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Public Debt and Economic Growth: Evidence from National, Regional, and Cross-Country Studies

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Abstract
The relationship between public debt and economic growth has been widely debated in economic literature, yet empirical findings remain inconclusive, particularly for developing economies such as India. This paper provides a structured and critical review of the empirical literature on the public debt–growth nexus, with a specific focus on the Indian context. Organized into four thematic sections, the review synthesizes evidence from studies examining debt sustainability and threshold effects at national and sub-national levels, India-specific time-series analyses, cross-country and institutional perspectives, and recent methodological advances in econometric modelling. The reviewed literature reveals that the growth effects of public debt are highly heterogeneous and non-linear, varying with debt composition, fiscal discipline, institutional quality, and regional characteristics. While several India-focused studies highlight the adverse long-run impact of excessive public debt—particularly when accompanied by rising debt-servicing burdens and non-productive expenditure—others suggest that moderate and well-managed debt can support economic growth under favorable conditions. Cross-country evidence further underscores the importance of governance and institutional capacity in mediating debt outcomes, while methodological innovations demonstrate that empirical conclusions are sensitive to model specification, threshold identification, and treatment of endogeneity. Overall, the paper concludes that public debt is neither inherently growth-enhancing nor uniformly growth-retarding; rather, its impact depends on the scale, composition, and management of borrowing. The review highlights the need for prudent fiscal policy, productive deployment of public debt, and strong institutional frameworks to ensure sustainable growth in India.

I. Introduction

Public debt has emerged as a central concern in contemporary macroeconomic policy debates, particularly for developing economies like India that face competing demands of growth, fiscal discipline, and social expenditure. In recent decades, rising public debt levels—accentuated by structural reforms, fiscal decentralization, and exogenous shocks such as the global financial crisis and the COVID-19 pandemic—have renewed interest in understanding how debt influences economic growth. The theoretical and empirical literature on the debt–growth nexus, however, offers no uniform conclusions, pointing instead to context-specific outcomes shaped by debt composition, institutional quality, fiscal management, and methodological choices. Against this backdrop, the present paper undertakes a structured review of the literature on public debt and economic growth, with a particular emphasis on India. Organized into four sections, the paper synthesizes evidence from national and sub-national studies, India-specific time-series analyses, cross-country and institutional perspectives, and advanced econometric approaches, with the objective of providing a coherent understanding of the conditions under which public debt supports or constrains economic growth.

II. Public Debt Sustainability, Threshold Effects, and Macroeconomic Dynamics in India: Evidence from National and Sub-National Studies

Understanding the relationship between public debt and economic growth has become increasingly important in the Indian context, particularly in the aftermath of fiscal decentralization, the implementation of the FRBM framework, and the macroeconomic disruptions caused by the COVID-19 pandemic. A growing body of empirical literature has therefore examined public debt not merely in aggregate terms, but through diverse lenses such as sustainability conditions, threshold effects, regional heterogeneity, and macroeconomic transmission mechanisms. This section reviews key studies that analyze public debt dynamics in India at both national and sub-national levels, employing a range of econometric techniques to assess whether rising public debt supports growth, undermines fiscal stability, or produces region-specific outcomes. Together, these studies provide

important insights into the evolving debt–growth nexus in India and set the foundation for a more nuanced understanding of fiscal policy effectiveness.

Bal et al. (2025) aimed to measure public debt sustainability across twenty-eight Indian states, specifically examining the situation in three distinct geographical groupings: southeastern, northwestern, and northeastern regions. The study period spans from 2012–2013 to 2020–2021 for the southeast, and 2012–2013 to 2019–2020 for the northwest and northeast, capturing both the post-Fiscal Responsibility and Budget Management (FRBM) Act era and the onset of the COVID-19 pandemic. Utilizing annual data from the Economic Political Weekly Research Foundation (EPWRF) database, the researchers employed Domar's stability test and a panel vector autoregressive (PVAR) model in a generalized method of moments (GMM) approach to dynamically assess the relationship between public debt, economic growth (GSDP), and gross primary deficit. While the Domar's stability conditions suggested that debt was sustainable across all regions based on the nominal growth rate criterion, the core findings derived from the more rigorous PVAR model revealed heterogeneous results. Specifically, the PVAR analysis indicated that public debt is sustainable in the southeastern region, where a positive shock to economic growth results in a negative response to the public debt-to-GSDP ratio and the gross primary deficit. Conversely, the findings demonstrated that public debt is unsustainable in both the northwestern and northeastern regions, often exhibiting a positive response of public debt following a shock in economic growth, and an undesirable widening of the gross primary deficit following an unexpected debt shock. These outcomes underscore the necessity for state governments in the northwestern and northeastern regions to prioritize enhanced fiscal discipline, broaden their revenue bases, and implement sound long-term debt management strategies to restore sustainable growth.

