IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Public Debt, Inflation, And Economic Growth In India: Evidence From An ARMAX Model (1991–2024)

[1]Ganga. S, [2] Dr.S.Nehru

[1] Research Scholar, Department of Economics, The Gandhigram Rural Institute (Deemed to be University) Gandhigram-624302, Dindigul District, Tamil Nadu

[1] Senior Professor, Department of Economics, The Gandhigram Rural Institute (Deemed to be University) Gandhigram-624302, Dindigul District, TamilNadu

Abstract

This research explores the dynamic connections among economic growth and essential macroeconomic factors growth of public debt, inflation rates, government consumption spending, and population growth in India from 1991 to 2024. The study utilizes an Autoregressive Moving Average with Exogenous Inputs (ARMAX) model to investigate autoregressive patterns and the immediate impacts of fiscal and monetary influences on GDP growth. The findings indicate that fluctuations in public debt have a significant and strong negative impact on economic growth, demonstrating that increased debt growth negatively influences India's short-term output performance. Inflation demonstrates a substantial negative effect, highlighting the necessity of maintaining price stability. On the other hand, government spending on consumption positively and significantly impacts GDP growth, indicating its encouraging short-term role, whereas population growth has a positive yet only slightly significant effect. The model shows strong explanatory capability ($R^2 = 0.73$), and diagnostic assessments validate its stability. The results highlight the importance of fiscal responsibility, managing inflation, and targeted government expenditure to maintain India's growth path.

[1] *Research Scholar(email id : sureshganga920@gmail.com) , Department of Economics, The Gandhigram Rural Institute (Deemed to be University) Gandhigram-624302, Dindigul District, Tamil Nadu*

[2] *Senior Professor(email id : samynehru@yahoo.com) , Department of Economics, The Gandhigram Rural Institute (Deemed to be University) Gandhigram-624302, Dindigul District, TamilNadu*

Keywords: Public Debt, Inflation, Government Expenditure, Economic Growth, ARMAX Model, India

Introduction

Sustaining stable and inclusive economic growth remains a key challenge for developing economies such as India, where fiscal policy, public debt management, and inflation control play a decisive role in macroeconomic stability. Since the initiation of economic reforms in 1991, India has experienced periods of rapid expansion alongside episodes of rising fiscal deficits and increasing public debt. While structural reforms enhanced market efficiency and growth potential, persistent fiscal pressures have continued to influence the country's growth trajectory.

Public debt occupies a central position in macroeconomic policy debates due to its dual role in supporting growth and posing sustainability risks. On the one hand, debt-financed expenditure can stimulate economic activity when resources are allocated toward productive sectors such as infrastructure, education, and health. On the other hand, excessive debt accumulation may generate debt-overhang effects, raising future tax expectations, increasing interest burdens, and discouraging private investment. These competing effects make the debt–growth relationship particularly relevant for India, especially in the post-reform period marked by expanding fiscal commitments.

Inflation further complicates this relationship by influencing real income, investment decisions, and overall macroeconomic stability. Persistent price pressures erode purchasing power and increase uncertainty, potentially weakening growth performance. In India, inflation dynamics have been shaped by supply-side constraints, fiscal expansion, and global price shocks, reinforcing the importance of coordinated fiscal and monetary policy.

Government expenditure plays a complementary role in shaping growth outcomes. From a demand-side perspective, public consumption can support short-run economic activity, particularly during periods of subdued private demand. However, the growth impact of government spending depends critically on its composition and efficiency, with productive expenditure yielding stronger long-term benefits than unproductive outlays.

Despite the extensive literature on public debt, inflation, and government expenditure, much of the existing empirical work on India relies on static or long-run frameworks that may overlook short-run dynamics and feedback effects. To address this limitation, the present study employs an Autoregressive Moving Average with Exogenous Inputs (ARMAX) model to examine the short-run impact of public debt growth, inflation, government consumption expenditure, and population growth on India's economic growth during the period 1991–2024. By incorporating both dynamic persistence and exogenous macroeconomic influences, the study provides policy-relevant insights into the determinants of short-run growth in India.

Literature Background

The relationship between public debt and economic growth has been extensively examined in both theoretical and empirical literature, yet findings remain mixed and context-specific. The theoretical foundation originates from Domar's (1944) debt sustainability condition, which argues that public debt remains manageable as long as the economy's growth rate exceeds the interest rate on government borrowing. Building on this, Bohn (1998) introduced the fiscal reaction function, suggesting that fiscal policy is sustainable when primary surpluses respond positively to rising public debt.

