefficient of 1.806521 (p = 0.0023), suggesting that previous increases in interest rates lead to higher fiscal deficits. Conversely, INT_{t-2}^+ and INT_{t-2}^- show significant negative coefficients, indicating that both lagged positive and negative changes in interest rates influence the fiscal deficit in opposing directions. Regarding the money supply (MS), positive changes (MS^+) generally show significant impacts, with MS_{t-1}^+ having a positive coefficient of 0.188033 (p = 0.0379), while current MSˆ+ has a significant negative coefficient of -0.38694 (p = 0.0014). Negative changes (MS^-) also show mixed effects, with MS_{t-1}^- having a highly significant negative coefficient of -0.57704 (p = 0.0004), indicating that decreases in money supply significantly reduce the fiscal deficit. For the real effective exchange rate (REER), positive changes ($REER^+$) and their lags generally show significant negative impacts on the fiscal deficit, with $REER\__{t-1}^{+}$ having a significant coefficient of -0.44002 (p = 0.0154). Negative changes in REER ($REER^-$) also influence the fiscal deficit significantly, with $REER\__{t-1}^{-}$ and $REER\__{t-2}^{-}$ having significant negative coefficients, indicating that depreciations in the exchange rate lead to lower fiscal deficits. The constant term (c) is not significant (coefficient = 0.519907, p = 0.856), suggesting that other explanatory variables capture the variation in the fiscal deficit well. Overall, the NARDL model results highlight the asymmetric effects of various macroeconomic variables on the fiscal deficit. Significant positive and negative changes in the current account deficit, inflation, interest rates, money supply, and real effective exchange rate demonstrate the complex interplay between these factors and the fiscal deficit. The results validate FD's significant and positive effects on the CAD and vice versa in the short- and long-run, and the extents of these effects are higher in the long-run than those in the short-run. Optimal lag length in the unrestricted error correction models has been estimated using the Schwarz information criterion. The maximum lag length is set as three for the lagged levels of the exogenous variables. Three stability and diagnostic tests are applied to check the NARDL model's robustness. The diagnostic results for both NARDL estimations confirm the robustness and reliability of the models. For the equations with ΔCAD and ΔFD as dependent variables, the Breusch–Godfrey LM test revealed no evidence of serial correlation, indicating that the residuals are free from autocorrelation. Similarly, the ARCH test results confirmed the absence of heteroskedasticity, suggesting constant error variance across observations. The Ramsey RESET test further validated the correctness of the functional form, as the insignificant F-statistics (p-values of 0.645 and 0.9838, respectively) indicate that the models are well-specified with no omitted variables. Overall, the residual and stability diagnostics affirm that both NARDL models satisfy the essential classical assumptions, ensuring the reliability and validity of the estimated coefficients.

The superscripts "+" and "–" denote the positive and negative partial sum decompositions, respectively. The long-run coefficients for positive and negative changes in CAD, FD, INF, INT, MS, and REER are denoted as CAD+-, FD+–, INF+–, INT+-, MS+–, and REER+–, respectively, and are found to be statistically significant. The F-statistics indicate the overall model's significance. Our analysis reveals both long-run and short-run relationships among the variables, particularly between CAD and FD, supporting the Keynesian hypothesis. However, there is no evidence supporting the Ricardian Equivalence theorem in the Indian context. These findings align with previous research by Santhosh (2016). To explore the direction of asymmetries and their changes over time, we employed asymmetric cumulative dynamic multipliers, which reaffirmed the robustness of our results. Higher public expenditure and flexible fiscal policies likely contributed to an increased fiscal deficit. The co-movement of the fiscal deficit and current account deficit aligns with expectations during cyclical output shocks (Banday & Aneja, 2019). Empirical evidence highlights that interest rates and food inflation are significant challenges for the Indian economy.

