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Determinants of Indian Fiscal Deficit in NARDL Model

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ABSTRACT

In this paper the author showed the trends of fiscal deficit and examined the short run and the long run nexus between fiscal deficit and gross domestic product per capita, inflation rate (CPI), external debt (% of GDP), unemployment rate (% of labour force), income inequality (income share difference between top 10% and bottom 50%), and military expenditure respectively during 1950-51-2023-24 in India by applying Non-linear Auto Regressive Distributed Lag model. It found that the estimated NARDL (3,4,4,2,0,4,0,0,0,0,0,1) model revealed both positive and negative changes of GDP per capita, inflation rate, & external debt which produced both negative and positive impacts on fiscal deficit respectively. The positive and negative changes of unemployment, income inequality and defense expenditure created positive impact insignificantly. Cointegration equation showed convergent but relation between positive change in inflation at lag 1 is only significant on fiscal deficit and the rests are insignificant. The positive and negative changes in the long run are symmetrical that's why the cumulative dynamic multiplier shocks from positive and negative changes from all determinants have created explosive symmetrical impacts on fiscal deficit. The model is stable, non-normal, heteroscedastic and serially correlated.

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Introduction

Fiscal deficit may be affected by both positive and negative shocks from its determinants which contain the short-run as well as the long-run asymmetrical impacts as non-linear influences that create favorable and unfavorable changes in the dynamics of fiscal deficit process in India. How the positive changes and negative changes of GDP per capita, inflation rate, external debt, unemployment rate, income inequality and defense expenditure of India during 1951-2023 produce favorable and adverse shocks arising from cumulative dynamic multiplier effects on fiscal deficit has been vividly examined in this paper through NARDL model [1]. Keynesian deficit financing approach and Modern Monetary Theory will be greatly benefited through Non-linear Auto Regressive Distributed Lag method when introducing fiscal and monetary policy especially in counter cyclical fiscal and monetary policy in achieving long run price stability and macroeconomic balances. The asymmetric responses may rise fiscal deficit if there are increasing crowding out effects. NARDL approach might be beneficial to long run sustainability of fiscal management in India. The nonlinear relationship between fiscal deficit and economic growth and non-linear causality can help to implement finance-led growth strategy where threshold limit of fiscal deficit is the target variable during wide macroeconomic fluctuations.

Literature Review

India's fiscal deficit has been catapulting at the rate of 1.06% per year linearly and 0.1317% per year exponentially during 1970-2015 which have two upward structural breaks in 1978 and 2009.Indian fiscal deficit is positively associated with growth rate, external debt, current account deficit, openness and nominal exchange rate significantly which was observed by cointegration and vector error correction analysis where impulse response functions are diverging. The threshold limit of fiscal deficit (Center State) was found as 6% of GDP beyond which GDP growth is negative. The state fiscal deficit has no significant convergence patterns [2].

The Fiscal Responsibility and Budget Management Act contains positive impact on reducing fiscal deficit in India because of achievement of fiscal consolidation and becomes revenue-led while it was able to reduce capital and plan expenditure which was tested empirically during 1989-90-2015-16 [3].

The OLS model in India during 1990-91-2019-20 revealed that current account deficit, interest payment, and real effective exchange rate have negative impact, while saving-investment gap, gross domestic product, consumer price index and terms of trade have positive impact on India's fiscal deficit. There is unidirectional causality running from gross fiscal deficit to current account deficit according to Granger causality test. There is bidirectional causality running from gross fiscal deficit to current account deficit and saving-investment gap, and from current account deficit and saving investment gap to gross fiscal deficit according to Wald test. Johansen cointegration test states that impact of fiscal deficit on economic growth has negative relation with tax revenue and fiscal deficit and positive relation with private investment and

exchange rate. Cointegrating relation converged to equilibrium significantly [4].

There is short run and long run asymmetry between negative and positive parts of fiscal deficit and oil consumption and positive and negative changes in fiscal deficit on CPI appears to be positive and significant in India during 1990-91-2021-22 which was found in NARDL model where the positive changes in fiscal deficit has larger influence on CPI compared to negative changes and the cointegrating equation has been converging towards equilibrium at the speed of adjustment of 62% per annum [5].

There is asymmetric association between fiscal deficit, GDP and gross domestic capital formation in the short and long run in India during 1980-81-2016-17 where gross domestic capital formation has positive influence on GDP and fiscal deficit had adverse impact on GDP while gross domestic capital formation had positive impact on GDP in NARDL model [6].

According to NARDL model in India during 1980-81-2016-17, there is asymmetries between the positive and negative changes of fiscal deficit and oil price in the long run and the positive and negative changes in fiscal deficit on whole sale price index is positive and significant while money supply had no asymmetry in both short and long run. The positive and negative changes of money supply on WPI is insignificant. The effect of positive and negative changes in oil prices on WPI is positive and significant. Cointegrating equation is convergent and significant where speed of adjustment is 62% per year [7].

In NARDL model in India during 1970-71-2018-19, it was found that there are asymmetric impact of fiscal deficit on current account deficit, saving investment gap and exchange rate in which saving investment gap has positive impact on current account deficit and exchange rate has negative impact on current account deficit while there is asymmetry of fiscal deficit on current account deficit [8].

There is unidirectional causality from fiscal deficit to inflation. Moreover, positive and negative changes in fiscal deficit have asymmetric response on inflation but asymmetry is higher in positive changes which were found in NARDL model in India from 1970-2016 [9].

Even Fiscal deficit has asymmetric impact on macroeconomic variables such as economic growth, exchange rate and inflation rate respectively which was found in Nigeria during 1981-2021 [10]. Besides, fiscal deficit has asymmetric effects on CO2 emission in India during 1972-2021 as examined in NARDL model [11].

Purpose of the Paper

The paper endeavors to examine the short run and the long run non-linear relationships between fiscal deficit and gross domestic product per capita (in Rs), inflation rate (CPI), external debt (% of GDP), unemployment rate (% of labour force), income inequality (income share difference between top 10% and bottom 50%), and military expenditure (% of GDP) respectively during 1950-51-2023-24 in India by applying Non-linear Auto Regressive Distributed Lag model.

