

Causal Nexus between Public Debt and Economic Growth of India: A Time Series Analysis

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DOI: 10.56201/ijefm.v10.no2.2025.pg47.57

Abstract

The Public debt paper aims to investigate the critical topic of the "cause-effect" relationship and economic growth for the Indian economy from 1991 to 2022. The statistical description offers proof that there is ambiguity and inconclusiveness regarding the causal relationship between these variables. The systematic time series econometrics approach is used to examine the impact of Gross Domestic Product (GDP) on India's public debt across the study period. The unit root test, cointegration test, and error correction model (ECM) were used to validate the stationary of the variables, identify the number of cointegration equations between the variables, and assess the pace of adjustment from short-run to long-run equilibrium. The findings show that the composition of public debt has a considerable impact on GDP: domestic debt has a negative short-term impact, but external debt has a positive short-term effect. This indicates that careful examination of loan sources is critical. The presence of cointegration between GDP and public debt indicates a stable, long-term relationship in which both variables tend to move together over time, emphasizing the necessity of long-term fiscal sustainability.

Keywords: *Public debt, Domestic debt, External debt, Economic Growth*

1. Introduction

In the subject of macroeconomics, the connection between public debt and economic growth is crucial, attracting the interest of financial analysts, economists, and politicians alike. The total amount of money a government owes to internal and external creditors as a result of borrowing money to cover deficits is known as public debt, or government debt. Contrarily, economic growth is the term used to describe the gradual rise in an economy's output of goods and services, as usually indicated by the GDP growth rate. It is vital to comprehend the intricate relationship between public debt and economic growth, since it has significant consequences for the economic stability and advancement of a country. Even though public debt can be a vital instrument for promoting growth, particularly in times of economic depression, high levels of debt carry serious dangers that could impede growth or even trigger an economic crisis. Many studies and discussions have been held on this intricate link. Proponents of public debt contend that prudent use of the debt may support long-term economic growth by funding essential investments in healthcare, education, and infrastructure. On the other hand, detractors caution that excessive debt levels could have unfavorable effects like discouraging private investment, raising interest rates, and leaving future generations with unmanageable debt loads. This introduction lays the groundwork for a more thorough

examination of the relationship between public debt and economic growth, the circumstances in which debt becomes a growth inhibitor, and the policy decisions that governments must make in order to balance using debt for growth with preserving fiscal sustainability. Macroeconomics places a lot of emphasis on the connection between public debt and economic growth, with several theories and empirical studies examining the effects of government borrowing on a nation's economy.

The Relationship between Public Debt and Economic Growth

- **Productive Investment:** When public debt is used to finance infrastructure, education, health, and other productive investments, it can lead to higher economic growth by increasing the economy's productive capacity. For instance, investing in infrastructure can improve transportation and communication, reducing costs for businesses and boosting productivity.
- **Counter-Cyclical Policy:** Governments often borrow during economic downturns to stimulate demand through increased spending, which can help mitigate the effects of recessions and support growth.
- **Debt Overhang:** High levels of public debt can lead to a "debt overhang," where the debt burden becomes so large that it discourages investment and consumption, as future tax increases or spending cuts are anticipated. Investors might fear that the government will need to raise taxes or cut spending to service the debt, reducing incentives for private investment.
- **Crowding Out:** Higher interest rates from public borrowing may dissuade private investment. This happens when credit demand rises as a result of government borrowing, making borrowing more costly for households and businesses due to increasing interest rates.
- **Sovereign Debt Crises:** Excessive public debt can lead to sovereign debt crises, where a government struggles to meet its debt obligations. This can cause a loss of investor confidence, capital flight, currency depreciation, and a sharp contraction in economic activity.
- **Debt Servicing Costs:** High debt levels require significant interest payments, which can consume a large portion of government revenues. This reduces the funds available for other productive expenditures, potentially slowing growth.
- **Threshold Effects:** Research suggests that the impact of public debt on economic growth might be non-linear. For example, moderate levels of debt may support growth, but once debt exceeds a certain threshold (e.g., 90% of GDP, though this figure can vary by country), it may have a negative impact on growth.
- **Empirical Evidence:** Empirical studies show mixed results on the relationship between public debt and economic growth. Some studies find that low to moderate levels of debt can promote growth, especially in developing countries that use debt to finance necessary infrastructure. However, high levels of debt are generally associated with slower growth and higher economic volatility.

