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Indian Fiscal Deficit in Autoregressive Distributed Lag (ARDL) 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 Auto Regressive Distributed Lag model. The paper found that the fiscal deficit contains a quadratic trend and denoised wavelet shrinkage. Automatically selected ARDL (3,0,2,3,0,0,3) model, where Akaike Information Criterion (AIC) is minimum, showed that the fiscal deficit is positively associated with inflation and negatively related with debt and per capita GDP significantly in the long run while positively related with inflation and debt and negatively related with military expenditure in the short run significantly. The cointegrating equation states that inflation and debt are directly related and GDP per capita is inversely related to fiscal deficit, and it is converging towards equilibrium at the speed of adjustment of 92% per annum significantly. Unemployment and income inequality have a positive impact on the fiscal deficit in the short and long run insignificantly. The model is stable and contains no serial correlation but contains heteroscedasticity and non-normality. The model demands expenditure-reducing policies in non-plan and defence expenditure, as well as employment and poverty amelioration-oriented fiscal financing at a threshold limit, to achieve sustainable economic growth.

Keywords: *External Debt; Fiscal Deficit; Gross Domestic Product Per Capita; Income Inequality; Inflation; Unemployment Rate*

JEL Classification Codes: C22, C23, D63, E24, E31, E62, H60, H63

Introduction

Modern Monetary Theory (MMT) is a post-Keynesian thought where fiscal deficit does not matter, and the government creates huge deficit to issue base money for large-scale spending to alleviate poverty, climate change and unemployment through financing by taxation or issue debt. Government can issue its currency and pay off debt obligations, although it can create hyperinflation. MMT is not based on the concept that deficits will burden the next generation. MMT may consider three types of policies, such as pure debt finance, pure monetary finance and debt finance for a longer period. Under monetary finance, the government generally follows an inflation target. Both the fiscal and monetary policy mix may be applied. MMT is based on the pre-NAIRU, or fixed, Philips Curve concepts. The MMT financing program consists of a combination of high deficits, tax, borrowing, and monetary finance (Dowd, 2020). In MMT, a state can control its currency and finance a fiscal deficit at low or no cost through money creation and direct funding from the central bank or to pay off debts, although too much additional deficit financing for public spending or tax cuts in an economy with full employment will push up inflation. MMT depends on central bank's autonomy of setting interest rates from the short term to the long term

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through a variety of techniques. MMT gives priority to fiscal policy over the monetary policy. It can minimise real structural constraints on government macro-economic policy in the context of global capital flows (Jackson, 2020).

The Goldilocks theory of fiscal deficits assumed that if the interest rate is less than the growth rate and induces an increase in the fiscal deficit, then debt will explode, so that under zero lower bound, the relationship between deficit and debt can become non-monotonic, and both low and high deficits can increase debt. If income inequality rises, then fiscal space outside zero lower bound expands but decreases at zero lower bound (Mian, Straub & Sufi, 2024).

Policy makers could not control fiscal balance; rather, it is the need of the economic system where policy makers set spending, tax rate, and predict tax revenues and total spending but cannot control budgetary dynamics. Fiscal deficit is considered sustainable when a sovereign government has the financial flexibility to meet the demands of deficits under tight rules of accounting in monetary freedom for which it did not promote financial crisis (Tymoigne, 2023).

India's fiscal policy aims to maintain sustainable economic growth with price stability so as to achieve full employment and equity, motivating an increase in tax revenue, public expenditure and reasonable borrowing. Fiscal Responsibility and Budget Management Act (FRBMA), 2003, is functioning to improve macro-economic fundamentals. The framework of GST has been playing a vital role in India's fiscal structure.

Review of Literature

Fiscal policy may determine the price level, even if monetary authorities pursue an inflation targeting strategy using fiscal theory of price level in conducting monetary and fiscal policy interactions, which was successful in the sustainability of the Italian government deficit over the period of 1861–2020, applying cointegration where the primary public surplus and public debt are positively related in the basic fiscal theory of price level equation (Congregado, Díaz-Roldán & Esteve, 2023).

In transitional economies of southeast Europe, it was found that public debt to GDP, foreign direct investment in GDP, exports, and imports in GDP have an important effect on economic growth, while public debt and imports have a positive influence on economic growth, unlike exports and foreign direct investment, which show an adverse effect on economic growth and the inflation rate, and the employment rate and the real interest rate do not show any significant consequences on economic growth during 2005-2019 by using Fixed effect and Dynamic panel Linear Regression analysis (Gllogjani & Balaj, 2021).

In India during 1980-81-2012-13, the fiscal deficit had an adverse effect on growth, but it promotes growth if deficit is spent on capital formation following golden rule of public finance. The result was found by applying vector error correction model (Ramu & Gayithri, 2016).

In Bangladesh, real fiscal deficit and real GDP are positively cointegrated, which was found by using cointegration and vector error correction analysis from 1993/94 to 2015/16 (Hussain & Haque, 2017).