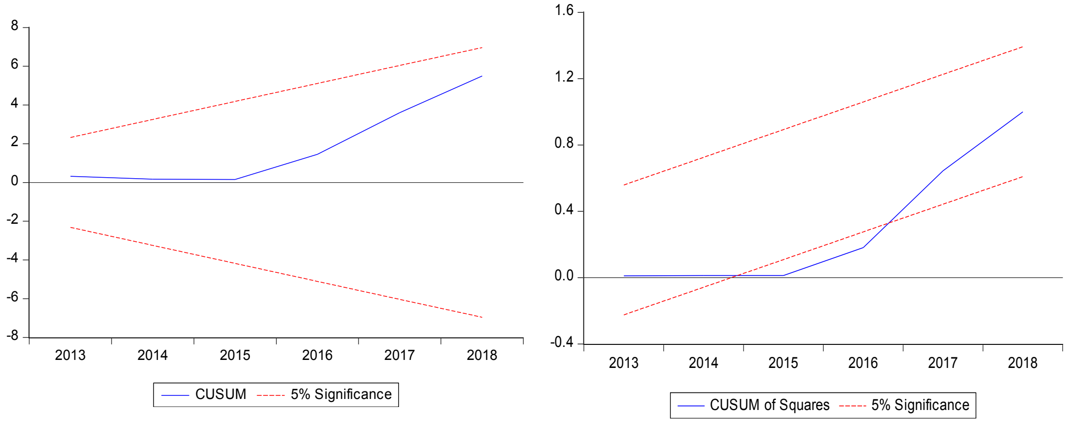

Figure 1A. Plot of Cumulative Sum of squares of Recursive Residuals and CUSUM

Figure 1A illustrates the results of the CUSUM and CUSUM of Squares stability tests. In both plots, the blue lines remain within the red 5% significance boundaries, indicating that the estimated coefficients are stable over the sample period. This stability suggests that the model parameters do not experience structural breaks, consistent with the parameter stability criterion proposed by Pesaran and Smith (2001).