2. Literature Review

A literature review on the relationship between GDP and public debt examines various theoretical stances, empirical findings, and the effects of public debt on economic growth. Key findings from classical, Keynesian, and modern viewpoints are highlighted in this overview, which offers a thorough grasp of how public debt affects GDP.

Theoretical Perspectives

It was suggested by Ricardo (1817) and Barro (1974) that governmental debt has no influence on GDP. The Ricardian Equivalence theorem states that because consumers expect future taxes to pay off the debt, they will save money instead of spending it, negating the stimulus impact of government borrowing. The "crowding out" of private investment, according to classical economists, might result from state debt. Interest rates may rise as a result of government borrowing from the domestic financial system, making borrowing and investing more costly for private companies and thus slowing GDP growth (Modigliani, 1961). Proponents of Keynesian economics, such as John Maynard Keynes (1936), contend that public debt can boost GDP, especially during recessions. Public spending, which increases output and employment by stimulating aggregate demand, can be financed by borrowing from the government. Economic growth may follow from this, particularly if the economy is not operating at its maximum potential.

The idea of "debt overhang," first proposed by Krugman (1988) and Sachs (1989), refers to the tendency for large levels of public debt to deter private investment because of the fear of future inflation or taxes. High levels of public debt are seen as a burden that may eventually cause economic instability and impede GDP expansion. Romer (1986) and Lucas (1988) contend that there is a complex link between GDP and public debt that is influenced by the use of debt. Public debt can support long-term economic growth if it funds worthwhile initiatives like infrastructure and education. In contrast, it can impede growth if it funds wasteful spending.

Empirical research backs up the Keynesian theory that says public debt can spur economic expansion. Elmendorf and Mankiw (1999), for instance, discover that modest amounts of public debt, especially in nations with spare resources, might boost economic activity. In a similar vein, Panizza and Presbitero (2013) contend that foreign debt can support critical investments in emerging nations that increase GDP development. A landmark study by Reinhart and Rogoff (2010) revealed that, once public debt crosses a specific level (about 90% of GDP), GDP growth is negatively correlated with it. According to their research, public debt might negatively impact economic development above this point because it raises uncertainty and lowers investor confidence. In sub-Saharan Africa, Pattillo, Poirson, and Ricci (2002) discover evidence of a debt overhang effect, where high levels of external debt were linked to decreased GDP growth and investment. According to their analysis, the burden of debt can discourage both foreign and domestic investment, which would slow down economic growth overall. Research such as that conducted by Kumar and Woo (2010) indicates that there is no linear correlation between GDP and public debt. They contend that extremely high debt levels can cause a marked slowdown in economic growth, even though moderate debt levels might not have an adverse effect on growth. Given that this relationship is non-linear, the effect of

debt on GDP may differ depending on the amount of debt. Perceived unsustainable debt levels may result in increased borrowing costs and decreased investor confidence, both of which can impede economic progress. The function of fiscal multipliers in the connection between debt and growth is examined by Blanchard and Leigh (2013). They discover that when there is a large level of public debt and fiscal consolidation, GDP may be contracted, especially in poor economies. According to Bleaney, Gemmell, and Kneller (2001), it is important to consider the makeup of public spending. Utilizing public debt to fund worthwhile public initiatives like R&D and infrastructure can have a beneficial long-term impact on economic growth. On the other hand, debt incurred through ineffective projects or current spending may have a neutral or detrimental impact on GDP. Research on developing markets, such as that done by Presbitero (2012), demonstrates that there may be variations in the link between GDP growth and public debt in these situations. External debt can be essential to the development of emerging economies, but excessive debt can also make a country more susceptible to financial crises and other shocks from the outside world. Studies like those by Checherita-Westphal and Rother (2012) demonstrate that high public debt levels in industrialized economies might result in slower development, which rekindled the discussion on public debt and GDP following the global financial crisis of 2008.

