International Journal of Applied Social Science
(An International Double Blind Peer Reviewed / Refereed Research Journal of Social Science)
Volume 12 (11 & 12), November & December (2025) : 935-942

RESEARCH PAPER
ISSN : 2394-1405 (Print)

Received : 11.10.2025; Revised : 26.10.2025; Accepted : 11.11.2025 **DOI** : https://doi-ds.org/doilink/01.2026-46875869/IJASS/12.11&12/935-942

Public Debt and Economic Growth in India: An ARDL Analysis

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ABSTRACT

The linkage between public debt and economic growth continues to be a central issue in India's development framework, especially in the context of maintaining fiscal sustainability while promoting inclusive growth. This study empirically examines how public debt influences India's GDP growth rate by employing annual time-series data spanning from 1981 to 2023. To enhance the reliability of the estimates, the analysis includes key control variables such as Foreign Direct Investment (FDI), Gross Capital Formation (GCF), Trade Openness (TO), Inflation, and Population. Preliminary stationarity analysis using ADF and PP tests revealed a mixed order of integration at level and first difference. Consequently, Autoregressive Distributed Lag (ARDL) bounds testing approach was employed. The Bounds Test confirmed a stable long-run relationship among the variables. The empirical results present a distinct contrast between time horizons. In the short run the public debt exerts a significant negative impact on growth it indicating immediate fiscal crowding-out effects. But in the long run, the impact becomes statistically insignificant, it suggesting that debt does not permanently hinder economic performance. The Error Correction Term is negative and significant which confirm a rapid speed of adjustment to equilibrium. Diagnostic tests, including Breusch-Godfrey and CUSUM confirm the model is free from serial correlation and structurally stable. These findings suggest that while India's long-term growth trajectory is resilient, the policymakers must cautiously manage the contractionary shocks associated with short-term borrowing.

Keywords: Public Debt, Economic Growth, ARDL, Cointegration, Fiscal Policy

INTRODUCTION

Public debt occupies a central position in fiscal policymaking, particularly in emerging economies such as India, where government borrowing is frequently employed to support economic expansion and development objectives. While public borrowing can facilitate growth by financing infrastructure, capital formation, and social investment, sustained increases in debt levels raise concerns regarding fiscal sustainability and their possible implications for economic performance. Competing economic theories offer differing explanations: Keynesian perspectives emphasize the expansionary effects of deficit-financed spending, whereas neoclassical arguments caution that rising public debt may restrain growth by increasing interest obligations and displacing private investment (Modigliani, 1961; Diamond, 1965).

Theoretical debates on the debt–growth relationship are further shaped by concepts such as the debt overhang hypothesis, which posits that excessive indebtedness discourages investment and slows economic activity (Krugman, 1988; Sachs, 1989), and the debt neutrality or Ricardian equivalence proposition, which suggests that public debt does not exert lasting effects on growth as economic agents adjust their saving and consumption behavior in anticipation of future taxation (Barro, 1974). These contrasting viewpoints indicate that the growth effects of public debt may vary across time horizons and institutional contexts.

Empirical findings on the relationship between public debt and economic growth remain inconclusive. Cross-country studies often identify negative or nonlinear

How to cite this Article: Khamari, Sourav Suman and Das, Menaka (2025). Public Debt and Economic Growth in India: An ARDL Analysis. *Internat. J. Appl. Soc. Sci.,* **12** (11 & 12) : 935-942.

effects of debt beyond certain thresholds (Reinhart and Rogoff, 2010; Checherita-Westphal and Rother, 2012), whereas country-specific analyses frequently report mixed outcomes. In India, the steady rise in public debt since the early 1980s, alongside structural reforms and recurring fiscal pressures, underscores the need for renewed empirical investigation using updated data and robust econometric methods.

Against this backdrop, the study explores the relationship between public debt and economic growth in India over the period 1981–2023 by applying the Autoregressive Distributed Lag (ARDL) framework. This approach is well suited to the analysis as it accommodates variables integrated at different levels and enables the concurrent assessment of both short-term dynamics and long-run equilibrium associations. By employing GDP per capita as a measure of economic performance and incorporating gross capital formation as a key explanatory variable, the study seeks to clarify whether public debt imposes short-term growth constraints or remains neutral in the long run. The findings contribute to the existing literature and provide important policy insights for effective debt management and sustainable economic growth in India.