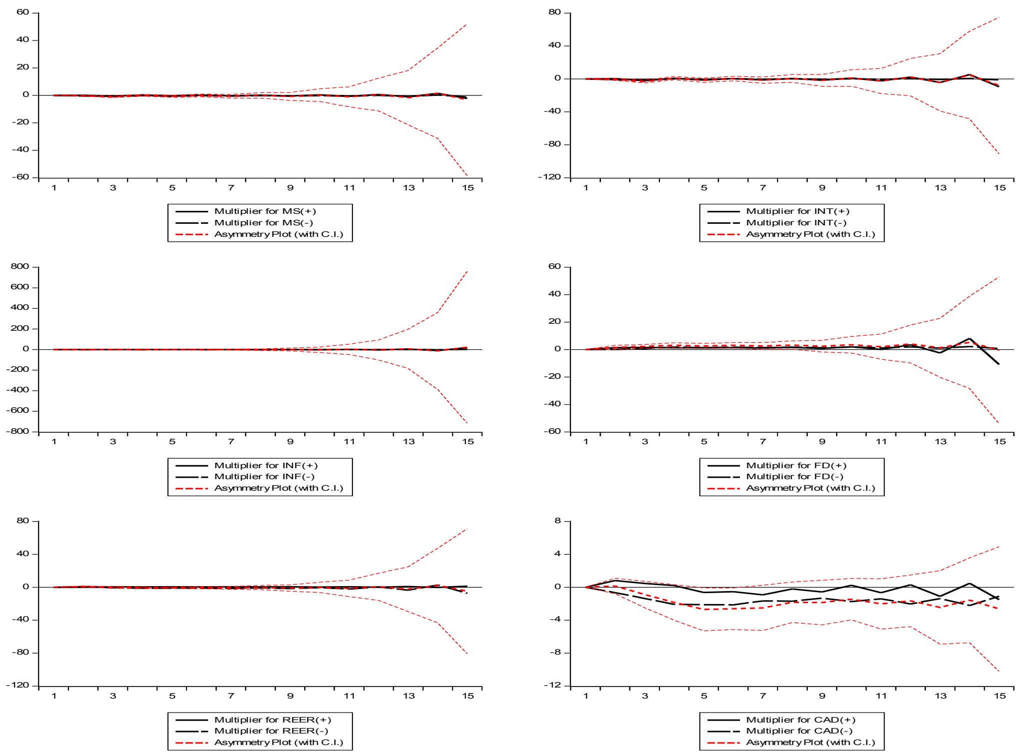

Figure 2A. NARDL Multiplier graph Model 1

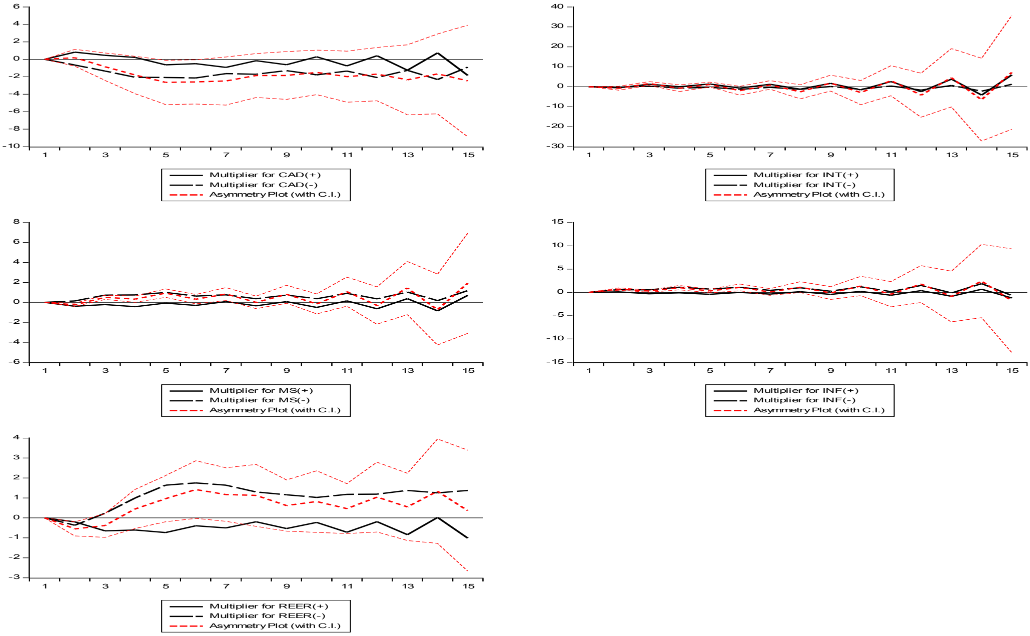

Figure 2B. NARDL Multiplier graph Model 2

4. Conclusion

The study provides crucial insights and policy implications for managing both the fiscal deficit and current account deficit (CAD) in the short and long run. A key conclusion is that tighter fiscal policies are necessary to control the fiscal deficit, which is a significant contributor to the CAD. Policymakers should prioritize optimizing public expenditure by rationalizing subsidies, improving tax collection, and effectively managing public debt. These actions would help reduce the fiscal deficit, which, in turn, has a long-term influence on the CAD. Additionally, the study emphasizes the importance of monetary policy and exchange rate management. Evidence indicates that increases in the money supply and exchange rate devaluation affect the CAD, highlighting the need for monetary authorities to stabilize exchange rates and control inflation. Targeting inflation, reducing excessive money supply growth, and avoiding aggressive currency devaluation are essential to mitigating external imbalances. The study also identifies asymmetric effects between fiscal and current account deficits, signaling the need for structural reforms in both fiscal and trade policies. Policymakers should adopt flexible strategies that respond to different economic phases. Structural reforms targeting fiscal management, trade policies, and competitiveness are particularly crucial during periods of economic expansion or contraction to manage these asymmetric effects. The study finds that increased public spending, especially when unmatched by revenues, widens the fiscal deficit and exacerbates the CAD. Governments should invest in growth sectors like infrastructure, technology, and education, which could boost exports and reduce import dependence. Effective public expenditure management can therefore help reduce both fiscal and current account deficits. In the external sector, the study warns that poorly designed policies such as trade liberalization can widen the CAD. Policymakers should focus on promoting exports and reducing import dependency, ensuring that trade policies align with long-term economic sustainability. Strengthening domestic production capacities is crucial in this regard. Additionally, sound public debt management is vital, as excessive reliance on foreign borrowing could further strain the CAD. Policymakers are encouraged to implement sustainable debt strategies to mitigate the impact of public debt on external balances. Despite its contributions, the study has some limitations. Its findings are based on data from a specific country, limiting the generalizability of results. Furthermore, the study does not account for external shocks like financial crises, oil price fluctuations, or geopolitical events, which could affect the fiscal-CAD relationship. Incorporating such factors would provide a more comprehensive understanding of these dynamics. The study suggests conducting cross-country analyses to explore how different policy environments and economic structures influence these relationships. This would enhance the generalizability of the findings. Future research should also explore additional macroeconomic variables like inflation, interest rates, and capital account dynamics, as they could further illuminate the factors driving fiscal and trade imbalances. Sectoral analyses examining contributions from manufacturing, services, and agriculture could provide more targeted policy recommendations. Moreover, further exploration of asymmetries in other macroeconomic variables and institutional quality, such as governance and transparency, could offer valuable insights into effective fiscal and trade policy management.

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