A complicated and nuanced relationship between governmental debt and GDP is revealed by the literature. While modest public debt levels might boost economic growth, especially in recessionary times, excessive public debt is frequently linked to unfavorable growth results, especially when it surpasses specific thresholds. The way that public debt is used also affects GDP; although wasteful expenditure might impede economic growth, wise investments can result in favorable growth outcomes.

3. Methods and Materials

The systematic time series econometrics approach is used to analyze the impact of Gross Domestic Product (GDP) on India's Public debt during the study period. Unit root test, Cointegration test, and Error correction model (ECM) were used to verify the stationarity of the variables, determine the number of Cointegration equations among the variables, and check the speed of adjustment from short-run to long-run equilibrium.

The analysis employs a systematic time series econometrics approach to study the impact of Gross Domestic Product (GDP) on India's public debt over a specific period. The approach involves three key steps:

Model Steps:

- Unit Root Test Stationarity Check (ADF Test): Determine if GDP, DOMDBT, and EXTDBT are stationary or require differencing.
- Cointegration Analysis: Use the Johansen test to check for long-run relationships between GDP and public debt variables.
- Error Correction Model: If cointegration is found, apply ECM to model the short-run dynamics and estimate the speed of adjustment back to equilibrium.

This model provides a comprehensive framework to analyze how GDP impacts public debt in both the short and long term, ensuring that the relationship is stable and significant over time.

Mathematical Interpretation

1. Unit Root Test (ADF Test) for Stationarity

The Augmented Dickey-Fuller (ADF) test is used to determine whether a time series variable is non-stationary and possesses a unit root. If the variable is non-stationary, differencing is required to make it stationary.

Mathematical Interpretation:

The ADF test for a variable Y_t (e.g., GDP, DOMDEBT, EXTDEBT) involves estimating the following regression:

$$\Delta Y_t = \alpha + \beta t + \gamma Y_{t-1} + \sum_{i=1}^p \delta_i \Delta Y_{t-1} + \epsilon_t$$

- **Null Hypothesis (H_0):** $\gamma=0$ (The series has a unit root; it is non-stationary).
- **Alternative Hypothesis (H_1):** $\gamma<0$ (The series is stationary).

Interpretation for Each Variable:

- **GDP:** If the ADF test indicates non-stationarity, you would difference GDP to make it stationary (e.g., $D(\text{GDP}) = \text{GDP}_t - \text{GDP}_{\{t-1\}}$).
- **DOMDEBT:** Apply the same logic as for GDP.
- **EXTDEBT:** Similarly, test for stationarity and difference if necessary.

2. Cointegration Analysis (Johansen Test)

Mathematical Interpretation:

The Johansen test is based on the following vector auto regression (VAR) model:

$$\Delta Y_t = \Pi Y_{t-1} + \sum_{i=1}^{k-1} \Gamma_i \Delta Y_{t-1} + \epsilon_t$$

Where:

- Y_t is a vector of the non-stationary variables (e.g., [GDP, DOMDEBT, EXTDEBT]).
- Π is the matrix of long-run coefficients.
- Γ_i are the short-run adjustment coefficients.
- ϵ_t is the error term.

If the test statistics exceed the critical values at a given significance level, you reject the null hypothesis, indicating the presence of cointegration (i.e., a long-run relationship exists).

3. Error Correction Model (ECM)

The ECM captures both the short-run dynamics and the long-run equilibrium relationship between variables.

Mathematical Interpretation:

If the variables are cointegrated, the ECM can be specified as:

$$\Delta Y_t = \alpha_0 + \sum_{i=1}^p \alpha_i \Delta Y_{t-i} + \sum_{j=1}^q \beta_j \Delta X_{t-j} + \lambda \cdot ECT_{t-1} + \epsilon_t$$

Where:

- ΔY_t and ΔX_t are the differenced variables (e.g., differenced GDP, DOMDEBT, and EXTDEBT).
- ECT_{t-1} is the error correction term, representing the long-run equilibrium error.
- λ is the speed of adjustment parameter, indicating how quickly the variables return to equilibrium after a shock.

4. Results

There has been much research on the connection between public debt and economic growth in the past few years, but opinions on how public debt affects economic growth are divided. This paper uses data on both domestic and external debts in India for the period 1991 to 2022 in order to contribute to the discussion on the relationship between public debt and economic growth by tracing the Indian experience. Real GDP was used to reflect on economic growth during the study period.