Empirical evidence across countries indicates that the growth impact of public debt is often nonlinear. Reinhart and Rogoff (2010) reported that economic growth tends to slow when public debt exceeds certain thresholds, while Checherita-Westphal and Rother (2012) found that high debt levels crowd out private investment and reduce productivity in the euro area. Similarly, Pattillo, Poirson, and Ricci (2002), analyzing developing economies, showed that excessive external debt negatively affects growth due to debt overhang effects and inefficient resource allocation.

From a Keynesian perspective, public borrowing can stimulate short-run economic growth if directed toward productive investment. Barro (1990) and Elmendorf and Mankiw (1999) emphasized that government spending, particularly on infrastructure and human capital, can enhance growth by expanding productive capacity. However, the growth outcome depends largely on fiscal credibility and the efficiency of public expenditure (Cochrane, 2011). Eberhardt and Presbitero (2015) further demonstrated that the debt–growth relationship varies considerably across countries, reflecting institutional and structural differences.

In the Indian context, several studies highlight the adverse growth implications of rising public debt and fiscal imbalances. Rangarajan and Srivastava (2005) and Kaur and Mukherjee (2012) found that increasing fiscal deficits and debt accumulation constrain growth through higher interest burdens and reduced fiscal space. Mohanty (2019) argued that persistent debt accumulation poses risks to macroeconomic stability, while Patnaik and Narayanan (2020) provided evidence that fiscal deficits have a significant negative impact on India's real GDP growth in the post-reform period. In contrast, Ghosh and Misra (2021) emphasized that well-targeted capital expenditure can enhance productivity and support long-term economic expansion, underscoring the importance of expenditure quality rather than size.

The inflation–growth relationship has also received substantial attention. Fischer (1993) and Bruno and Easterly (1998) demonstrated that low to moderate inflation may coexist with stable growth, whereas high inflation undermines investment, distorts price signals, and hampers economic performance. For South Asian economies, Mallik and Chowdhury (2001) showed that moderate inflation can support growth in the short run,

but excessive inflation becomes growth-inhibiting. Indian studies, including Singh and Kalirajan (2007), confirm the presence of an optimal inflation range conducive to growth.N

Regarding government expenditure, empirical studies suggest that fiscal spending has short-run demand-stimulating effects but mixed long-run outcomes depending on its composition. Blinder and Solow (1973) highlighted the counter-cyclical role of fiscal policy, while Barro (1990) incorporated public expenditure as a growth-enhancing factor in endogenous growth models. For India, Dash and Raja (2013) and Misra and Khundrakpam (2009) found that government consumption supports short-term growth, although long-term sustainability requires a shift toward productive capital investment.

Despite this extensive literature, most studies examine public debt, inflation, and government expenditure in isolation or rely on static or long-run frameworks such as OLS, ARDL, or cointegration techniques. Limited attention has been given to dynamic models that capture short-run feedback effects and exogenous shocks simultaneously. The ARMAX framework addresses this gap by integrating autoregressive and moving average components with key fiscal and monetary variables, allowing a more comprehensive analysis of short-run macroeconomic dynamics affecting India's economic growth

Data and Methodology

Data Description

The study is based on annual time-series data covering the period from 1991–92 to 2023–24. The primary variable is real Gross Domestic Product (GDP), expressed in logarithmic form (lgdp) to capture proportional changes in economic growth and reduce heteroscedasticity. Public debt is included as the first difference of the logarithm of public debt (d_ldeb) to reflect changes in debt growth rather than its absolute level. Inflation (linf) is measured using the annual consumer price inflation rate, representing price-level dynamics in the economy. Government final consumption expenditure is incorporated as the first difference of its logarithm (d_lgfc) to assess short-run fiscal spending effects on growth. Population growth is captured through the first difference of the logarithm of total population (d_lpop), indicating demographic influences on economic performance. Data for the study are sourced from authoritative and reliable institutions, including the Reserve Bank of India (RBI) Handbook of Statistics on Indian States, the Ministry of Statistics and Programme Implementation (MoSPI), and the World Bank's World Development Indicators (WDI) database.

Variable Description

Variables	Description
Real GDP Growth (annual percentage change)	Real GDP Growth refers to the percentage increase in the total value of goods and services produced within the country, adjusted for inflation over the previous years. It essentially measures the real economic growth by comparing the output of the current year to the output of previous year using constant prices to eliminate the impact of price changes.
Public Debt to GDP Ratio	The total liabilities of centre and state governments in India expressed as a percentage of GDP constitutes the public debt to GDP ratio. This ratio is a key indicator of a country's economic health and fiscal sustainability reflecting the extent to which the government is borrowing to finance its expenditures.
Inflation, Consumer (Annual %)	Inflation as measured by the consumer price index reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services that may be fixed or changed
Population growth (annual %)	Annual population growth for year t is the exponential rate of growth of midyear population from year t-1 to t is expressed as percentage
Government final consumption expenditure (as % of GDP)	**Government Final Consumption Expenditure** refers to spending on goods and services by residents to meet individual or collective needs. Government FCE covers current spending on goods, services, and employee compensation, including defense and security (excluding military capital outlays). It is expressed as a percentage of GDP, the total income from goods and services produced in an economy during a given period.