Review of Literature:

The relationship between public debt and economic growth has been widely studied, especially in emerging economies like India, were borrowing finances development. While debt can support growth through infrastructure and investment, excessive debt may threaten fiscal sustainability and crowd out private investment. Theoretical perspectives vary, from Keynesian expansionary effects to neoclassical caution, with concepts like debt overhang and Ricardian equivalence highlighting short-term constraints and long-term neutrality. Hassan *et al.* (2025) analysed the impact of domestic and external debt, along with their servicing obligations, on Nigeria's economic growth using ARDL modelling on data from 1986–2024. They found that domestic and external debt positively influence growth, while debt servicing negatively affects it, with short-run borrowing supporting output. Bidirectional causality exists between domestic debt and GDP, highlighting the need for careful debt management to sustain long-term growth. Kovaèeviæ (2025) analysed the relationship between public debt and economic growth in Serbia from 2001 to 2023 using ARDL and NARDL models. The study finds an asymmetric effect: reductions in public debt boost growth more than increases reduce it, while higher debt service negatively affects GDP per capita. Additionally, an increase in the current account deficit is positively associated with growth. The study by Bulut (2025) examines Türkiye's economic growth determinants from 1970–2019 using the Dynamic ARDL (DYNARDL) simulation approach. Findings indicate that external debt negatively affects growth, government size constrains short-term growth but is neutral in the long run, and energy consumption strongly drives output, with human capital also contributing positively. The results emphasize efficient public spending, debt sustainability, energy security, and investment in education for long-term growth. Barik and Sahu (2020) analyse the long-run relationship between public debt and economic growth in India (1980–2018) using the ARDL approach. They find that both internal and external public debt negatively impact long-term growth, while fixed investment positively influences GDP per capita. The results highlight the importance of investment-supportive policies and caution against excessive reliance on public debt. Bal and Rath (2014) investigate the impact of public debt on India's economic growth from 1980 to 2011 using the ARDL model. The study finds a long-run equilibrium relationship, with central government debt, total factor productivity growth, and debt servicing significantly affecting short-run growth. The authors recommend maintaining intergenerational fiscal equity to stabilize the debt-to-GDP ratio over the long term. Attard (2019) examines the relationship between public debt and economic growth using a dynamic panel ARDL approach. The study finds that high levels of public debt negatively affect economic growth, while moderate borrowing can support growth when used for productive investment. The results highlight the importance of debt management policies to sustain long-term economic performance. Latip (2020) investigates the relationship between public debt and economic growth in Malaysia from an ARDL perspective. The study finds that high public debt negatively impacts long-term economic growth, while moderate debt can support growth if directed toward productive investment. The findings underscore the need for prudent debt management policies to maintain fiscal sustainability. Getinet and Ersumo (2020) examine the impact of public external debt on Ethiopia's economic growth using the ARDL co-integration approach. The study finds that external debt has a significant negative effect on long-

term economic growth, particularly when debt levels exceed sustainable thresholds. The results highlight the importance of managing external borrowing to ensure fiscal sustainability and support growth. Hilton (2021) investigates the relationship between public debt and economic growth in a developing economy using contemporary data. The study finds that excessive public debt negatively affects long-term economic performance, while moderate debt can promote growth when allocated to productive investments. The findings emphasize the need for effective debt management and fiscal discipline to sustain economic development. Sharma and Mittal (2019) examine the impact of fiscal deficit and capital formation on India's economic growth using a nonlinear ARDL model. The study finds that fiscal deficits negatively affect growth in the long run, while capital formation positively contributes to economic performance. The results highlight the importance of promoting investment and managing deficits to sustain long-term growth. Mohanty *et al.* (2016) examine the causal relationship between public debt and economic growth across 15 NSC states of India (1991–2015) using the Dumitrescu-Hurlin causality test and FMOLS. The study finds bidirectional causality and reports that public debt, total revenue, and total credit positively influence growth. The authors recommend effective debt management, tax reforms, and credit strategies to enhance productivity and sustain long-term economic growth. Singh and Kumar (2022) investigate the impact of public debt on India's economic growth from 1980 to 2019 using Johansen cointegration, FMOLS, and Granger causality tests. The study finds that domestic debt, total factor productivity, and exports are key long-run growth determinants, while economic growth influences external debt and debt servicing in the short run. The authors recommend productive utilization and careful management of public debt to support sustainable economic growth. Manik and Khan (2017) examine the dynamic relationship between public debt and economic growth in India (1980–2016) using Johansen cointegration, VECM, and Granger causality techniques. The study finds long-run cointegration among domestic debt, external debt, and growth, with unidirectional causality from economic growth and domestic debt to external debt. The authors suggest that India should maintain high growth while managing public debt carefully and increasing revenue to fund development expenditures.