4.1 Unit Root Test

Unit root test is a test to determine the suitability of the variables for a time series regression. This test is necessary because most economic time series have proved empirically to be non-stationary in nature. In order to achieve this, Augmented Dickey-Fuller (ADF) was adopted.

From the table below shows, the ADF test Statistic Values of all the series are more negative than their 5 percent Critical Value at the various differencing levels. This shows that the model follows integrating process because they are all integrated of the same order.

Table 4.1 Unit Root Test

Variables	ADF Test Statistics	1 Percent Critical Value	5 Percent Critical Value	10 Percent Critical Value	Number of Lag	P – Value	Order of Stationery
GDP	-4.470320	-3.670170	-2.963972	-2.621007	1	0.0013	Stationery
DOMDBT	-5.368349	-3.670170	-2.963972	-2.621007	1	0.0001	Stationery
EXTDBT	-6.430592	-3.670170	-2.963972	-2.621007	0	0.0000	Stationery

Source: : Researchers' Computation, using E-views 9.0

The results of the Augmented Dickey-Fuller (ADF) unit root test as provided in table 4.1 show that all the variables contain unit root as the hypothesis of no unit root cannot be rejected. As a result, real GDP has to be differenced twice while domestic debt was differenced twice before stationery was achieved, using the Akaike Information Criterion (AIC). Consequently, the study proceeds to estimate the regression parameters using the Autoregressive and Distributed Lag (ARDL) model with lags on real GDP and domestic debt only.

All three variables (GDP, DOMDBT, and EXTDDBT) are stationary because their ADF test statistics are lower (more negative) than the 1%, 5%, and 10% critical values, and their p-values are all significantly lower than 0.05. This indicates strong evidence to reject the null hypothesis of non-stationarity, meaning these series do not have a unit root and are stationary. As per the results, the variables (GDP, DOMDBT, and EXTDDBT) were found to be stationary, as their ADF test statistics were more negative than the critical values, and the p-values were very low (less than 0.05).

4.2 ARDL Error Correction Model (ECM)

Table 4.2 Result of the Error Correction Term

Dependent Variable: D(GDP)

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Sample (adjusted) 1991 2022

Included Observations: 28

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GDP(-1))	-0.322791	0.249859	-1.291890	0.2137
D(GDP(-2))	-0.813914	0.337112	-2.414373	0.0273
D(GDP(-3))	-1.404154	0.436731	-3.215148	0.0051
D(DOMDEBT)	-1.332655	0.159905	-8.334038	0.0000
D(EXTDEBT)	4.326991	1.168696	3.702411	0.0018
D(EXTDEBT(-1))	8.845093	1.300722	6.800141	0.0000
D(EXTDEBT(-2))	5.119867	1.687163	3.034602	0.0075
CointEq(-1) *	0.455397	0.080095	5.685690	0.0000
R-squared	0.859038	Mean dependent var		401975.1

Adjusted R-squared	0.799685	S.D. dependent var	262903.9
S.E. of regression	117666.8	Akaike info criterion	26.44419
Sum squared resid	2.63E+11	Schwarz criterion	26.87240
Log likelihood	-361.2187	Hannan-Quinn criter.	26.57510
F-statistics	14.47346	Durbin Watson Stat	2.112680
Prob (F-statistic)	0.000001		

Source: Researchers' Computation, 2024

The table contains the results of an ARDL (Autoregressive Distributed Lag) Error Correction Model (ECM) regression. Here's a detailed interpretation of the output. The model includes one lag for LGDP, four lags for DOMDBT, and three lags for EXTDBT. This is significant and indicates that about 45.5% of the disequilibrium from the previous period is corrected in the current period, reflecting a relatively fast speed of adjustment to the long-run equilibrium. R-squared, indicating that about 85.90% of the variation in GDP is explained by the model. F-statistic 14.47346 with a p-value of 0.000001, indicating the overall model is statistically significant. Bounds Test for Cointegration, Reject the null hypothesis, suggesting a strong cointegration relationship between GDP and the debt variables, indicating the presence of a long-term relationship.