Methodology and Sources of Data

In analyzing the behaviour of gross fiscal deficit of India from 1950-51 to 2023-24, the paper used nonlinear trend estimates. To examine the stationarity, it applied Augmented Dicky-Fuller test, then applied NARDL model of Shin et al.(2014). The residual test for serial correlation, and heteroscedasticity through Brauch-Pagan model (1979) and normality tests through Q-Q plot have been done following Wilk and Gnanadesikan (1968) model and stability test of the model (CUSUM) was done following Page (1954) model [13,14]. Wavelet shrinkage estimator was used following Donoho and Johnstone (1992) and Haar model (1910) to and to find noise trend of residuals [15,16]. Wald test (1943) been applied to find asymmetric effects [17].

Data on Gross Fiscal deficit (in Rs.Cr.) from 1951 to 1969 was taken from IMF, and from 1970 to 2024 was taken from RBI. The data on Gross National Income per capita (in Rs) during 1951-2023 was collected from RBI. The data on CPI (2010=100) from 1951 to 2024 was taken from St.Louisfed.org. The data on unemployment rate (% of total labour force) from 1990 to 2023 was taken from World Bank and for the data on the unemployment rates of 1st, 2nd, 3rd, and annual plans were taken from [18]. Data on unemployment 1970 to 1990 were collected from Krishna, 1984; West Cott & Bednarzik, 1981; NSS 68th round (2011-12), respectively. The data on external debt (in million $) during 1951-1969 was taken from IMF, from 1970 to 1990 was taken from macrotrends.net and from 1991 to 2023 was taken from the World Bank. The data on income shares of top 10% and bottom 50% of India were taken from World Inequality Data Lab.(income inequality=h10-b50).The data on Indian military expenditure (% of GDP) from 1960 to 2023 was taken from https://www.macrotrends.net/global-metrics/ countries/ ind/india/ military-spending-defense-budget.(the data from 1951 to 1959 were computed).

Econometric Results and Observations

Trend of Fiscal Deficit

Fiscal deficit of India from 1951-2023 contains quadratic trend which is estimated below. It is upward followed by a downward significant trend while it is increasing at the rate of 7.79% per year in the linear trend line estimate.

$$\text{Log}(y)=3.207+0.3017t - 0.00299.\ t^2+u_i$$
$$(8.72)^*\ \ (13.15)^*\ \ (-9.98)^*$$

R^2=0.81, F=149.26*, DW=0.64, n=73, y=fiscal deficit of India, t =time, *=significant at 5% level, t statistics are in first brackets. The fitted trend line is shown in Figure 1 below.

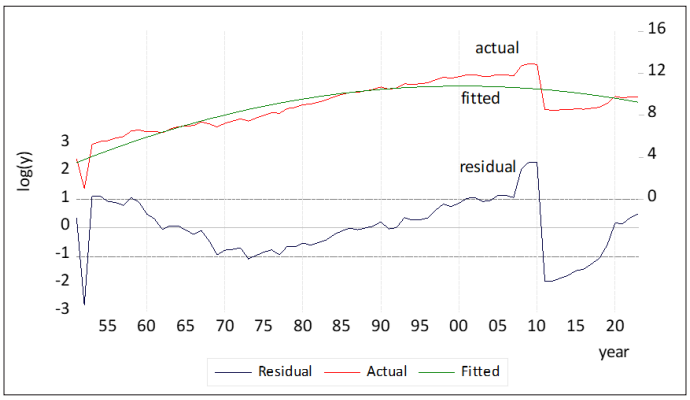

Figure 1: Trend line of fiscal deficit
Source: Plotted by Author

• Unit Root Test

According to ADF unit root test (1979) with AIC assuming constant and trend, all the level series except GDP per capita contain unit root and are non-stationary at level while all are stationary at first difference which have been tabulated in Table-1.

Table 1: Unit Root Test (Assuming Constant and Trend, ADF Test Applying AIC)

Variable	ADF (prob)	Critical Value (5% level)	Unit Root, Stationary/Nonstationary
Log(y)	-2.288(0.43)	-3.473447	Contains Unit Root, Non-Stationary
dlog(y)	-11.980(0.00)	-3.474363	No Unit Root, Stationary
Log(x_1)	-3.7808(0.023)	-3.474363	No Unit Root, Stationary
dlog(x_1)	-8.5627(0.00)	-3.474363	No Unit Root, Stationary
Log(x_2)	-4.5507(0.0026)	-3.474363	Contains Unit Root, Non-Stationary
dlog(x_2)	-7.4752(0.00)	-3.474363	No Unit Root, Stationary
Log(x_3)	-1.7931(0.697)	-3.474363	Contains Unit Root, Non-Stationary
dlog(x_3)	-7.7957(0.00)	-3.474363	No Unit Root, Stationary
Log(x_4)	-3.9844(0.013)	-3.474363	Contains Unit Root, Non-Stationary
dlog(x_4)	-11.1304(0.00)	-3.474363	No Unit Root, Stationary
Log(x_5)	-1.5730(0.794)	-3.474363	Contains Unit Root, Non-Stationary
dlog(x_5)	-9.5438(0.00)	-3.474363	No Unit Root, Stationary
Log(x_6)	-2.2264(0.467)	-3.474363	Contains Unit Root, Non-Stationary
dlog(x_6)	-5.47946(0.00)	-3.474363	No Unit Root, Stationary

Source: Calculated by Author

[where y= gross fiscal deficit, x1= GDP per capita,x2=inflation rate,x3=external debt%of GDP,x4=unemployment rate,x5=income inequality,x6=military expenditure % of GDP]

Estimation of NARDL

Following,Shin et al.(2014),the NARDL estimates was done. The estimated NARDL (3,4,4,2,0,4,0,0,0,0,0,1) model with maximum 4 lags during 1956-2023 (after adjustment) in India interprets that fiscal deficit is significantly related with previous periods positively at lag 1 and negatively at lag 2 & 3.The positive changes of GDP per capita at level and lag 4 are positively related with fiscal deficit and negatively related in lag 1 & lag 3 significantly. The negative changes of GDP per capita are negatively related with fiscal deficit in lag 4 significantly. The positive changes in inflation rate at level and lag 2 are positively associated with fiscal deficit and negatively related in lag 1 respectively at significant level. The positive changes of external debt(% of GDP) are directly related with fiscal deficit and indirectly related in lag 3 and indirectly related in lag 4 significantly. The positive and negative changes in unemployment rate, income inequality and military changes have insignificant positive impact on fiscal deficit (Table 2).