Objectives of the Study:

This study is based on two objectives;

- To analyze the trends and patterns of public debt and economic growth in India.
- To assess both the long-term and short-term impacts of public debt on India's economic growth.

METHODOLOGY

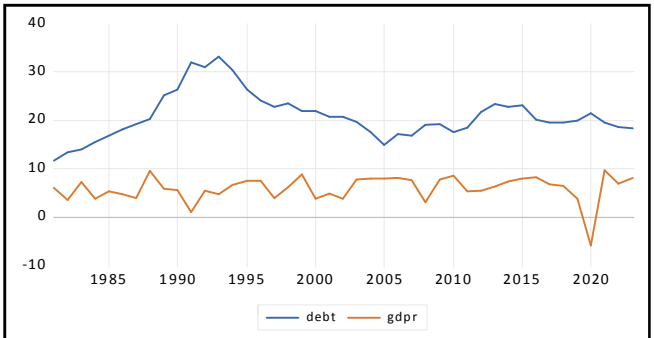
This research empirically examines the influence of public debt on India's economic growth by utilizing annual time-series data for the period 1981–2023. Economic growth is represented by the GDP growth rate (GDPR), which acts as an indicator of overall economic performance. Public debt, measured as a proportion of GDP, constitutes the core explanatory variable. To strengthen the model and minimize the risk of omitted variable bias, several control variables are included, namely Gross Capital Formation (GCF), Foreign Direct Investment (FDI), Trade Openness (TO), Inflation (INF), and Population (POP). All data were obtained from the World Bank's World Development Indicators (WDI) database.

The empirical analysis is conducted using the Autoregressive Distributed Lag (ARDL) bounds testing framework. This approach is appropriate given that the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests indicate a combination of variables integrated at level and at first difference.

The estimation procedure involves three stages. Initially, the ARDL bounds test is applied to verify the presence of a long-run association among the variables. Subsequently, an Error Correction Model (ECM) is estimated to analyze short-run dynamics and the speed at which deviations from long-run equilibrium are corrected. Lastly, a set of diagnostic checks including the Breusch-Godfrey LM test, Breusch-Pagan test, Ramsey RESET test, and the CUSUM stability test are performed to validate the reliability and stability of the model.

RESULTS AND DISCUSSION

The analysis of India's public debt alongside economic growth over the study period uncovers several notable trends. The debt trajectory (blue line) shows that public debt reached its highest level of 33.15% of GDP



Source: Author's own calculation

Fig. 1 : Trends of Public Debt and GDP Growth

in the early 1990s, before declining considerably and stabilizing at approximately 20% in recent years. In contrast, GDP growth (orange line) exhibited considerable volatility, averaging 5.96%, with a pronounced contraction to -5.78% in 2020 due to the global COVID-19 crisis (Fig. 1).

The graphical evidence points toward a broadly inverse association between public debt and economic growth. This relationship is particularly visible during the early 1990s, when high debt levels were accompanied by relatively weak growth performance. Such a pattern aligns with the debt overhang hypothesis, which suggests that excessive public borrowing may dampen growth by discouraging private investment and intensifying fiscal constraints.

The Fig. 1 further illustrates the resilience of the Indian economy. The sharp "V-shaped" rebound after the 2020 downturn indicates the economy's ability to recover quickly from shocks. Overall, these observations imply that although high public debt may temporarily constrain growth, the economy demonstrates the capacity to adjust over time, especially when sound fiscal and structural policies are in place to support investment and stability.