ARMAX Model

The Autoregressive Moving Average with Exogenous Inputs (ARMAX) Model is a dynamic time-series econometric framework that combines essential components

- Autoregressive Component(AR) : Captures persistence in the dependent variable by linking current GDP Growth to its past values
- Moving Average Component(MA) : It accounts for the impact of past shocks or unexplained variance.
- Exogenous variables : It incorporates external macroeconomic factors such as public debt growth, inflation, government expenditure and population growth.

The ARMAX Model is used in this study because it is well suited to capture the short run dynamic relationship between economic growth and key macroeconomic variables such as public debt, inflation, and government expenditure and population growth. Economic growth exhibits time dependence meaning that current GDP growth is influenced by past values as well as previous economic shocks. The autoregressive and moving average components of ARMAX Model accounts for this persistence. Unlike static models, ARMAX is well suited to analyze short run macroeconomic fluctuations in India's post reform period, providing a robust framework to assess how fiscal and monetary factors affect economic growth.

Estimation Procedure

1. Stationarity Tests:

Augmented Dickey-Fuller (ADF) tests confirmed that variables were integrated of order I(1), hence differenced to ensure stationarity.

2. Model Estimation:

The ARMAX(1,1) model was estimated using Exact Maximum Likelihood (AS 197) method in Gretl software.

3. Diagnostics:

Model diagnostics include R^2, AIC, BIC, Hannan–Quinn criterion, and stability tests based on AR and MA roots.

General ARMAX(1,1) Model Specification

The ARMAX model with one autoregressive term (AR(1)) and one moving average term (MA(1)), plus exogenous variables, is expressed as:

$$GDP_t = \alpha + \emptyset_1 GDP_{t-1} + \beta_1 In(Inf_t) + \beta_2 \Delta In(Debt)\_t + \beta_2 \Delta In(gfc)\_t + \beta_4 \Delta In(pop)\_t + \varepsilon_t + \theta_1 \varepsilon_{t-1}$$

Where:

- α = constant term
- $\emptyset_1$ = autoregressive coefficient
- θ_1 = moving average coefficient
- ε_t= error term (white noise)
- $InInf_t$= inflation (log-transformed)
- $\Delta In(Debt_t)$= first difference of log public debt
- $\Delta In(gfc_{t)}$= first difference of log government final consumption expenditure
- $\Delta In(pop_t)$= first difference of log population growth

Table 1 : ARMAX(1,1) Model Estimates

Variable	Coefficient	Std. Error	z-stat	p-value	Significance
const	2.374	0.238	9.96	2.21e−23	***
φ₁ (AR term)	0.442	0.464	0.953	0.341	Not significant
θ₁ (MA term)	−0.247	0.482	−0.512	0.608	Not significant
linf	−0.281	0.124	−2.266	0.024	**
d_ldeb	−8.345	0.996	−8.375	5.54e−17	***
d_lgfc	1.738	0.876	1.983	0.047	**
d_lpop	1.862	1.034	1.801	0.072	*

Interpretation

- Public Debt (d_ldeb):

The coefficient (−8.35) is highly significant and negative, indicating that rising debt growth strongly depresses economic growth. This result suggests that excessive borrowing burdens fiscal sustainability and limits productive investment.

- Inflation (linf):

The negative coefficient (−0.28) confirms that inflation adversely affects growth, consistent with classical theory and prior empirical studies. Sustained inflation erodes real purchasing power and investor confidence.

- Government Consumption (d_lgfc):

The positive and significant coefficient (1.74) implies that government spending stimulates short-run economic growth, reflecting a Keynesian demand-side effect.

- Population Growth (d_lpop):

Population change shows a positive, marginally significant coefficient (1.86), indicating that demographic expansion may contribute to growth through labor force effects.