Sore, Ayana and Demissie (2024) examined fiscal deficit in 42 Sub-Saharan African nations between 2011 and 2021 by applying the GMM model, which revealed that an increase in fiscal deficit led to an increase in economic growth in the short run and a decrease in the long run. Real effective exchange rates and inflation hinder economic growth in the short run, and gross fixed capital formation has a positive impact on growth in the long run.

Banerjee *et al.* (2022) examined the effects of fiscal deficits on inflation by estimating Phillips curve-type models augmented with fiscal deficits, using panel data of 21 advanced economies from 1972 to 2011 in simple linear models under fiscal and monetary policy regimes. It found that the relationships between higher deficits and future inflation vary notably between the fiscally led and monetary-led regimes, and it is much weaker in the monetary-led regime than in the fiscally led regime. Under a fiscally led regime, the corresponding effect is over five times as high in magnitude. Real GDP growth is associated with economically stronger effects on inflation in the fiscally led regime than in the

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monetary-led regime. Similar to fiscal deficits, the coefficient on real GDP growth in the intermediate regimes falls between those estimated in the fiscally led and monetary-led regimes. An exchange rate appreciation obtains the expected negative sign with a statistically significant coefficient only in the monetary-led regime such that an appreciation is associated with lower future inflation. Thus, higher deficits are associated with lower future inflation if monetary policy is independent rather than non-independent.

Philip (2021) employed Vector Autoregression model in Kenya to find the nexus between a budget deficit and selected macroeconomic variables during 1976 – 2018 following Keynesian Mundell–Fleming framework and found that shocks from both interest rate and exchange rate had a positive impact on budget deficit. External debt servicing and current account deficit shocks had a negative impact on the budget deficit.

Banday and Aneja (2019) examined the nexus between budget deficit and current account in the Chinese economy during 1985-2016 using ARDL model and showed that budget deficit decreases current account, which is known as a negative shock, while budget deficit increases current account which is known as a positive shock. Growth shock, and changes in interest rate and exchange rate led to divergence of deficit so that stability of interest rate and inflation were considered as target variable.

Ekpo, Akpan and Ekaetor (2024) studied the relation between growth and fiscal deficit in Nigeria from 1981 to 2021 using ARDL and Granger causality test and found that gross capital formation and trade openness had a positive and significant effect on economic growth both in the long-run and short-run. Unemployment rate, interest rate and inflation rate affect growth negatively in the long-run and short-run. The exchange rate had an insignificant positive impact on economic growth in the long run but in the short run. There is a unidirectional causality between real gross domestic product and fiscal deficit, and there is causality from real GDP to fiscal deficit.

India's fiscal deficit has been increasing at the rate of 1.06% per year linearly and 0.1317% per year exponentially during 1970-2015 which has two upward structural breaks in 1978 and 2009.The Indian fiscal deficit is positively related to the 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 (centre + state) was found to be 6% of GDP, beyond which GDP growth is negative. The state fiscal deficit has no significant convergence patterns (Bhowmik, 2017).

The Fiscal Responsibility and Budget Management Act has a positive impact on reducing fiscal deficit in India because of achievement of fiscal consolidation and becoming revenue-led while it was able to reduce capital and plan expenditure, which was tested empirically during 1989-90-2015-16 (Patra, 2017).

Darshini and Gayithri (2021) used fixed effect model in 14 Indian states to relate per capita GSDP, conditional transfers and fiscal space during 1981-81-2014-15 with sub-periods of 1981-1991,1992-2003 and 2003-2014 respectively and observed that there is positive and significant relation between per capita GSDP and discretionary transfers during 1981-1991 and 2003-2014 while it is insignificant during 1992-2003 but there is negative and significant correlation with political affiliations and fiscal space during 2003-2014.

The OLS model in India during 1990-91-2019-20 revealed that current account deficit, interest payment, and real effective exchange rate have a negative impact, while the saving-investment gap, gross domestic product, consumer price index and terms of trade have a 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 the Wald test. Johansen cointegration states that the impact of fiscal deficit on economic growth has a negative relation with tax revenue and fiscal deficit

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and a positive relation with private investment and exchange rate. Cointegrating relation converged to equilibrium significantly (Fouzdar, 2022).

Gnimassoun and Do Santos (2021) tested on 110 developing countries during 1998-2017 by cross section regression analysis and found that fiscal balance is positively related with real GDP per capita, inflation rate, growth rate, and currency anchoring while negatively related with public debt % of GDP, real interest rate, and financial development. The results are robust and face multicollinearity.

Significance of the study

The paper endeavours to examine the short run and the long run 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 Auto Regressive Distributed Lag model. The paper also verified the nature of Indian gross fiscal deficit in nonlinear fashion, interpreting the Wavelet noise estimate and decomposition under H.P. Filter model.

Methodology

In analysing the behaviour of gross fiscal deficit of India from 1950-51 to 2023-24, the paper used nonlinear trend estimates, H.P. Filter model (1997), and Wavelet shrinkage estimator following Donoho and Johnstone (1996) and Haar model (1910). To examine the stationarity, it applied Augmented Dicky and Fuller (1979) test, assuming constant trends for all series, and then applied automatic selection of lag in ARDL model of Pesaran, Shin and Smith (2001), and for Bound test, the model of Pesaran and Shin (1999) was utilised. The residual test for serial correlation and heteroscedasticity through the Breusch-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.