Bal (2025) conducted an empirical investigation titled "How much public debt is threshold in India?". It aimed to establish the optimal, globally maximum threshold level for India's public debt-to-GDP ratio. This comprehensive study analyzed annual macroeconomic data, including variables such as real interest rate, gross fiscal deficit (GFD), and economic growth (Y_t), collected from the Reserve Bank of India over the period spanning 1970 to 2019. Methodologically, the research first employed the Autoregressive Distributed Lag (ARDL) model to identify the key determinants of public debt and resolve endogeneity issues, confirming that the real interest rate, gross fiscal deficit, and economic growth significantly drive the level of national debt in the long run. Subsequently, the Genetic Algorithm (GA), a specialized optimization technique, was utilized to precisely calculate the threshold ratio. The major findings consistently revealed that the ratio of public debt to GDP should not exceed the range of 61% to 64% in India, a critical level validated by supplementary threshold regression analysis. The results underscore that economic development is positively affected only when public debt remains below this established threshold, suggesting that once debt surpasses this ceiling (e.g., 64.36% of GDP), it exerts a depressing effect on the economy.

Mohanty and Panda (2020) through their study titled "How Does Public Debt Affect the Indian Macroeconomy? A Structural VAR Approach" sought to empirically assess the dynamic macroeconomic effects of public debt in India, focusing on its influence on the interest rate, investment, inflation, and economic growth. Analyzing annual time series data spanning the period from 1980 to 2017, sourced from the Reserve Bank of India's Handbook of Statistics, the research utilized a Structural Vector Autoregression (SVAR) framework to establish short-run dynamics, having first determined through an ARDL bounds test that no long-run relationship existed among the variables. The investigation separated its analysis into the impacts of total combined central and state debt, central government debt, and distinct effects of domestic versus external debt. The major findings derived from the impulse response functions demonstrated that public debt, generally supporting the classical view, acts as a burden on the Indian economy. Specifically, public debt was found to have an adverse impact on economic growth and a positive impact on the long-term interest rate in the short run, while its effect on both inflation and investment was mixed or negligible. Crucially, the analysis revealed that domestic debt exerts a significantly more adverse influence on key macro variables than external debt, necessitating better control and productive allocation of this specific type of borrowing.

Pratibha&Muniyoor's (2025) study titled, "India's Debt Dilemma: Investigating Threshold, Primary Surplus, and Institutional Quality," was designed to measure India's general government debt threshold and examine the instrumental role of institutional quality (IQ) in mitigating the adverse effects of public debt (PD) on economic growth and primary surplus (PS). Utilizing annual macroeconomic data, including general government debt (as a percentage of GDP), GDP per capita, IQ (sourced from the economic freedom index), and primary surplus, collected from sources such as the IMF, World Bank, and the Reserve Bank of India, the analysis spanned a prolonged period, covering 1985 to 2023 for the debt threshold estimation and 1985 to 2020 for the fiscal reaction function analysis. Methodologically, the researchers employed the quadratic autoregressive distributed lag (ARDL) equation model to determine the long-run nonlinear relationship between debt and growth, alongside the fiscal reaction function approach to assess debt sustainability by observing the primary surplus response to rising PD. The empirical results revealed that India's public debt threshold is 76.83% of GDP, indicating that the country has already surpassed this critical limit, largely due to the continuous accumulation of PD in the recent past and the acceleration of public expenditure during the post-

COVID-19 phase. Furthermore, while rising PD negatively affects primary surplus, the study established that IQ plays a significant role in stimulating economic growth and, crucially, acts as an alleviating factor that reduces the negative impact of public debt on the primary surplus.

Thakur (2023) attempted to analyze the temporal evolution, spatial patterns, and macroeconomic determinants of outstanding public debt across Indian states, aiming also to provide policy recommendations for curbing high debt levels. Utilizing annual data spanning the period from 1980–81 to 2019–20, primarily sourced from the Reserve Bank of India, the study employed a multi-methodological approach that included descriptive statistics—specifically the Gini coefficient, Theil entropy, and moving averages—to track spatial inequality trends, alongside time series regression analysis (multiple regression models) to identify the key determinants of total center and state liabilities. Descriptive statistical analysis revealed a considerable level of inter-state inequality in debt levels, though inequality has generally been declining over each decade, with the Gini coefficient reaching its lowest value in 2019–20. The regression models indicated that lending rates, GDP growth, and trade balance are negatively related to total liability, while net FDI flows, GDP, trade balance, and foreign exchange reserves are positively related to total liability in other estimated models. Crucially, predictive maps derived from state lag regression models forecasted that both lagging states (such as Bihar and Sikkim) and developed states (such as Maharashtra and Gujarat) would incur high public debts; however, lagging states are predicted to utilize debt for servicing interest costs and non-plan expenditure, whereas developed states would direct borrowing towards interest servicing and planned expenditure.