In the Table 1 shows the descriptive statistics of the variables included in the analysis. Public debt, measured as a percentage of GDP, recorded an average value of approximately 20.86 per cent over the study period, with a standard deviation of 4.73, suggesting a moderate degree of fiscal variability. The dependent variable, GDP growth, registered a mean rate of 5.96 percent; however, the distribution is negatively skewed (–2.03), indicating the occurrence of occasional periods of economic contraction.

The correlation matrix serves as a preliminary diagnostic tool to assess bivariate relationships and screen for multicollinearity. The findings indicate an inverse relationship between public debt and GDP growth, lending support to the debt overhang hypothesis. Whereas Gross Capital Formation exhibits the strongest positive correlation aligning with capital-centric growth theories. Notably, the matrix highlights a high degree of collinearity among structural variables, particularly between Trade Openness and both Gross Capital Formation and FDI (Table 2).

Table 1 : Descriptive Statistics

Variable	Obs	Mean	Std. dev.	Min	Max	Skewness	Kurtosis
GDPR	43	5.956089	2.664136	-5.77773	9.689592	-2.036295	9.87999
Debt	43	20.86276	4.733502	11.61544	33.15748	0.7626204	3.589702
FDI	43	0.998717	0.886678	0.002584	41.9508	0.735819	3.022014
GCF	43	30.37037	5.441025	21.03957	55.79372	0.4316152	2.204127
TO	43	31.66545	14.63654	12.21927	3.620523	0.1259385	1.524508
INF	43	7.523981	2.986438	3.328173	13.87025	0 .4025927	2.126436
POP	43	1.689624	0.465605	0.874972	2.866779	0.0969121	2.252933

Source: Author's own calculation

Table 2 : Correlation Matrix

	gdpr	debt	gcf	to	fdi	inf	pop
gdpr	1						
debt	-0.1565	1					
gcf	0.283	-0.2787	1				
to	0.1881	-0.1853	0.8678	1			
fdi	-0.0406	-0.1762	0.7502	0.8501	1		
inf	-0.0864	0.2025	0.2113	-0.2747	-0.2561	1	
pop	-0.1342	0.1443	0.5019	-0.6939	-0.6125	0.3875	1

Source: Author's own calculation

Unit Root test:

To enhance the reliability of the empirical findings, the stationarity properties of the time-series data were examined prior to estimation. Assessing stationarity is a crucial prerequisite in time-series analysis, as it ensures that key statistical characteristics—such as the mean, variance, and autocovariance remain stable over time.

The stationarity of the variables was tested using both the Augmented Dickey–Fuller (ADF) and Phillips–Perron (PP) unit root tests. The results reveal a mixed order of integration among the variables. GDP growth and inflation were found to be stationary at level, whereas public debt, foreign direct investment, gross capital formation, trade openness, and population became stationary after first differencing. The presence of variables integrated of order I (0) and I (1) validate the application of the Autoregressive Distributed Lag (ARDL) modelling framework, making it the most suitable econometric approach for the present analysis (Table 3 and 4).

To examine the existence of a long-run relationship among the variables, the ARDL bounds testing approach was employed. The central statistic in this procedure is the F-statistic, which was computed to be 5.505. Evidence of cointegration is established when the calculated F-statistic exceeds the upper critical bound value. At the 5 percent significance level, the upper bound is 4.343. Since the estimated F-statistic is substantially higher than this critical value, the null hypothesis of no long-run relationship is rejected. Accordingly, the results confirm that the variables are cointegrated, indicating the presence of a stable long-run relationship among them (Table 5).

ARDL Model:

The long-run estimates presented in the upper panel of the table reveal a crucial finding regarding the debt-growth nexus in India. The coefficient of public debt is statistically indistinguishable from zero, it means debt accumulation does not exert a permanent influence on economic growth. This supports the "debt neutrality" hypothesis in the long run, implying that the economy eventually adjusts to fiscal expansions without lasting structural damage. Among the control variables, Gross Capital Formation acts as a positive driver of long-term growth, with a coefficient of 0.369, although it is only significant at the 10%. Interestingly, Foreign Direct