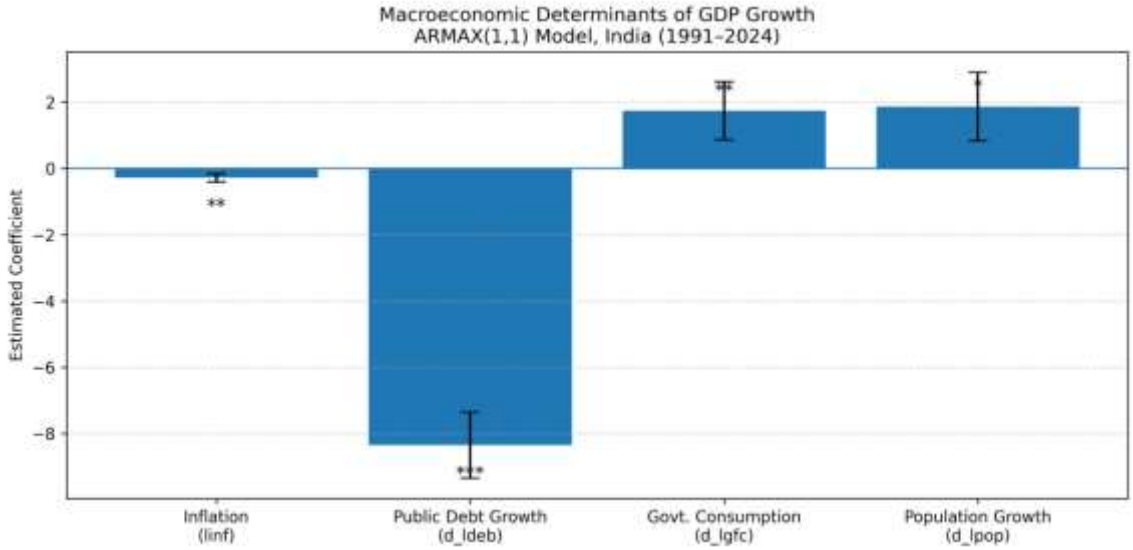
- AR and MA Terms:

Both AR(1) and MA(1) terms are statistically insignificant, suggesting that most GDP dynamics are explained by the exogenous macroeconomic variables rather than past GDP or residual effects.

Findings of the study

- The ARMAX results provide strong empirical evidence of short-run macroeconomic linkages between fiscal and monetary variables and India's GDP growth.
- The negative impact of public debt growth reinforces concerns about fiscal sustainability. Rapid increases in borrowing can lead to debt overhang effects, where expectations of future taxation and repayment burdens depress current investment and consumption
- The negative influence of inflation aligns with the notion that price instability deters long-term investment, distorts resource allocation, and undermines growth.
- Conversely, government consumption expenditure demonstrates a short-term stimulative role, consistent with Keynesian theory that fiscal expansion supports demand during periods of sluggish private activity. However, the long-term effectiveness depends on the efficiency and productivity of spending.
- The positive population coefficient may reflect the demographic dividend, with an expanding labor force supporting growth. Yet, this effect is modest and statistically marginal, suggesting that population growth alone is insufficient without parallel productivity gains**.**

Macroeconomic Determinants of GDP Growth in India



*Notes: Error bars represent ± one standard error. ***, ** and * denote statistical significance at the 1%, 5% and 10% levels, respectively.*

The above figure illustrates the estimated coefficients of the ARMAX(1,1) model assessing the impact of key macroeconomic variables on GDP growth in India during the period 1991–2024. The figure clearly shows that public debt growth exerts the strongest negative and statistically significant effect on economic growth. The large magnitude of the coefficient indicates that rapid increases in public debt substantially dampen short-run GDP growth, supporting the debt-overhang hypothesis whereby higher borrowing raises future tax expectations and discourages private investment. Inflation also exhibits a negative and statistically significant impact on GDP growth, though its magnitude is smaller compared to public debt growth. This finding suggests that price instability undermines real economic activity by eroding purchasing power, increasing uncertainty, and adversely affecting investment decisions. In contrast, government consumption expenditure displays a positive and statistically significant effect on GDP growth, reflecting a short-run Keynesian demand-stimulating role of fiscal spending. This indicates that government expenditure can support output growth in the short term, particularly during periods of weak private demand. Population growth shows a positive but marginally significant relationship with GDP growth, implying that demographic expansion contributes modestly to economic performance, possibly through labor force growth. However, the relatively weaker significance suggests that population growth alone is insufficient to sustain higher growth without complementary improvements in productivity, education, and employment generation.Overall, the figure highlights that India's short-run economic growth is more strongly influenced by fiscal and monetary variables than by autoregressive persistence, emphasizing the importance of prudent debt management, inflation control, and efficient government spending for sustaining economic growth.