Table 2: NARDL Estimate

Dependent=y				
Variables	**Coefficient**	**Std. Error**	**t-Statistic**	**Probability**
y_{t-1}	0.701691	0.156391	4.486762*	0.0001
y_{t-2}	-0.275513	0.158737	-1.735651**	0.0907
y_{t-3}	-0.601664	0.150955	-3.985716*	0.0003
x_{1t}^{+}	6.777328	4.259089	1.591262	0.1198
x_{1t-1}^{+}	-11.73410	6.285708	-1.866791**	0.0697
x_{1t-2}^{+}	-7.411038	6.742879	-1.099091	0.2786
x_{1t-3}^{+}	-20.80186	7.399292	-2.811330*	0.0078
x_{1t-4}^{+}	25.67866	7.378958	3.479985*	0.0013
x_{1t}^{-}	2.062757	19.91961	0.103554	0.9181
x_{1t-1}^{-}	33.32328	27.07195	1.230915	0.2259
x_{1t-2}^{-}	-3.710835	28.06888	-0.132205	0.8955
x_{1t-3}^{-}	5.062090	28.57013	0.177181	0.8603
x_{1t-4}^{-}	-54.56354	25.22706	-2.162897*	0.0369
x_{2t}^{+}	20291.56	10211.54	1.987120*	0.0542

x_{2t-1}^{+}	-38237.23	14795.28	-2.584420*	0.0137
x_{2t-2}^{+}	28859.15	9913.613	2.911063*	0.0060
x_{2t}^{-}	23364.31	89496.69	0.261063	0.7955
x_{3t}^{+}	1.881607	0.921070	2.042848*	0.0480
x_{3t-1}^{-}	-0.051764	0.885903	-0.058431	0.9537
x_{3t-2}^{-}	0.084510	0.847945	0.099665	0.9211
x_{3t-3}^{-}	-4.333840	1.112075	-3.897075*	0.0004
x_{3t-4}^{-}	2.131624	1.084306	1.965888**	0.0566
x_{3t}^{-}	-2.504361	1.943300	-1.288716	0.2053
x_{4t}^{+}	982.4146	6045.509	0.162503	0.8718
x_{4t}^{-}	2337.092	4485.347	0.521050	0.6054
x_{5t}^{+}	176250.2	372415.1	0.473263	0.6387
x_{5t}^{-}	393862.5	750809.8	0.524584	0.6029
x_{6t}^{+}	23920.15	21061.78	1.135714	0.2632
x_{6t-1}^{+}	-20464.00	18789.59	-1.089114	0.2830
C	30318.65	175611.9	0.172646	0.8638
R^2=0.899, F=11.792*, loglikelihood=-789.1060, AIC=24.09135, SC=25.07055, DW=2.590427, n=68, *=sig.at 5%,**=significant at 10% level				

Source: Calculated by Author

The Bounds test revealed that F statistic=5.0922 and t statistic=-6.173 which are greater than the critical values of I(0) and I(1) at 1%,5%, and 10% significant levels. So that there is long run cointegration and has no constraint to apply NARDL model (Table 3).

Table 3: Bounds Test

F Statistic	N=70	10%	5%	1%
I(0)	Asymptotic	1.830	2.060	2.540
I(1)	Asymptotic	2.940	3.240	3.860
t- statistic				
I(0)	Asymptotic	-2.570	-2.860	-3.430
I(1)	Asymptotic	-4.690	-5.030	-5.680

Source: Calculated by Author

Conditional Error Correction

Therefore, the estimated conditional error correction NARDL model during 1956-2023 is given below. It interpreted that fiscal deficit of the past year is negatively linked to fiscal deficit of India at level significantly in the long run. The positive and negative changes of GDP per capita have insignificant negative impacts on fiscal deficit. The positive changes of inflation rate at lag 1 have positive impacts to fiscal deficit significantly while negative changes have positive insignificant impact on fiscal deficit. The negative changes of external debt of level and lag 1 have insignificant negative impacts on fiscal deficit. The positive and negative changes of unemployment rate, income inequality and military expenditure have insignificant positive impacts on fiscal deficit in the long run.

In the short run, the increment of fiscal deficit in lag 1 &2 are positively associated with fiscal deficit significantly. The positive changes of increment of GDP per capita at lag 3 are negatively related with fiscal deficit significantly while negative changes at lag 2 & lag 3 are positively related with fiscal deficit significantly. The positive changes of increment of inflation at level are positively related with fiscal deficit while lag 1 is negatively related significantly. The positive changes of increment of external debt at level, lag 1 and lag 2 are significantly positive association with fiscal deficit while lag 3 is negatively related. The changes of increment of military expenditure influenced fiscal deficit positively at insignificant level. It is a good fit having significant F and DW and minimum AIC(Table 4).

Table 4: Conditional Error Correction

variables	**coefficient**	**Standard Error**	**T statistic**	**Probability**
	Long run			
y_{t-1}	-1.175486	0.190420	-6.173126*	0.0000
x_{1t-1}^{+}	-7.491002	5.046203	-1.484483	0.1459
x_{1t-1}^{-}	-17.82624	33.26774	-0.535842	0.5952
x_{2t-1}^{+}	10913.48	3767.018	2.897113*	0.0062