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 from World Bank and for the data on the unemployment rates of 1st, 2nd, 3rd, and annual plans were taken from Dutt and Sundaram (1998). Data on unemployment rates from 1970 to 1990 were collected from Krishna, 1984; Westcott and Bednarzik, 1981; National Sample Survey Office (2011-12), respectively. The data on external debt (in million $) during 1951-1969 was taken from IMF, from 1970 to 1990, it was taken from macrotrends.net, and from 1991 to 2023, it 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=h_{10}-b_{50}).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).

Results and Discussion
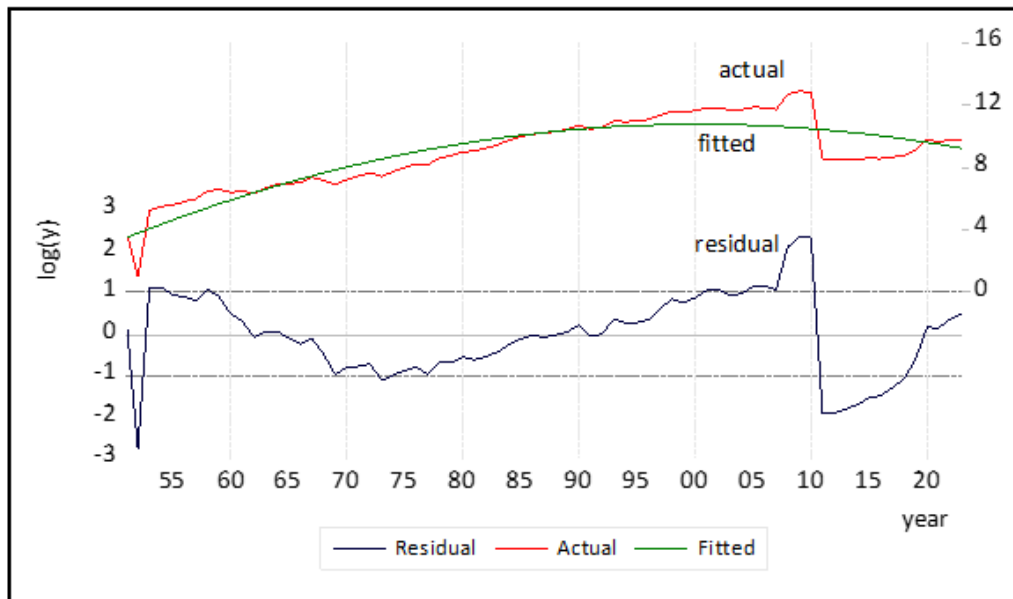
A. Trend of fiscal deficit

Fiscal deficit of India from 1951 to 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.

$Log(y)=3.207+0.3017t-0.00299t^2+u_i$

      (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.
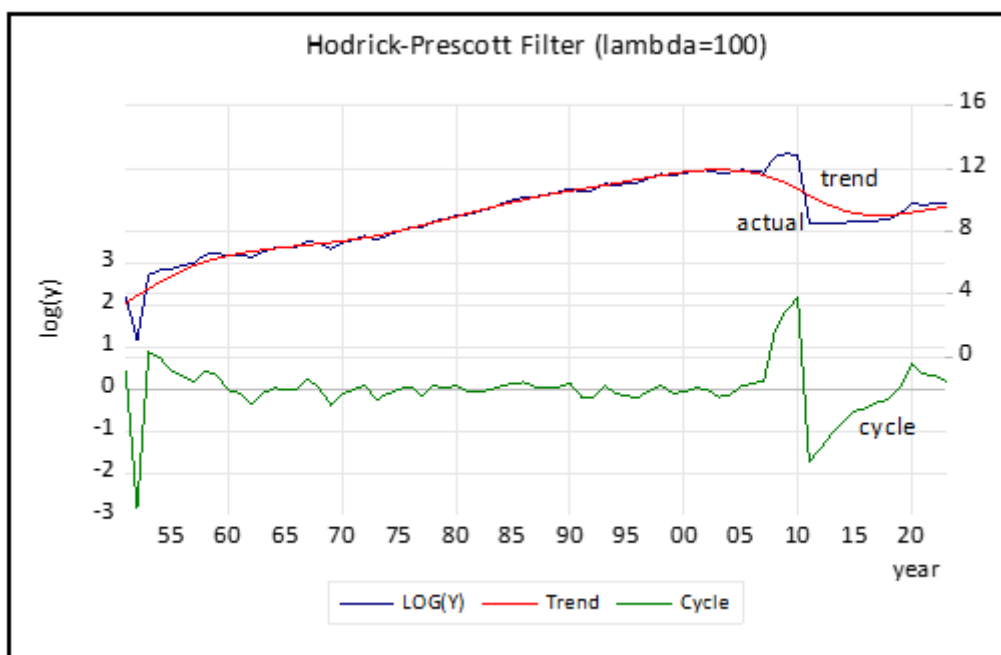
The fitted trend line is shown in Figure 1 below.