Roy & Paul (2023) empirically investigated the relationship between public debt (specifically internal debt) and State Gross Domestic Product (SGDP) across 29 Indian states, thereby addressing a crucial gap in literature concerning sub-national debt dynamics in developing economies. The research utilized panel data from the Reserve Bank of India (RBI) and the Centre for Monitoring Indian Economy (CMIE) databases, covering the post-reform period spanning 2000 to 2020. Methodologically, the investigation employed both the random error component model and the fixed effect model, and crucially incorporated the Generalized Method of Moments (GMM) estimator—the Arellano–Bond difference GMM—to address potential endogeneity and ensure dynamic estimation. The core findings demonstrate a positive and significant impact of debt in enhancing the Indian SGDPs. Across all models, including the robust GMM estimation, the results were consistent: internal public debt is beneficial, with elasticities suggesting that a 10% increase in debt has the potential to increase SGDP approximately by 0.3% to 0.7%. This beneficial role is attributed to the productive use of borrowed funds for crucial developmental purposes, such as social sector expenditures, capital expenditures, and infrastructure improvements.

The studies reviewed in this section collectively demonstrate that the relationship between public debt and economic growth in India is highly contingent on sustainability conditions, threshold levels, regional contexts, and institutional arrangements. While some evidence points to growth-enhancing or sustainable debt outcomes—particularly when borrowing is productively deployed or remains below critical thresholds—other studies reveal clear risks of unsustainability, adverse macroeconomic spillovers, and pronounced inter-state disparities. Importantly, this strand of literature highlights that aggregate conclusions often mask substantial heterogeneity across regions, debt compositions, and fiscal regimes. These insights underscore the need to move beyond broad national or panel-level assessments toward more granular, India-specific analyses that directly examine long-run debt–growth linkages, debt servicing burdens, and fiscal viability within distinct economic and institutional settings. Accordingly, the next section builds on this foundation by reviewing empirical studies that focus explicitly on India-specific time-series evidence, offering deeper insights into how public debt, its composition, and associated fiscal dynamics have shaped economic growth outcomes over time.

III. India-Specific Time-Series Evidence on Public Debt, Fiscal Sustainability, and Economic Growth

While cross-country and panel-based studies offer useful generalizations on the public debt–growth relationship, country-specific time-series analyses are crucial for capturing the institutional, structural, and historical particularities of an economy like India. Against this backdrop, a significant strand of literature has focused explicitly on India, examining the long-run and short-run dynamics between public debt, its composition, fiscal variables, and economic growth using national and sub-national time-series data. These studies employ diverse econometric frameworks to assess debt sustainability, causality, and macroeconomic transmission channels, often incorporating critical elements such as debt servicing costs, fiscal deficits, foreign exchange reserves, and productivity. This section reviews key India-focused empirical contributions that provide nuanced insights into how public debt has influenced growth trajectories and fiscal outcomes over time.

Malik & Agarwal (2023) aimed to assess the sustainability of J&K's expanding public debt and model the relationship between the state's total liabilities, debt servicing burden, and economic growth. Covering the period from 1991 to 2021, the study utilized annual data on variables such as per-capita income, total outstanding liabilities to GSDP ratio, and interest payments to revenue receipts ratio, collected from sources

including the Central Statistics Office (CSO) and the Reserve Bank of India (RBI). Methodologically, the investigation employed the Domar's debt sustainability model to understand fiscal viability, alongside the Autoregressive Distributed Lag (ARDL) model and the corresponding Error Correction Model (ECM) to estimate both long-run co-integration and short-run dynamics. The empirical findings indicated that J&K's debt-to-GSDP ratio consistently exceeded the national average, and while the implementation of the FRBM Act briefly restored sustainability, the debt became unsustainable again between 2018 and 2021, exacerbated by the state's bifurcation and the COVID-19 pandemic. Crucially, the econometric analysis demonstrated that public debt and the debt-servicing burden both exert a negative and significant impact on per-capita income in J&K across both the short and long run, supporting the classical view that rising debt acts as an economic burden.