Policy Implications

- Fiscal Prudence: The strong negative impact of debt growth on GDP underscores the need for maintaining sustainable debt levels. The government should focus on productive borrowing and enhance fiscal responsibility mechanisms under the FRBM framework.
- Inflation Management: As inflation reduces growth, coordinated monetary and fiscal policies should ensure price stability through prudent expenditure management and supply-side interventions.
- Productive Government Spending: While government consumption aids short-term growth, emphasis should be placed on capital expenditure, infrastructure, and human development to sustain long-term productivity gains.
- Population and Employment Policies: Harnessing the demographic dividend requires parallel policies that improve labor productivity, education, and job creation.

Conclusion

This study applied an ARMAX model to analyze India's macroeconomic dynamics between 1991 and 2024. The findings reveal that public debt growth and inflation have statistically significant negative impacts on GDP growth, while government consumption contributes positively, and population growth shows a modest positive influence. These results affirm the importance of balanced fiscal policy where debt accumulation is managed prudently, inflation remains contained, and public expenditure is directed toward growth-enhancing sectors. Future research may extend this analysis by exploring long-run cointegration (ARDL/VAR models) or comparing India's debt-growth dynamics with other emerging economies.

References

- Barro, R. J. (1990). *Government spending in a simple model of endogenous growth.* Journal of Political Economy, 98(5), S103–S125.
- Blinder, A. S., & Solow, R. M. (1973). *Does fiscal policy matter?* Journal of Public Economics, 2(4), 319–337.
- Bohn, H. (1998). *The behavior of U.S. public debt and deficits.* Quarterly Journal of Economics, 113(3), 949–963.
- Bruno, M., & Easterly, W. (1998). *Inflation crises and long-run growth.* Journal of Monetary Economics, 41(1), 3–26.
- Checherita-Westphal, C., & Rother, P. (2012). *The impact of high government debt on economic growth: An empirical investigation for the euro area.* European Economic Review, 56(7), 1392–1405.
- Cochrane, J. H. (2011). *Understanding policy in the great recession: Some unpleasant fiscal arithmetic.* European Economic Review, 55(1), 2–30.

- Dash, D. K., & Raja, P. (2013). *Public debt and economic growth nexus: Evidence from India.* Indian Economic Journal, 61(3), 91–110.

- Diamond, P. A. (1965). *National debt in a neoclassical growth model.* American Economic Review, 55(5), 1126–1150.

- Domar, E. D. (1944). *The "burden of the debt" and the national income.* American Economic Review, 34(4), 798–827.

- Eberhardt, M., & Presbitero, A. F. (2015). *Public debt and growth: Heterogeneity and non-linearity.* Journal of International Economics, 97(1), 45–58.

- Elmendorf, D. W., & Mankiw, N. G. (1999). *Government debt.* In J. B. Taylor & M. Woodford (Eds.), *Handbook of Macroeconomics* (Vol. 1C, pp. 1615–1669). Elsevier.

- Fischer, S. (1993). *The role of macroeconomic factors in growth.* Journal of Monetary Economics, 32(3), 485–512.

- Ghosh, P., & Misra, S. (2021). *Fiscal policy and economic growth in India: The role of government expenditure composition.* Economic & Political Weekly, 56(15), 62–70.

- Kaur, B., & Mukherjee, S. (2012). *Public debt and economic growth: A reassessment of the relationship in India.* RBI Occasional Papers, 33(1), 1–20.

- Krugman, P. (1988). *Financing vs. forgiving a debt overhang.* Journal of Development Economics, 29(3), 253–268.

- Mallik, G., & Chowdhury, A. (2001). *Inflation and economic growth: Evidence from four South Asian countries.* Asia-Pacific Development Journal, 8(1), 123–135.

- Misra, B. M., & Khundrakpam, J. K. (2009). *Fiscal consolidation in India: Issues and policy initiatives.* RBI Occasional Papers, 30(3), 1–23.

- Mohanty, D. (2019). *Fiscal policy and macroeconomic stability in India.* Indian Economic Review, 54(2), 159–184.

- Patnaik, I., & Narayanan, A. (2020). *Debt sustainability and fiscal responsibility in India: A macroeconomic analysis.* Economic & Political Weekly, 55(10), 45–53.

- Pattillo, C., Poirson, H., & Ricci, L. (2002). *External debt and growth.* IMF Working Paper 02/69.

- Rangarajan, C., & Srivastava, D. K. (2005). *Fiscal deficits and government debt in India: Implications for growth and stabilization.* Economic & Political Weekly, 40(27), 2919–2934.

- Reinhart, C. M., & Rogoff, K. S. (2010). *Growth in a time of debt.* American Economic Review, 100(2), 573–578.

- Singh, K., & Kalirajan, K. P. (2007). *Inflation and economic growth in India: An empirical analysis.* Journal of Policy Modeling, 29(6), 893–909.