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Source: Plotted by author
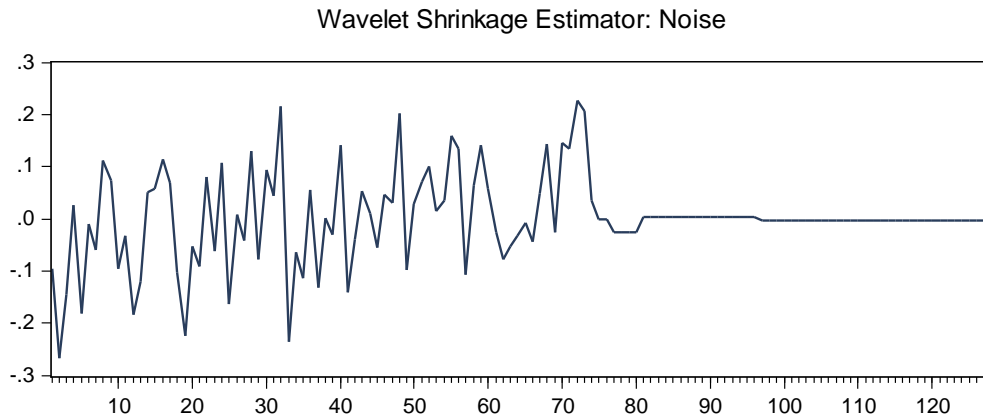**Figure 1: Trend Line of Fiscal Deficit**

Under the decomposition of H P Filter model, the trend is similar with quadratic trend while there are small cyclical fluctuations and volatility after 2007 which is shown in Figure 2 below.

Source: Plotted by author
Figure 2: Decomposition

In the Discrete Wavelet Transform in maximum 7-scale decomposition during 1951-2023 filtering from Haar model (1910), it was found that the denoised function of fiscal deficit of India is converging towards zero, which is seen in Figure 3 below.

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Wavelet Shrinkage Estimator: Noise

Source: Plotted by author.

Figure 3: Denoised Function of Fiscal Deficit
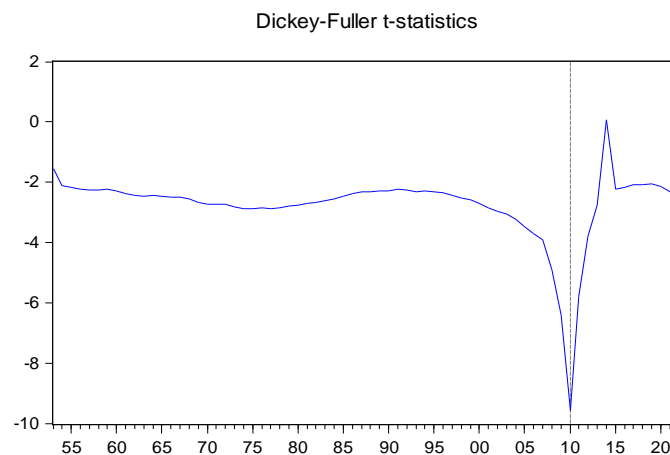
B. Unit root test

According to ADF unit root test 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 has 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

It has a break unit root in 2010 according to ADF test statistic where ADF=-9.5606(p<0.01) and 5% critical value is -4.859812. It is shown in Figure 4 below.

Dickey-Fuller t-statistics

Source: Plotted by author

Figure 4: Break Unit Root.

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C. Estimated ARDL model

The ARDL (3,0,2,3,0,0,3) model has been automatically selected with maximum 4 lag under minimum AIC which is estimated below.

$$y_t = 0.578y_{t-1} - 0.0383y_{t-2} - 0.461y_{t-3} - 1.558x_1 + 24159.5x_2 - 40393.67x_{2t-1}$$

(4.45)*   (-0.27)   (-3.46)*   (-1.68)**   (3.23)*   (-4.02)*

$$+23657.95x_{2t-2} - 0.385x_3 + 0.414x_{3t-1} + 0.496x_{3t-2} - 2.006x_{3t-3}$$

(3.39)*   (-0.75)   (0.62)   (0.76)   (-3.6)*

$$+983.39x_4 + 207130.4x_5 + 24840.74x_6 - 15853.60x_{6t-1} - 35861.85x_{6t-2}$$

(0.26)   (0.88)   (1.34)   (-0.59)   (-1.33)

$$+32157.89x_{6t-3} - 55711.67$$

(1.73)**   (-0.91)

R^2=0.845,F=16.78*,AIC=24.132,SC=24.71,DW=1.85,*=significant at 5% level,**=significant at 10% level, n=70, y=gross fiscal deficit(in Rs.Cr.),x_1=GDP per capita (in Rs),x_2=CPI (percentage change per year),x_3= Total external Debt(million dollar),x_4=unemployment rate (percentage of labour force),x_5=income inequality(h10-b50),x_6=military expenditure(million Rs),t values are in the first brackets.