x_{2t}^{-}	23364.31	89496.69	0.261063	0.7955
x_{3t-1}^{-}	-0.287863	1.111895	-0.258894	0.7971
x_{3t}^{-}	-2.504361	1.943300	-1.288716	0.2053
x_{4t}^{+}	982.4146	6045.509	0.162503	0.8718
x_{4t}^{-}	2337.092	4485.347	0.521050	0.6054
x_{5t}^{+}	176250.2	372415.1	0.473263	0.6387
x_{5t}^{-}	393862.5	750809.8	0.524584	0.6029
x_{6t-1}^{+}	3456.156	15414.29	0.224218	0.8238
Short run				
dy_{t-1}	0.877177	0.164264	5.340048*	0.0000
dy_{t-2}	0.601664	0.150955	3.985716*	0.0003
dx_{1t}^{+}	6.777328	4.259089	1.591262	0.1198
dx_{1t-1}^{+}	2.534229	4.972171	0.509683	0.6132
dx_{1t-2}^{+}	-4.876809	5.908484	-0.825391	0.4143
dx_{1t-3}^{+}	-25.67866	7.378958	-3.479985*	0.0013
dx_{1t}^{-}	2.062757	19.91961	0.103554	0.9181
dx_{1t-1}^{-}	53.21228	33.01757	1.611635	0.1153
dx_{1t-2}^{-}	49.50145	26.73716	1.851410**	0.0719
dx_{1t-3}^{-}	54.56354	25.22706	2.162897*	0.0369
dx_{2t}^{+}	20291.56	10211.54	1.987120*	0.0542
dx_{2t-1}^{+}	-28859.15	9913.613	-2.911063*	0.0060
dx_{3t}^{+}	1.881607	0.921070	2.042848*	0.0480
dx_{3t-1}^{+}	2.117705	1.086500	1.949108**	0.0587
dx_{3t-2}^{+}	2.202215	0.960213	2.293466*	0.0274
dx_{3t-3}^{+}	-2.131624	1.084306	-1.965888**	0.0566
dx_{6t}^{+}	23920.15	21061.78	1.135714	0.2632
C	30318.65	175611.9	0.172646	0.8638
R^2=0.756, F=4.076*, loglikelihood=-789.1060, DW=2.596, SIC=25.06, AIC=24.09, n=68, *=sig.at 5%,**=significant at 10% level				

Error Correction

The estimated error correction especially in the short run implies that cointegrating term has been converging towards equilibrium at the speed of adjustment of 117% per annum significantly. The increment of fiscal deficit in lag 1 & 2 influenced positively on fiscal deficit significantly. The positive incremental change of GDP per capita impacted positively on fiscal deficit at level while negatively at lag 3 significantly. The negative changes of incremental of GDP per capita at lag 1,2, &3 have positive influences on fiscal deficit significantly. The positive incremental change of inflation at level has positive impact while at lag 1 has negative impact on fiscal deficit significantly. The incremental positive changes of external debt at level, at lag1 and lag 2 influenced positively on fiscal deficit while positive change at lag 3 influenced negatively at significant level. The incremental change of military expenditure has insignificant positive impact on fiscal deficit(Table 5).

Table 5: Error Correction

	Coefficient	Standard Error	T statistic	Probability
Short run				
COINTEQ	-1.175486	0.132424	-8.876705*	0.0000
dy_{t-1}	0.877177	0.121923	7.194492*	0.0000
dy_{t-2}	0.601664	0.112717	5.337847*	0.0000
dx_{1t}^{+}	6.777328	3.027018	2.238946*	0.0297
dx_{1t-1}^{+}	2.534229	2.650894	0.955990	0.3438
dx_{1t-2}^{+}	-4.876809	3.970043	-1.228402	0.2252
dx_{1t-3}^{+}	-25.67866	4.533427	-5.664295*	0.0000
dx_{1t}^{-}	2.062757	10.97866	0.187888	0.8517
dx_{1t-1}^{-}	53.21228	16.38598	3.247428*	0.0021
dx_{1t-2}^{-}	49.50145	17.37804	2.848505*	0.0064

dx^{-}_{1t-3}	54.56354	18.60855	2.932175*	0.0051
dx^{+}_{2t}	20291.56	7316.106	2.773546*	0.0078
dx^{+}_{2t-1}	-28859.15	6770.248	-4.262642*	0.0001
dx^{+}_{3t}	1.881607	0.568789	3.308092*	0.0018
dx^{+}_{3t-1}	2.117705	0.559355	3.785979*	0.0004
dx^{+}_{3t-2}	2.202215	0.494107	4.456958*	0.0000
dx^{+}_{3t-3}	-2.131624	0.694131	-3.070924*	0.0035
dx^{+}_{6t}	23920.15	14612.07	1.637013	0.1080
C	30318.65	175611.9	0.172646	0.8638
R^2=0.756, F=8.468*, loglikelihood=-789.1060, DW=2.596, SIC=24.38, AIC=23.76, n=68, *=sig.at 5%,**=significant at 10% level				

Source: Calculated by Author

Cointegration

The cointegrating equation is estimated below. The cointegrating equation has been interpreted as normalized variable Zt-1.It is approaching towards equilibrium at the speed of adjustment of 117% per year significantly. Only positive changes of inflation rate at lag one has positive influence on fiscal deficit significantly. Other determinants are insignificant. The positive and negative changes of GDP per capita and external debt have negative impacts on fiscal deficit. Moreover, the positive and negative changes in unemployment rate, income inequality and military expenditure have positive influences on fiscal deficit insignificantly (Table 6).

Table 6: Cointegrating Equation

Normalized Variable Zt-1 and Other Variables	Coefficient	Standard Error	T statistic	Probability
Y_{t-1}	-1.175486	0.190420	-6.173126*	0.0000
x^{+}_{1t-1}	-6.372684	4.304755	-1.480383	0.1443
x^{-}_{1t-1}	-15.16500	28.44169	-0.533196	0.5960
x^{+}_{2t-1}	9284.225	3240.246	2.865284*	0.0058
x^{-}_{2t}	19876.30	76807.57	0.258780	0.7967
x^{+}_{3t-1}	-0.244888	0.940525	-0.260374	0.7955
x^{-}_{3t}	-2.130490	1.638009	-1.300658	0.1986
x^{+}_{4t}	835.7518	5156.279	0.162084	0.8718
x^{-}_{4t}	1988.192	3802.577	0.522854	0.6031
x^{+}_{5t}	149938.1	308355.9	0.486250	0.6287
x^{-}_{5t}	335063.5	633760.3	0.528691	0.5991
x^{+}_{6t-1}	2940.193	13004.83	0.226085	0.8219
*=sig.at 5% level				

Source: Calculated by author

The cointegrating equation is depicted in Figure 2 which is passing around equilibrium but after financial crisis it is volatile yet, it is approaching towards equilibrium. Since most of the cointegrating relations are insignificant for which it did not merge with zero line.