Barik&Sahu (2022) aimed to investigate the long-run relationship between economic growth and public debt in India, specifically examining the differential effects of internal and external liabilities. Utilizing annual time series data spanning the period from 1980 to 2018, gathered from sources including the National Accounts Statistics and the Reserve Bank of India's Handbook of Statistics, the researchers employed the Autoregressive Distributed Lag (ARDL) approach and the bounds test for cointegration. Having established cointegration among GDP per capita, public debt components, fixed investment, and trade openness, and incorporating a structural break identified in 2003, the Error Correction Model (ECM) was subsequently used to analyze short-run dynamics and adjustment. The major empirical results consistently supported the conclusion that public debt has a significant negative effect on India's economic growth in the long run; moreover, the analysis revealed that internal public debt exerts a more pronounced adverse impact on GDP per capita compared to external public debt. Conversely, fixed investment was confirmed to be a significant positive driver of long-run economic growth, while the ECM indicated a stable long-run relationship with a high speed of adjustment towards equilibrium.

Bal &Rath (2014) empirically examined the effect of public debt on India's economic growth within an extended growth accounting framework, differentiating its approach by including variables such as total factor productivity (TFP), internal and external debt, and debt service payments. Analyzing annual time series data spanning the period from 1980 to 2011, gathered primarily from the Reserve Bank of India's Handbook of Statistics and World Bank data, the research employed a two-step methodological approach. TFP growth was first measured using the non-parametric Malmquist approach based on Data Envelopment Analysis (DEA), before the core relationships were established using the Autoregressive Distributed Lag (ARDL) model. The ARDL bounds test confirmed the existence of a long-run equilibrium relationship among the variables. The major findings demonstrated that both domestic debt and external debt impose a significant negative impact on India's economic growth in the long run, a result attributed to the pattern of government borrowings being utilized heavily for consumption expenditure rather than productive capital formation. Conversely, the short-run analysis using the Error Correction Model (ECM) confirmed that variables, including central government debt, TFP growth, and debt services, significantly affect economic growth, with the adjustment speed suggesting 75% convergence toward equilibrium after one year. The ultimate conclusion advises that the government must follow the objective of inter-generational equity in fiscal management to stabilize the debt-to-GDP ratio, particularly given the increased liabilities following the global financial crisis.

The core objective of the study by Saini &Muniyoor (2021) was to empirically examine the long-run relationship and causal dynamics between public debt and economic growth in India, specifically integrating the often-omitted role of foreign exchange reserves. This analysis utilized annual time series macroeconomic data spanning the period from 1984 to 2019, drawing on sources such as the World Development Indicators and the Reserve Bank of India's Handbook of Indian Statistics. Methodologically, the research employed a two-pronged approach using the Bayer-Hanckcointegration technique (a robust method integrating four individual tests) alongside the Autoregressive Distributed Lag (ARDL) bounds test to estimate long- and short-run coefficients and confirm cointegration. Furthermore, the Granger causality test was employed to determine the direction of the relationship. Both cointegration tests confirmed a stable long-run relationship among the variables. The major findings revealed a significant negative relationship between public debt and economic growth in the long run, and crucially, the analysis established a unidirectional causality running strictly from public debt to economic growth. Additionally, the study found that foreign exchange reserves also have a significant adverse effect on economic growth in the long run. Consequently, the research concludes that reducing public debt is imperative for sustainable growth, necessitating the generation of a primary surplus to manage burgeoning interest liabilities.

Sasmal&Sasmal (2018) aimed to analyze the impact of public expenditure on economic growth and evaluate the viability of India's fiscal policy when budget deficits are financed by public borrowing, using alternative criteria to judge fiscal solvency in the short run. Utilizing annual time series data spanning the period from 1970–1971 to 2015–2016, sourced primarily from the Reserve Bank of India (RBI) publications, the research employed the theoretical framework of Bruce and Turnovsky (1999) with modifications, and empirically verified its propositions using time series analysis, specifically the augmented Dickey–Fuller unit root test, the Engle–Granger co-integration test, and OLS regression, supplemented by the pair-wise Granger

causality test. The major findings consistently indicated a deterioration in India's fiscal balance, reflecting non-viability of fiscal policy in the short run, based on key metrics like the ratio of Gross Fiscal Deficit (GFD) to Net National Product (NNP), which exhibited an increasing trend over the period. Econometric results demonstrated that a decline in NNP growth significantly increases the ratio of GFD to NNP, and that increases in total government expenditure positively raise the GFD/NNP ratio. Furthermore, the analysis established that interest payment on public debt Granger causes the GFD/NNP ratio and is causally responsible for the increasing share of Revenue Expenditure (RE) in total expenditure, a crucial finding given that RE components are often non-developmental. The study concludes that the significant increase in non-developmental RE, alongside the growing debt burden, adversely impacts economic growth and leads to financial insolvency, necessitating increased fiscal discipline and productive utilization of borrowed funds.