The estimated ARDL (3,0,2,3,0,0,3) model states that fiscal deficit of India during 1951-2023 is positively related to fiscal deficit of previous year and negatively related to previous three years back significantly. Gross Domestic Product per capita of India at level affected negatively on fiscal deficit at level significantly. Inflation rate at level and at (t-2) period affected positively on fiscal deficit and inflation at(t-1) period affected negatively at 5% significant level. External debt at (t-3) period is negatively related to fiscal deficit. Unemployment rate and income inequality affected the fiscal deficit positively, which is statistically insignificant. Military expenditure at (t-3) period impacted fiscal deficit positively at 5% significant level. In other periods, military expenditure has both positive and negative effects insignificantly.
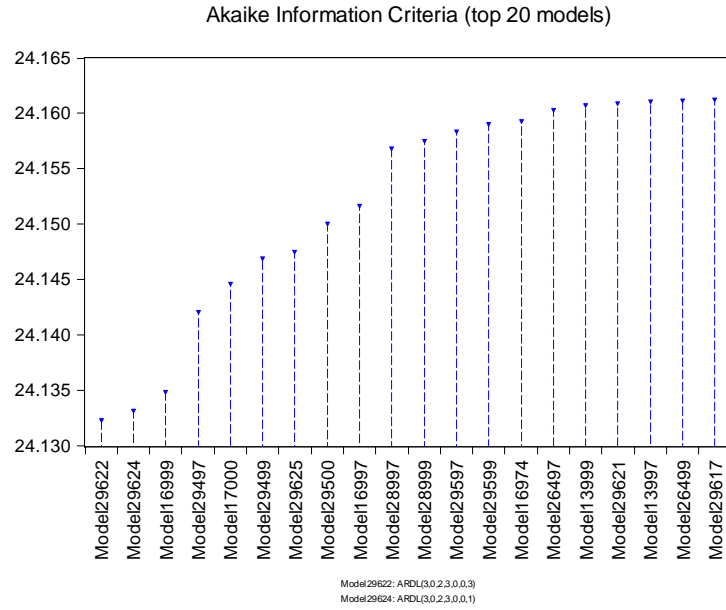
[i]Bound test

Bound test at H0=no level relationship reveals that F statistic=6.741 and t statistic=-5.4516 which are greater than the critical values of I(0) and I(1) at 10%, 5% and 1% significant levels, and they are asymptotic, which is shown in Table 2.

Table 2: Bound Test

|	F statistic		
N=70	10%	5%	1%
I(0)	2.233	2.629	3.436
I(1)	3.407	3.906	5.044
	T statistic		
I(0)	-2.570	-2.860	-3.43
I(1)	-4.04	-4.38	-4.99

Source: Calculated

Thus, there is cointegration among the variables and there is no barrier to fit ARDL (3,0, 2, 3, 0, 0,3) model in which AIC is minimum (24.132) among the best 20 models which is shown in Figure 5.

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Akaike Information Criteria (top 20 models)

Model29622: ARDL(3,0,2,3,0,0,3)
Model29624: ARDL(3,0,2,3,0,0,1)

Source: Plotted by author
Figure 5: The Fitted ARDL Model

The actual and fitted lines of fiscal deficit along with residual are given in Figure 6 where the fitted line has been approaching towards equilibrium or zero.
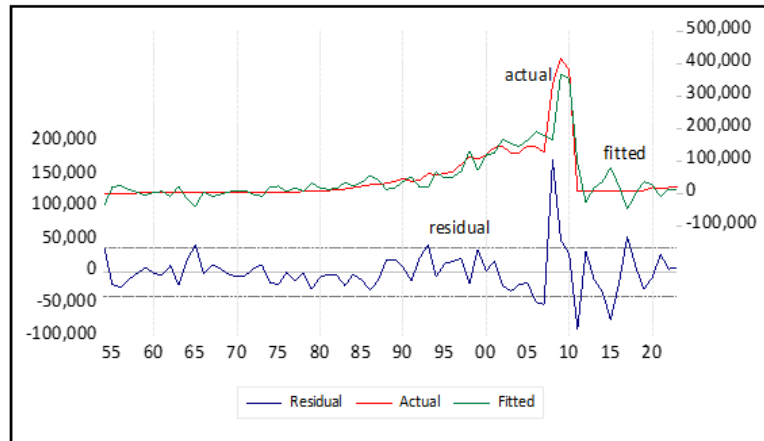
Source: Plotted by author
Figure 6: Actual vs Fitted

[ii] Conditional Error Correction

The conditional error correction model is estimated below

$$y_t = [-0.9209y_{t-1} - 1.558x_1 + 7423.77x_{2t-1} - 1.481x_{3t-1}$$

$$(-5.45)^* \qquad (-1.68)^{**} \quad (5.29)^* \qquad (-3.86)^*$$

$$+983.39x_4 + 207130.4x_5 + 5283.17x_{6t-1}]$$

$$(0.26) \qquad (0.88) \qquad (0.42)$$

$$+[0.499dy_{t-1} + 0.461dy_{t-2} + 24159.5dx_2 - 23657.95dx_{2t-1} - 0.385dx_3 + 1.51dx_{3t-1}$$

$$(3.97)^* \qquad (3.46)^* \qquad (3.23)^* \qquad (-3.39)^* \qquad (-0.75) \qquad (2.53)^*$$

$$+2.0dx_{3t-2} + 24840.74dx_6 + 3703.961dx_{6t-1} - 32157.89dx_{6t-2}]+55711.67$$

$$(3.60)^* \qquad (1.34) \qquad (0.20) \qquad (-1.73)^{**} \qquad (-0.91)$$

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R^2=0.62, F=5.02*, n=70, AIC=24.132, SC=24.71, DW=1.85, *=significant at 5% level, **=significant at 10% level, t values are in first brackets.