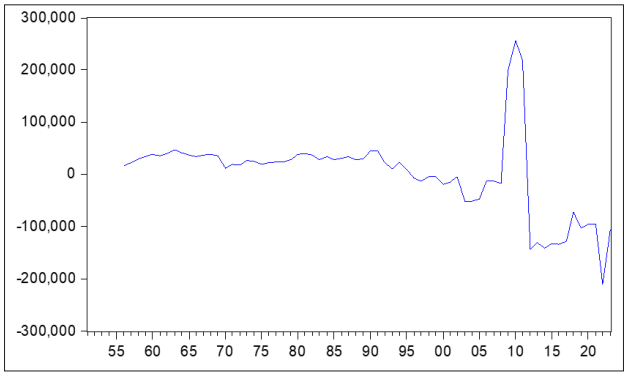

Figure 2: Cointegrating Equation
Source: Plotted by Author

Cumulative Dynamic Multiplier

The positive changes of GDP per capita have explosive shocks on the fiscal deficit on either direction over the horizon which is seen in cumulative dynamic multiplier graph in Figure 3.

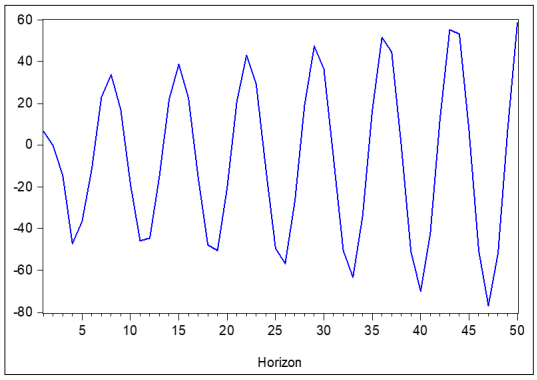

Figure 3: CDM -1: Response of Fiscal Deficit by Positive Changes in GDP Per Capita
Source: Plotted by Author

On the other hand, the negative changes of GDP per capital have explosive shocks on the fiscal deficit on either direction as like as positive changes over the horizon but negative responses explode higher than positive responses which is seen in cumulative dynamic multiplier graph in Figure 4.

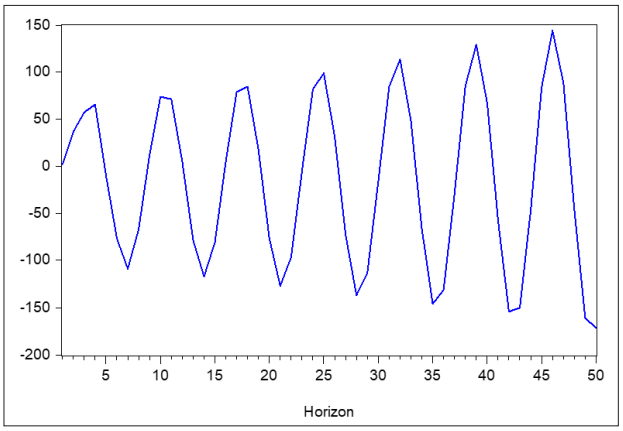

Figure 4: CDM-2- Response of Fiscal Deficit by Negative Changes in GDP Per Capita
Source: Plotted by Author

As period increases, the positive and negative changes in inflation rate have significant accelerating positive impact and negative impact on fiscal deficit where positive impact accelerated steeply more than negative impact which is depicted in cumulative dynamic multiplier graph in Figure 5 and 6 respectively.

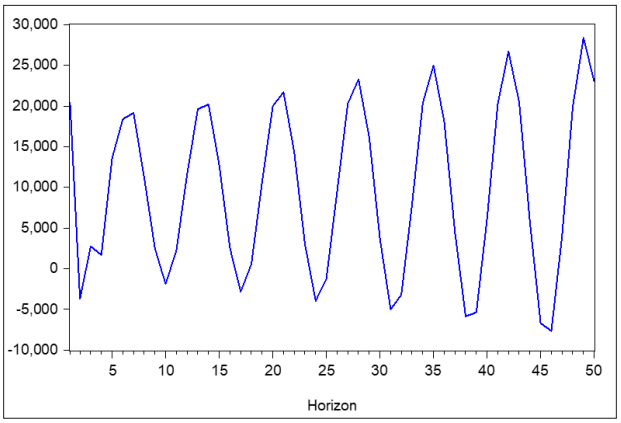

Figure 5: CDM-3- Response of Fiscal Deficit by Positive Changes in Inflation
Source: Plotted by Author

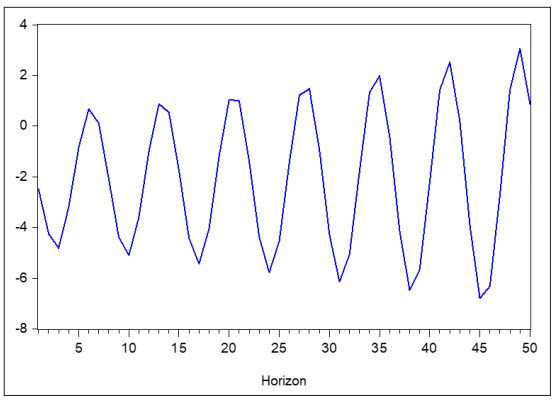

Figure 6: CDM-6- Response of Fiscal Deficit by Negative Changes in External Debt
Source: Plotted by Author

The positive and negative changes in unemployment rate have more explosive positive effects on the fiscal deficit than the negative impacts over the horizon which were observed in the cumulative dynamic multiplier graph in Figure 7 & 8.

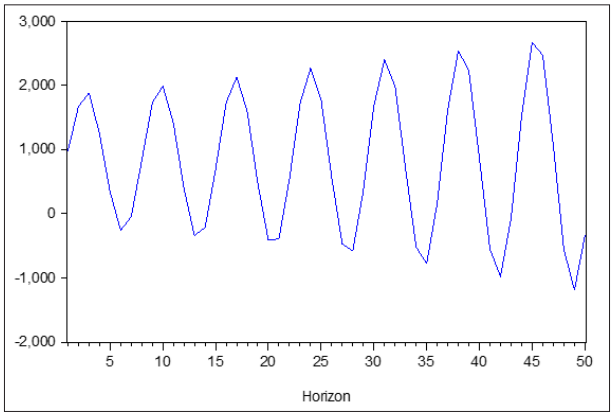

Figure 7: CDM-7- Response of Fiscal Deficit by Positive Changes in Unemployment Rate
Source: Plotted by Author

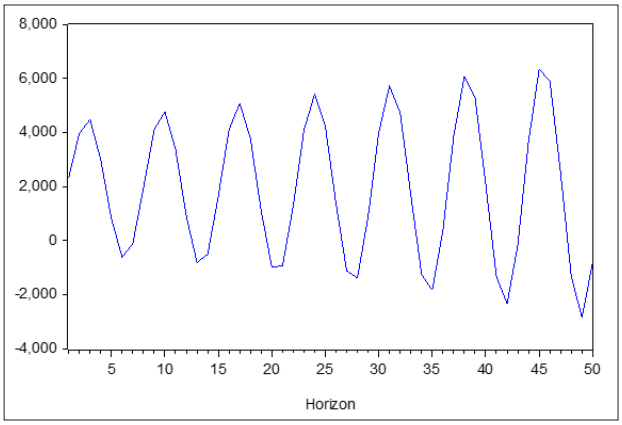

Figure 8: CDM-8- Response of Fiscal Deficit by Negative Changes in Unemployment Rate
Source: Plotted by author

The positive and negative changes in income inequality have more explosive positive effects on the fiscal deficit than the negative impacts which were observed in the cumulative dynamic multiplier graph in Figure 9 & 10.