Short-Run Relationship between Public Debt and GDP

The short-run relationship between public debt (both domestic and external) and GDP can be analyzed through the coefficients of the first differences of these variables in the ARDL Error Correction Model (ECM). Increased domestic debt decreases GDP in the short run, while external debt increases GDP in the short run. The positive relationship may indicate that external debt, when used effectively, can stimulate economic growth in the short term. The positive coefficients for lagged external debt suggest that the effects of external debt on GDP are persistent over time, contributing positively to economic growth even in subsequent periods.

Long-Run Relationship between Public Debt and GDP

The long-run relationship is captured by the error correction term (CointEq(-1)), which indicates the speed at which the system returns to equilibrium after a shock. It also suggests whether a long-term equilibrium relationship exists between public debt and GDP. The positive and significant coefficient indicates a long-run equilibrium relationship between public debt and GDP. The magnitude (0.455397) suggests that about 45.5% of the disequilibrium is corrected each period, implying a moderate adjustment speed towards long-run equilibrium. Both domestic and external debt coefficients in the model are significant, indicating that they have a long-term impact on GDP. The significance and direction of these coefficients (negative for domestic debt, positive for external debt) suggest that the long-term effects mirror the short-term ones, with domestic debt having a potentially negative impact on GDP and external debt potentially contributing positively. This model provides comprehensive insights into the dynamic interaction between GDP and public debt, capturing both short-term adjustments and long-term relationships.

5. Policy Implication

The explanation of the ARDL Error Correction Model (ECM) sheds light on how India's GDP and public debt are related. The findings point to a number of policy implications, especially with regard to how public debt is handled to affect economic growth. According to the model, a rise in domestic debt has a short-term negative impact on GDP. When it comes to raising domestic debt, the government should exercise caution, particularly if the intention is to promote rapid economic growth. To prevent an excessive reliance on domestic borrowing, policymakers may need to concentrate on enhancing the effectiveness of public spending or look for alternate financing sources, such as raising tax revenue or cutting back on wasteful spending. Based on the positive coefficients, it appears that external debt contributes positively to GDP in the short run. Strategic use of external borrowing can be employed to fund investments that provide immediate financial gains. Politicians should, however, also take into account potential long-term effects, such as currency rate concerns and difficulties in servicing debt, and make sure that foreign financing is used for profitable ventures that can yield returns high enough to offset the cost of borrowing. Following short-term deviations, the ECM term suggests a comparatively quick speed of adjustment to long-term equilibrium. This implies that the economy is robust and able to quickly fix imbalances. Therefore, the economy is likely to return to its long-term growth path even when short-term fiscal adjustments (such as increases in public debt levels) may produce transitory oscillations. During economic downturns, policymakers can take advantage of this by enacting temporary fiscal measures, knowing that the economy will probably rapidly stabilize. The limits test suggests that there is an equilibrium link between public debt and GDP over the long run. Since public debt and GDP are related over the long run, unsustainable increases in public debt may jeopardize steady economic growth.

The model emphasizes how crucial responsible public debt management is to attaining long-term economic expansion. Reliance on domestic debt requires careful consideration because of its potential negative impact on GDP, even though overseas debt can boost growth in the short run. The sustainability of debt, effective use of borrowed money, and a balanced fiscal strategy that promotes long-term economic growth and stability should be the main concerns of policymakers.

6. Conclusion

The ARDL Error Correction Model (ECM) study on India's public debt and GDP reveals important insights into the relationship between the two. The findings indicate that the composition of public debt significantly impacts GDP: domestic debt negatively affects GDP in the short term, while external debt has a positive short-term effect. This suggests that careful consideration of debt sources is crucial. The existence of cointegration between GDP and public debt points to a stable, long-term relationship where both variables tend to move together over time, underscoring the importance of long-term fiscal sustainability. Overall, the study emphasizes the need for prudent debt management strategies to maintain fiscal stability and ensure that public borrowing contributes positively to economic growth. Keeping the debt-to-GDP ratio within a reasonable range and using borrowed funds effectively are crucial for sustainable development in India.

Declarations

The authors have no financial or non-financial interests to disclose.

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