The conditional error correction states that in the long run, fiscal deficit at level is negatively related with fiscal deficit of the previous period significantly. GDP per capita at level and external debt at the previous period affected the fiscal deficit negatively, while inflation at the previous period affected the fiscal deficit significantly. Unemployment rate, income inequality and military expenditure at (t-1) period induced a fiscal deficit positively at a 5% insignificant level. In the short run, the change of fiscal deficit at (t-1) and (t-2) periods has a positive significant impact on fiscal deficit at that level. Incremental Inflation rates at t and (t-1) periods have positive and negative impacts on fiscal deficit significantly, and incremental external debt at (t-1) and (t-2) have positive impacts on fiscal deficit significantly. Incremental Military expenditure at (t-2) period is negatively associated with fiscal deficit at 10% significant level. The model is a good fit.

[iii] Error correction

The error correction model is given below

$$y_t = -0.9209CE + [0.499dy_{t-1} + 0.461dy_{t-2} + 24159.5dx_2 - 23657.95dx_{2t-1} - 0.385dx_3 + 1.51dx_{3t-1}$$

                (-7.25)*   (4.55)*   (3.933)*   (4.57)*   (-4.63)*   (-0.91)

(3.09)*

$$+2.0dx_{3t-2} + 24840.74dx_6 + 3703.961dx_{6t-1} - 32157.89dx_{6t-2}]\text{-}55711.67$$

  (4.45)*   (1.55)   (0.22)   (-1.96)*   (-5.27)*

R^2=0.62, F=8.66*, n=70, AIC=23.96, SC=24.35, DW=1.85, *=significant at 5% level, **=significant at 10% level, t values are in first brackets.

In the error correction model, the short run relation between fiscal deficit with its determinants has been specified, where fiscal deficit at level is positively related significantly with its previous years. Fiscal deficit at level is positively related with inflation at level and negatively related with inflation at previous year. Fiscal deficit at level is positively related to the debt at previous years but negatively related at level insignificantly. Military expenditure of previous period is negatively related with fiscal deficit but positively related at level insignificantly. The error correction is significant and approaching equilibrium at the speed of adjustment of 92% per annum.
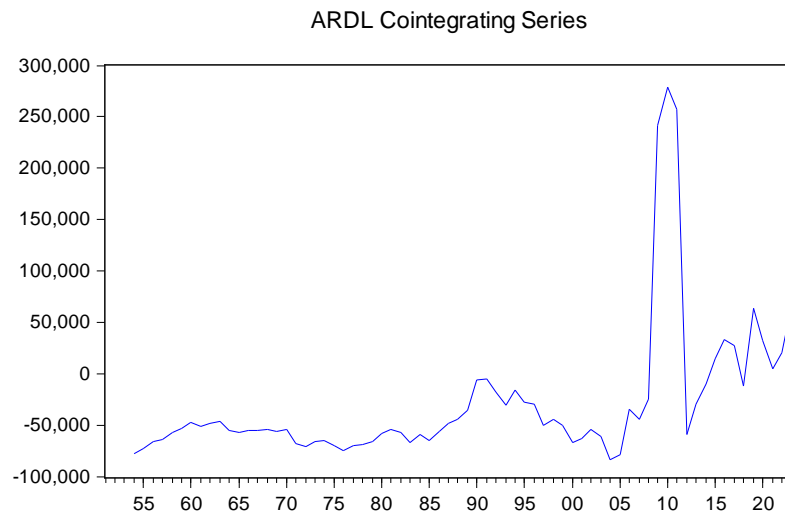
[iv]Cointegration

The cointegrating equation is convergent and significant. It has been approaching equilibrium at the speed of adjustment of 92% per year, where the negative relation between fiscal deficit and GDP per capita and debt is significant, and positive relation with inflation is also significant, while positive relation with unemployment, income inequality and military expenditure is insignificant. So that cointegrating equation does not coincide with the equilibrium line at the zero level.

The cointegrating equation is estimated below.

CE=-0.9209y_{t-1} - (-1.692x_1 + 8061.208x_{2t-1} - 1.608x_{3t-1} + 1067.8308x_4

    (-7.25)*   (-1.67)**   (5.19)*   (-5.14)*   (0.79)

+ 224915.2703x_5 + 5736.8095x_{6t-1})

   (0.34)   (0.66)

In Figure 7, the cointegrating equation is depicted neatly below.

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ARDL Cointegrating Series

Source: Plotted by author.
Figure 7: Cointegrating Equation

D. Residual test

[i] Residual correlogram

The residual correlogram revealed that there are autocorrelation and partial autocorrelation problems because Q stat, values of AC and PAC have probabilities less than 5% level except at 25-32 lags and 1-3 lags which are shown in Figure 8.