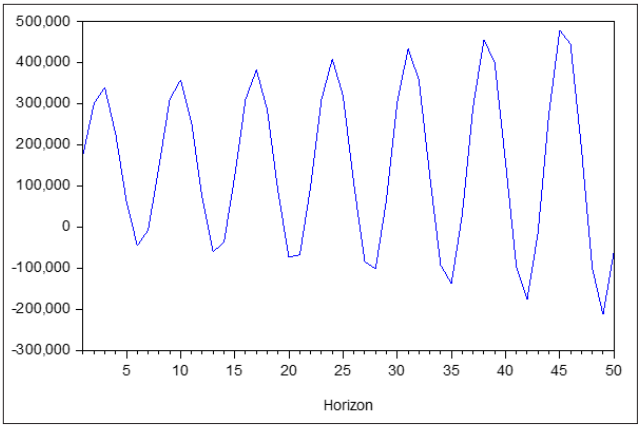

Figure 9: CDM-9- Response of Fiscal Deficit by Positive Changes in Income Inequality
Source: Plotted by Author

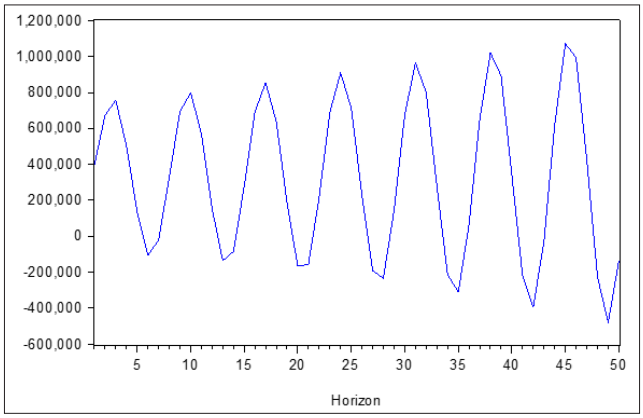

Figure 10: CDM-10- Response of Fiscal Deficit by Negative Changes in Income Inequality
Source: Plotted by Author

There is higher positive shock on fiscal deficit than negative shock as an increase in defense expenditure during the periods of horizon as shown in the cumulative dynamic multiplier graph in Figure 11.

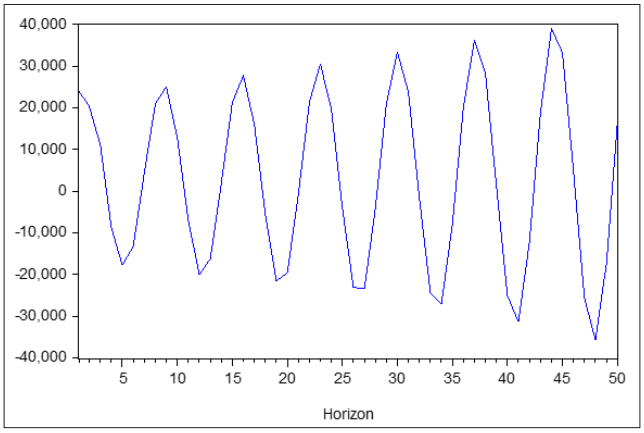

Figure 11: CDM-11- Response of Fiscal Deficit by Positive Changes in Military Expenditure
Source: Plotted by Author

Residual Test

According to Page (1954) model, the NARDL model is stable since CUSUM of squares line passes through the ±5% significant level as shown in Figure 12 below.

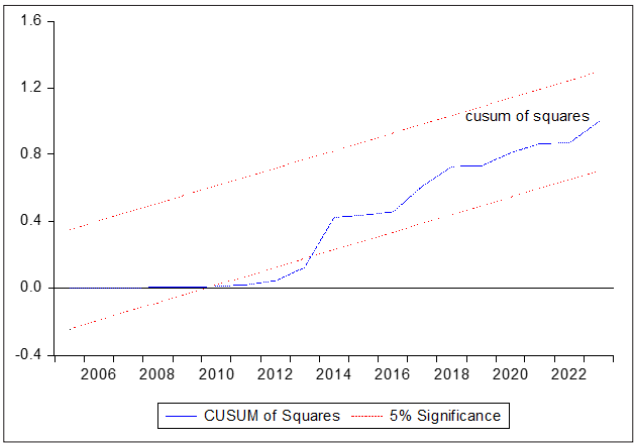

Figure 12: Stability
Source: Plotted by Author

The residual test of NARDL model for heteroscedasticity and serial correlation through Breusch-Pagan method revealed that the model contains heteroscedasticity and serial correlation as seen in Table 1 below where F, nR2 statistic at H0=no heteroscedasticity and no serial correlation are rejected [22].

Table 7: Residual Test

Heteroscedasticity Test			
F-Statistic	5.832943	Prob. F(29,38)	0.0000
Obs*R-Squared	55.52627	Prob. Chi-Square(29)	0.0021
Scaled Explained SS	89.34380	Prob. Chi-Square(29)	0.0000
Serial Correlation Test			
F-Statistic	6.910780	Prob. F(2,36)	0.0029
Obs*R-Squared	18.86464	Prob. Chi-Square(2)	0.0001

Source: Calculated by Author

According to, the residual test for normality reveals that the Q-Q plot between quantile of normal and quantile of residuals did not merge together in normal distribution line which is depicted in Figure 13. Therefore,the residuals are not normally distributed.