Table 3 : Augmented Dickey-Fuller (ADF) Unit Root Test Results

Variable	Level Test Statistic	p-value	1st Difference Test Statistic	p-value	Order of Integration
GDPR	–6.375	0	—	—	I(0)
Debt	–2.086	0.2502	–4.967	0	I(1)
FDI	–1.942	0.3127	–7.416	0	I(1)
GCF	–1.731	0.4151	–8.926	0	I(1)
TO	–0.880	0.7944	–5.627	0	I(1)
INF	-3.751	0.0035	—	—	I(0)
POP	-2.546	0.1046.	-11.290	0.0000.	I(1)

Source: Author's own calculation

Table 4 : Phillips–Perron (PP) Unit Root Test Results

Variable	Level Test Statistic	p-value	1st Difference Test Statistic	p-value	Order of Integration
GDPR	–6.389	0	—	—	I (0)
Debt	–2.296	0.1733	–5.057	0	I (1)
FDI	–1.880	0.3418	–7.451	0	I (1)
GCF	–1.564	0.5017	–8.867	0	I (1)
TO	–0.916	0.7828	–5.608	0	I (1)
INF	-3.771	0.0032	—	—	I (0)
POP	-2.252	0.1878	-15.326	0.0000	I (1)

Source: Author's own calculation

Table 5 : Bound Test

	Statistic	5% Critical Values		p value	
		I (0)	I (1)	I (0)	I (1)
F	5.505	2.802	4.343	0.001	0.015
T	-6.081	-2.847	-4.405	0.000	0.002

Source: Author's own calculation

Table 6 : ARDL Model

Variable	Coefficient	Std. Error	t-Statistic	p-Value	Interpretation (Short / Long Run)
Debt	–0.0293	0.0916	–0.32	0.751	No long-run effect
GCF	0.369*	0.1997	1.85	0.075	Weak positive long-run effect
to	–0.0169	0.0927	–0.18	0.856	No long-run effect
FDI	–1.7354	1.0155	–1.71	0.099	Weak negative long-run effect
inf	0.0537	0.1991	0.27	0.789	No long-run effect
pop	–0.4139	1.8798	–0.22	0.827	No long-run effect
ΔDebt	–0.6339*	0.2187	–2.90	0.007	Significant short-run negative effect
ΔGCF	–0.2106	0.2117	–0.99	0.328	No short-run effect
ΔTO	–0.0131	0.1319	–0.10	0.922	No short-run effect
ΔFDI	–0.7241	1.1406	–0.63	0.531	No short-run effect
ΔINF	–0.1323	0.1768	–0.75	0.46	No short-run effect
ΔPOP	–0.1150	1.3706	–0.08	0.934	No short-run effect
Constant	–1.9625	4.9447	–0.40	0.694	—
ECM (-1)	–1.0197***	0.1677	–6.08	0.000	Speed of adjustment (significant)

Source: Author's own calculation

Investment displays a weakly significant negative coefficient, potentially indicating local market frictions or displacement effects during the study period (Table 6).

In contrast to the long-run neutrality observed in the model, the short-run dynamics captured by the first-difference terms reveal the presence of immediate fiscal constraints. The coefficient associated with changes in public debt is negative and statistically significant, indicating that an abrupt increase in government borrowing leads to an instantaneous deceleration in GDP growth. This finding provides evidence of short-run crowding-out effects, whereby public borrowing competes with private investment for limited financial resources, thereby dampening economic activity in the short term.

Moreover, other short-run control variables, including variations in gross capital formation and trade openness, do not exhibit statistical significance, suggesting that fluctuations in public debt constitute the primary driver of short-term growth dynamics within the estimated framework. Additionally, the error correction term is negative and highly significant at the 1 percent level, confirming the presence of a stable adjustment mechanism and indicating that deviations from the long-run equilibrium are corrected over time.

The estimated coefficient of -1.02 suggests a very elastic adjustment process, indicating that the speed of convergence is remarkably swift. This magnitude indicates that any imbalance resulting from short-term disturbances is entirely resolved within the yearly timeframe, strengthening the structural stability of the Indian economy despite occasional fiscal fluctuations.