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob*
		1	0.060	0.060	0.2666	0.606
		2	-0.153	-0.157	2.0032	0.367
		3	-0.251	-0.237	6.7399	0.081
		4	0.226	0.247	10.632	0.031
		5	-0.059	-0.185	10.904	0.053
		6	-0.288	-0.314	17.438	0.008
		7	-0.167	-0.024	19.671	0.006
		8	0.121	-0.050	20.855	0.008
		9	0.252	0.132	26.121	0.002
		10	-0.169	-0.177	28.513	0.001
		11	-0.015	0.065	28.533	0.003
		12	0.006	-0.054	28.537	0.005
		13	0.120	-0.120	29.817	0.005
		14	-0.165	-0.040	32.277	0.004
		15	0.017	0.103	32.304	0.006
		16	0.029	-0.036	32.384	0.009
		17	-0.009	-0.158	32.391	0.013
		18	-0.106	-0.048	33.483	0.015
		19	-0.002	0.027	33.483	0.021
		20	0.090	-0.077	34.306	0.024
		21	-0.018	-0.028	34.340	0.033
		22	-0.116	-0.103	35.752	0.032
		23	-0.066	-0.087	36.221	0.039
		24	0.082	-0.121	36.957	0.044
		25	-0.009	-0.079	36.965	0.058
		26	-0.050	-0.004	37.253	0.071
		27	-0.004	-0.053	37.255	0.090
		28	0.134	-0.037	39.396	0.075
		29	0.005	-0.095	39.400	0.094
		30	0.007	0.026	39.406	0.117
		31	-0.015	-0.026	39.434	0.142
		32	0.054	-0.051	39.827	0.161

Source: Plotted by author.
Figure 8: Correlogram

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[ii] Serial correlation test

The residuals are not serially correlated according to Breusch-Godfrey Serial Correlation LM Test: where F-statistic but serially correlated according to nR^2 which is shown in Table 3.

Table 3: Serial Correlation LM Test (up to 2 lags)

statistic	value	Degree of freedom	probability
F-statistic	2.456491	Prob. F(2,50)	0.0960
Obs*R-squared(nR^2)	6.262794	Prob. Chi-Square(2)	0.0437

Source: Calculated by author

If the first-difference series of the log variable is taken, then there is no serial correlation problem, as shown in Table 4.

Table 4: No Serial Correlation

statistic	value	Degree of freedom	probability
F-statistic	0.736513	Prob. F(2,57)	0.4833
Obs*R-squared(nR^2)	1.763409	Prob. Chi-Square(2)	0.4141

Source: Author

[iii] Heteroscedasticity test

Breusch-Pagan-Godfrey Heteroskedasticity Test at H0=homoscedasicity implies that according F statistic, nR^2 and Scaled explained SS statistics revealed that H0 is rejected at less than 5% level that is there is problem of heteroscedasticity.

Table 5: Heteroskedasticity Test: Breusch-Pagan-Godfrey

| statistic	value	Degree of freedom	probability
F-statistic	2.157013	Prob. F(17,52)	0.0175
Obs*R-squared(nR^2)	28.94855	Prob. Chi-Square (17)	0.0350
Scaled explained SS	94.25271	Prob. Chi-Square(17)	0.0000

Source: Calculated by author

If the first-difference series of the log variable is taken, then there will be no heteroscedasticity problem, as shown in Table 6.

Table 6: No Heteroscedasticity

statistic	value	Degree of freedom	probability
F-statistic	0.699139	Prob. F(10,59)	0.7213
Obs*R-squared(nR^2)	7.416076	Prob. Chi-Square(10)	0.6857
Scaled explained SS	105.7982	Prob. Chi-Square(10)	0.0000