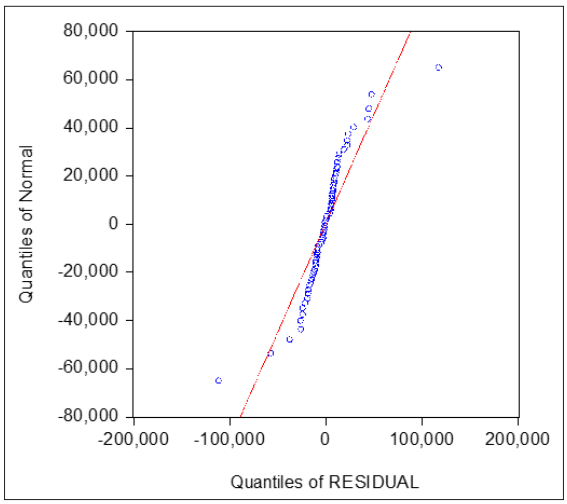

Figure 13: Normality Test
Source: Plotted by Author

Residuals of the NARDL model when fitted in Wavelet Shrinkage Estimator showed volatility of the noise which moved around zero applying Haar (1910) (Figure 14).

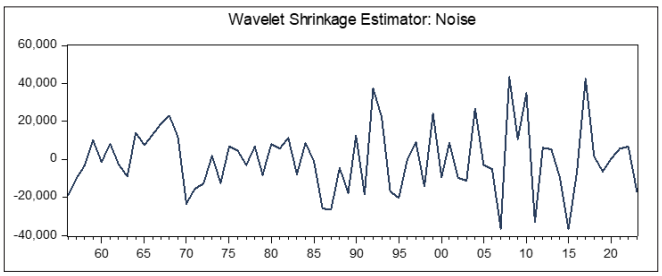

Figure 14: Wavelet Shrinkage Estimator
Source: Plotted by Author

Asymmetric Effects

There is no asymmetric effect of positive and negatives changes of GDP per capita on the fiscal deficit of India since probability of F statistic (1,38) =0.1206 and Chi-square (1) statistics=0.1206 are greater than 5% at H0=symmetry or no asymmetry which is accepted at 73% level as recorded by Wald test (1943) (Table 8).

Table 8: Asymmetry-1

Null Hypothesis: C(4)+C(5)+C(6)+C(7)+C(8)=C(9)+C(10)+C(11)+C(12)+C(13)			
Test Statistic	Value	df	Probability
t-statistic	0.347328	38	0.7303
F-statistic	0.120637	(1, 38)	0.7303
Chi-square	0.120637	1	0.7283

Source: Calculated by Author

Wald test revealed that there is no asymmetric effect of positive and negatives changes of inflation rate on the fiscal deficit of India since probability of F statistic (1,38) =0.019 and Chi-square (1) statistics=0.019 are greater than 5% at H0=symmetry or no asymmetry which is accepted at 89% level(Table 9).

Table 9: Asymmetry-2

Null Hypothesis: C(14)+C(15)+C(16)=C(17)			
Test Statistic	Value	df	Probability
t-statistic	-0.138332	38	0.8907
F-statistic	0.019136	(1, 38)	0.8907
Chi-square	0.019136	1	0.8900

Source: Calculated by Author

Wald test implies that there is no asymmetric effect of positive and negatives changes of external debt % of GDP on the fiscal deficit of India since probability of F statistic (1,38) =0.728 and Chi-square (1) statistics=0.728 are greater than 5% at H0=symmetry or no asymmetry which is accepted at 39% level(Table 10).

Table 10: Asymmetry-3

Null Hypothesis: C(18)+C(19)+C(20)+C(21)+C(22)=C(23)			
Test Statistic	Value	df	Probability
t-statistic	0.853602	38	0.3987
F-statistic	0.728637	(1, 38)	0.3987
Chi-square	0.728637	1	0.3933

Source: Calculated by Author

Wald test confirmed that there is no asymmetric effect of positive and negatives changes of unemployment rate % of total labour force on the fiscal deficit of India since probability of F statistic (1,38) =0.033 and Chi-square (1) statistics=0.033 are greater than 5% at H0=symmetry or no asymmetry which is accepted at 85% level(Table 11).

Table 11: Asymmetry-4

Null Hypothesis: C(24)=C(25)			
Test Statistic	Value	df	Probability
t-statistic	-0.183755	38	0.8552
F-statistic	0.033766	(1, 38)	0.8552
Chi-square	0.033766	1	0.8542

Source: Calculated by Author

Wald test implies that there is no asymmetric effect of positive and negatives changes of income inequality on the fiscal deficit of India since probability of F statistic (1,38) =0.073 and Chi-square (1) statistics=0.073 are greater than 5% at H0=symmetry or no asymmetry which is accepted at 78% level (Table 12).

Table 12: Asymmetry-5

Null Hypothesis: C(26)=C(27)			
Test Statistic	Value	df	Probability
t-statistic	-0.270964	38	0.7879
F-statistic	0.073422	(1, 38)	0.7879
Chi-square	0.073422	1	0.7864

Source: Calculated by Author

Wald test assured that there is no asymmetric effect of positive and negatives changes of military expenditure on the fiscal deficit of India since probability of F statistic (1,38) =1.45 and Chi-square (1) statistics=1.453 are greater than 5% at H0=symmetry or no asymmetry which is accepted at 23% level (Table 13).

Table 13: Asymmetry-6

Null Hypothesis: C(28)=C(29)			
Test Statistic	Value	df	Probability
t-statistic	1.205444	38	0.2355
F-statistic	1.453095	(1, 38)	0.2355
Chi-square	1.453095	1	0.2280

Source: Calculated by Author

Limitations

The NARDL model contains some general limitations. The data on the same variables were taken from various sources in different time periods especially for unemployment rate, external debt, and gross fiscal deficit of India. Personal computations were done in case of defense expenditure from 1951 to 1959.National public debt was not taken to relate debt and fiscal deficit of India. Only CPI was treated as inflation and no WPI was taken. Moreover, exchange rates (NEER or REER) that determined fiscal deficit via inflation were not taken in this model. The comparative study could be done by applying quantile regression or OLS regression or non-parametric analysis which may be released good outcomes. So, there is enough scope of future research relating to this model.