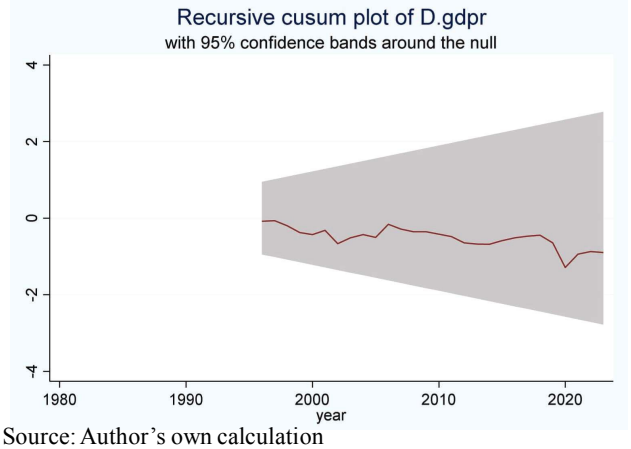
To assess the robustness and statistical soundness of the ARDL estimates, a comprehensive set of diagnostic tests was conducted. The presence of serial correlation in the residuals was examined using the Breusch–Godfrey LM test. The obtained p-value of 0.444 exceeds the conventional significance threshold, leading to the non-rejection of the null hypothesis and indicating the absence of serial correlation (Table 7).

Heteroskedasticity was evaluated using the Breusch–Pagan test, which yielded a p-value of 0.199. This result suggests that the error variance is constant over time, thereby confirming homoscedastic residuals and the reliability of the estimated standard errors. The structural adequacy of the model was further assessed

Table 7 : Diagnostic Tests

Test	Null Hypothesis (H_0)	Test Statistic	p-value	Decision	Conclusion
Breusch–Godfrey LM Test for Serial Correlation	No serial correlation	$\chi^2 = 0.585$ (df=1)	0.4444	Fail to reject H_0 at 5%	No serial correlation
Breusch–Pagan / Cook–Weisberg Test for Heteroskedasticity	Constant variance (no heteroskedasticity)	$\chi^2 = 1.64$	0.1998	Fail to reject H_0	No heteroskedasticity
Ramsey RESET Test	No omitted variables	F= 1.87	0.1597	Fail to reject H_0	Model correctly specified (no omitted variable bias)
CUSUM Test (Stability)	No structural break	Test statistics = 0.4618	0.9479	Below critical values	Parameters are stable (model stable)

Source: Author's own calculation



Source: Author's own calculation

Fig. 2 : Recursive Cusum Plot

through the Ramsey RESET test. The associated F-statistic, with a p-value of 0.159, implies correct model specification and indicates that the estimates are not affected by functional form misspecification or omitted variable bias.

Finally, parameter stability was examined using the CUSUM test. The test statistic of 0.4618 (p = 0.947) lies well within the critical bounds, confirming that the estimated coefficients remained stable over the entire sample period from 1981 to 2023. Collectively, these diagnostic results affirm the robustness and reliability of the estimated relationship between public debt and economic growth.

Conclusion :

This study empirically investigated the nexus between public debt and economic growth in India over the period 1981–2023. The Autoregressive Distributed Lag (ARDL) methodology was adopted due to the mixed order of integration observed among the variables, with some series being stationary at levels and others becoming stationary after first differencing. The results of the bounds testing procedure provided strong evidence of cointegration, thereby justifying the examination of both short-run dynamics and long-run relationships.

A key insight emerging from the analysis is the clear distinction between the short-run and long-run effects of public debt. In the short term, increases in public debt exert a statistically significant negative impact on economic growth. This adverse effect can be attributed to crowding-out mechanisms, whereby heightened government borrowing constrains the availability of financial resources for private investment, leading to a temporary slowdown in economic activity.

However, this negative impact completely disappears in the long run, supporting the theory of "debt neutrality" where the economy eventually adjusts to the fiscal burden without permanent damage. Additionally, the study highlights the resilience of the Indian economy; the error correction term indicates a very rapid speed of adjustment, meaning the economy fully recovers from short-term shocks within a single year.

From a policy perspective, these results suggest that the Indian government must tread carefully with sudden increases in borrowing. Since the short-term shock of debt is harmful, fiscal authorities should adopt a gradual approach to debt accumulation to avoid dampening immediate growth. Furthermore, because Gross Capital Formation was found to support long-term growth, it is crucial that borrowed funds are channelled strictly into productive assets like infrastructure and technology rather than consumption. This strategy ensures that while the economy absorbs the short-term costs of borrowing, the spending creates the necessary capital base to sustain development in the future.

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