[iv] Stability test

The model is stable because CUSUM line of residual recursive test is passing between ±5% significant boundaries which are shown below in Figure 9.
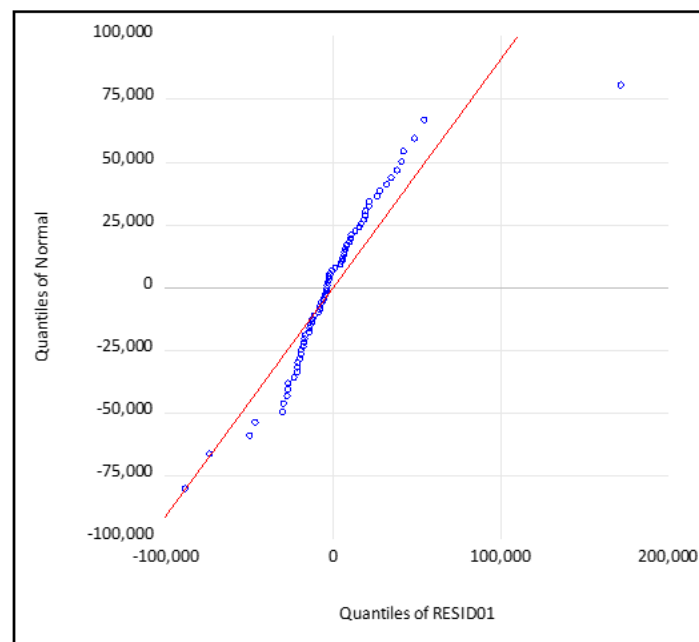
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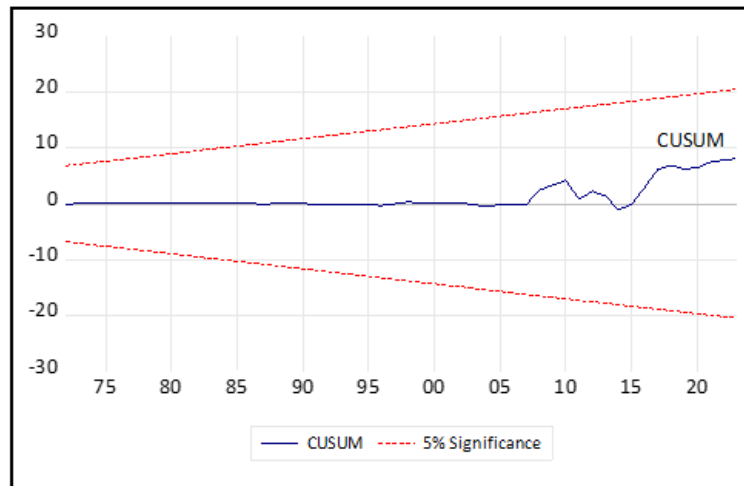
Source: Plotted by author
Figure 9: Stability Test

[v] Normality test

The Q-Q plot of the residuals did not merge with the normal distribution line which implies that the residuals are not normally distributed which is shown in Figure 10.

Source: Plotted by author
Figure 10: Q-Q Plot of Residuals

Policy considerations

Government expenditure reducing policies such as cutting non-plan expenditure, defense expenditure, increasing growth-led deficit financing with employment generation are highly admissible. Monitoring increasing tax revenues, sustainable plan expenditure and poverty-eliminating projects is welcome. Anti-cyclical fiscal and monetary policy, climate finance, and fiscal expansion in recession or depression should be given importance. Fiscal convergence in state fiscal deficit should be achieved.

Increasing debt-GDP ratio affected saving-investment adversely, followed by economic growth (Rangarajan & Srivastava, 2004), while this ARDL model is assured in building relation between fiscal deficit, external debt (% of GDP), and GDP per capita during 1951-2023 in India. Moreover, Rangarajan

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and Srivastava (2004) also found that expansionary fiscal policy produced inflation and adverse BOPs in India, in which the model has also shown both positive and negative effects of inflation in distributed lags. Therefore, controlling inflation rate and imposing a threshold fiscal deficit might be effective for sustainable fiscal policy. The paper observed that there is short and long run positive relation between fiscal deficit and income inequality, however insignificant, while Musibau, Zakari and Taghizadeh-Hesary (2024) examined a significant negative relation in 37 OECD countries during 2001-2015 providing increasing government expenditure. Higher tax revenue has a significant negative shock to unemployment and successive positive shocks in later periods, as evident in Turkey, which was examined by Yılmaz (2023) through structural VAR model from 1990 to 2021. Besides, Saraireh (2020) found higher spending reduced unemployment rate by 0.43% per year during 1990-2019 in Jordan by applying ARDL model. In this paper, ARDL model also verified that there is a positive insignificant relation between fiscal deficit and unemployment rate in India during 1951-2023.

Limitations

There are few limitations in this model. 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, respectively, without changing the units. Back calculations were done in case of defence expenditure from 1951 to 1959. National public debt was not taken into account in building the relation between debt and fiscal deficit of India. Only CPI was used to relate inflation and fiscal deficit, but no WPI was taken. Moreover, exchange rate (NEER or REER) that determined fiscal deficit via inflation was not taken into account in this model. The comparative study could be done with quantile regression or OLS regression or non-parametric analysis, which might be emerged good outcomes. So, there is a scope for future research relating to this model.

Conclusion

The paper concludes that the trend of fiscal deficit of India from 1951 to 2023 is quadratic. Its H.P. filter trend is upward, followed by downward and upward after 2010. The Wavelet shrinkage trend is being denoised towards equilibrium. The selected ARDL (3,0,2,3,0,0,3) model revealed that in the long run, fiscal deficit is correlated with previous years negatively, also, it is positively associated with inflation and inversely related with GDP per capita and debt significantly. Unemployment and income inequality were affected positively at an insignificant rate both in the short and long run. In the short run, fiscal deficit is positively affected by previous year's fiscal deficit, inflation and external debt but negatively affected significantly by military expenditure. The model showed stability and minimum AIC=24.132, containing autocorrelation and heteroscedasticity and no serial correlation and normality. The cointegration equation revealed that debt and inflation have positive impact and GDP per capita has negative impact on fiscal deficit significantly, while unemployment, defence expenditure and inequality have positive impact insignificantly. The cointegration has been converging towards equilibrium significantly at the speed of adjustment of 92% per annum.

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Conflict of interests

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