Policy Considerations

It is necessary to cut government expenditure, especially cutting non-plan expenditure, defense expenditure while increase in growth-led deficit financing with employment generation is highly admissible. Monitoring on increasing tax revenues, sustainable plan expenditure and poverty eliminating projects are welcome. Anti-cyclical fiscal and monetary policy, climate finance, fiscal expansion in recession

or depression should be given priority. Fiscal convergence in state fiscal deficit should be achieved in India [23].

Conclusions

The NARDL model of fiscal deficit of India during 1951-2023 concludes that the positive changes of GDP per capita at lag 4, inflation at level and lag 2, external debt at level led to positive impacts on fiscal deficit while GDP per capita at lag 1 & 3, inflation at lag 2 and external debt at lag 3 led to negative impacts on fiscal deficit significantly. On the other hand, negative changes of external debt at lag 4, led to positive impact on fiscal deficit while GDP per capita at lag 4 and external debt at lag 3 led to negative impacts on fiscal deficit significantly. The positive and negative changes of unemployment rate, income inequality and defense expenditure have positive impacts on fiscal deficit insignificantly.

In the short run, positive changes of GDP per capita at level, external debt at level, lag 1 & 2 have significant positive impacts on fiscal deficit while negative changes of GDP per capita at lag 2 & 3 have positive impacts on fiscal deficit significantly. The positive changes of GDP per capita at lag 3, inflation rate at lag 1 and external debt at lag 3 have negative impacts on fiscal deficit significantly. In the long run, positive changes of inflation at lag 1 have positive impacts on fiscal deficit and fiscal deficit of the previous year has negative impact on fiscal deficit of current period significantly. The cointegrating equation is converging towards equilibrium significantly at the speed of adjustment of 117% per annum towards equilibrium. Only positive changes of inflation rate at lag one have positive influence on fiscal deficit significantly. Other determinants are insignificant. The responses of positive and negative shocks from the positive and negative changes of all determinants on fiscal deficit in cumulative dynamic multiplier are explosive. The model is stable and non-normal having heteroscedasticity and serial correlation problems. There are symmetric long run effects from the positive and negative changes of factors of fiscal deficit.

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Conflict of interests

There is no conflict of interests in publication of this paper.

References

1. Shin Y, Yu B, Greenwood-Nimmo M (2014) Modelling Asymmetric Cointegration and Dynamic Multipliers in an ARDL Framework https://link.springer.com/chapter/10.1007/978-1-4899-8008-3_9.
2. Bhowmik D (2017) India's fiscal deficit: A macro-econometric approach. http://debeshbhowmik.weebly.com/my-publication.html.
3. Patra S (2017) Impact of Fiscal Responsibility and Budget Management on Deficit in India. The Indian Economic Journal Special Issue 95: 100-102.
4. Fouzdar AS (2022) Dynamics of India Fiscal Deficit: An Analytical Study of Issues and Management PhD Thesis. Dayalbagh Educational Institute https://shodhganga.inflibnet.ac.in/handle/10603/512601.
5. Rasid M Nexus between inflation and fiscal deficit in India: ARDL analysis. https://www.gims.net.in/pdf/research/nexus-between-inflation-and-fiscal-deficit-in-india-auto-regressive-distributed-lag-model-analysis.pdf.
6. Sharma V Mittal A (2019) Fiscal deficit, capital formation, and economic growth in India: a nonlinear ARDL model. Decision 46: 353-363.
7. Sharma V, Mittal A (2021) Revisiting the Dynamics of the Fiscal Deficit and Inflation in India: The Nonlinear Autoregressive Distributed Lag Approach. Ekonomika regiona [Economy of region 17: 318-328.
8. Sharma V, Adil M H, Fatima S, Mittal A (2021) Asymmetric Effect of Fiscal Deficit on Current Account Deficit: Evidence from India. Vision 28: 480-493.
9. Bhat J A, Sharma N K (2020) Identifying fiscal inflation in India: some recent evidence from an asymmetric approach. Journal of Economics, Finance and Administrative Science 25: 363-393.
10. Adedokun A, Adeniyi IA, Olaniyi CO (2024) The asymmetric effect of fiscal deficits on macroeconomic stability in Nigeria: evidence from nonlinear autoregressive distributed lag (NARDL), International Trade, Politics and Development 8: 144-164.
11. Asif M, Sharma V, Sharma HP, Aldawsari H, Wani SK, et al. (2023) Is fiscal deficit 'curse' or 'haven' for environmental quality in India? Empirical investigation employing battery of distinct ARDL approaches, Heliyon 10: 9-20711.
12. Dickey D, Fuller WA (1979) Distribution of the estimates for autoregressive time series with a unit root. Journal of the American Statistical Association74: 427-431.
13. Wilk MB, Gnanadesikan R (1968) Probability plotting methods for the analysis of data. Biometrika, Trust 55: 1-17.
14. Page ES (1954) Continuous Inspection Scheme. Biometrika 41: 100–115.
15. Donoho DL, Johnstone IM (1992) Non-classical Minimax Theorems, Thresholding, and Adaptation. https://web.stanford.edu/dept/statistics/cgi-bin/donoho/wp-tent/uploads/.
16. Haar A (1910) Zur Theorie der orthogonalen Funktionensysteme. Mathematische Annalen 69: 331-371.
17. Wald A (1943) Tests of Statistical Hypotheses Concerning Several Parameters When the Number of Observations Is Large. Transactions of the American Mathematical Society, 54: 426-482.
18. Dutt R, Sundaram KPM (1998) Indian Economy. New Delhi: S. Chand & Co. Retrieved from: https://www.scribd.com/doc/236485148/indian-economy-dutt-sundaram.
19. Krishna R (1984) The growth of aggregate unemployment in India: trends, sources, and macroeconomic policy options https://documents1.worldbank.org/curated/en/190601468752708595/pdf/multi0page.pdf,Accessed.
20. West Cott DN, Bednarzik RW (1981) Employment & unemployment: A Report in 1980. https://www.bls.gov/opub/mlr/1981/02/.
21. NSS 68th Round (2011) Labour and Employment. https://mospi.gov.in/sites/default/files/publication_reports/nss_rep_563_13mar15.pdf,
22. Breusch TS, Pagan AR (1979) A Simple Test for Heteroscedasticity and Random coefficients variation. Econometrica 47: 1287-1294.
23. Banday UJ, Aneja R (2019) Twin deficit hypothesis and reverse causality: a case study of China. https://doi.org/10.1057/s41599-019-0304-z.