Singh & Kumar (2022) aimed to provide updated findings on the relationship between public debt sources and economic growth, utilizing annual time-series data covering key macroeconomic indicators, including domestic debt, external debt, Total Factor Productivity (TFP), and exports, spanning the period from 1980 to 2019. To achieve this, the researchers employed a robust suite of econometric techniques: after confirming variable stationarity, the Johansen cointegration procedure established the presence of a long-run equilibrium relationship, and long-run coefficients were derived using the Fully Modified Ordinary Least Square (FMOLS) and Dynamic Ordinary Least Square (DOLS) methods to ensure coefficient stability and address endogeneity. Contrary to the findings of many previous studies in the Indian context, the core results demonstrated that public debt is generally associated with better economic growth, concluding that domestic debt (DD), TFP, and exports are significant and positive long-run determinants of economic development. Additionally, the short-run diagnostic test, the Toda and Yamamoto Granger causality test, established a crucial unidirectional causality running from economic prosperity (growth) to external debt, debt service payment, and TFP.

The India-focused time-series literature reviewed in the preceding section highlights that the growth implications of public debt are deeply shaped by debt composition, servicing burdens, fiscal discipline, and macroeconomic context. While much of this evidence points toward adverse long-run growth effects of excessive debt accumulation in India, it also reveals that these outcomes are not uniform and may vary with productivity dynamics, external conditions, and policy regimes. However, analyses confined to a single country inevitably face limitations in capturing broader structural heterogeneity and institutional contrasts. To place the Indian experience within a wider analytical perspective, it is therefore necessary to examine cross-country and regional studies that explicitly account for non-linearities, threshold effects, governance quality, and systemic heterogeneity in the public debt–growth relationship. This transition allows for a deeper understanding of the conditions under which debt becomes growth-retarding or growth-supportive.

IV. Debt Thresholds, Institutional Quality, and Heterogeneous Growth Effects: International and Regional Evidence

A growing strand of the literature has moved beyond linear and country-specific analyses to investigate how the relationship between public debt and economic growth varies across regions, economic systems, and institutional environments. These studies emphasize that the debt–growth nexus is inherently heterogeneous and often non-linear, with critical thresholds beyond which the growth effects of debt deteriorate sharply. By incorporating cross-country panel data, regional perspectives, and institutional indicators such as governance quality and corruption, this body of work provides a more nuanced understanding of why similar debt levels can yield markedly different growth outcomes across economies. This section reviews key international and regional studies that highlight the role of debt thresholds, institutional capacity, and governance structures in shaping the economic consequences of public debt.

Otieno&Dániel (2025) did a systematic literature review and it was designed to synthesize and analyze the most relevant empirical evidence on the dynamic relationship between public debt and regional economic growth, specifically exploring how this nexus is mediated by the broader macroeconomic and institutional environment. The study employed a meticulous Systematic Literature Review (SLR) methodology guided by the PRISMA framework, focusing on peer-reviewed articles published between 2011 and 2024, sourced primarily from the Web of Science, Scopus, and Science Direct databases. The analysis involved synthesizing findings from quantitative econometric models, which commonly utilized techniques such as Structural Vector Autoregressive Models (SVAR), the Generalized Method of Moments (GMM), and various panel regression approaches. The core conclusion derived from the synthesis is that high public debt generally exhibits a negative relationship with economic growth across advanced, emerging, and low-income countries. This relationship is consistently characterized as non-linear, with growth diminishing severely once debt surpasses specific thresholds (e.g., 44–45% of GDP in emerging markets), and this detrimental effect is most pronounced in regions where institutional capacity and debt management practices are deficient. Ultimately, the study

emphasizes that debt outcomes are contingent on the quality of governance and institutional frameworks, calling for more spatially informed research to capture regional spillover effects and guide tailored debt strategies.

Ahlborn&Schweickert (2018) conducted attemptedto challenge the assumption of homogeneous debt effects by arguing that heterogeneity in the public debt-growth relationship is structured by clusters of countries with distinct economic systems. Analyzing panel data for 111 developed and developing countries averaged over 5-year periods, the study covered the duration from 1971 to 2010, relying on macroeconomic data gathered from sources including the IMF and UNCTAD. Methodologically, the analysis was grounded in a standard long-run growth model utilizing Fixed Effects (FE) estimation to account for unobserved heterogeneity, supplemented by 2 Stage Least Squares (2SLS) to address endogeneity concerns. To test the core hypothesis, the researchers employed a rolling threshold technique based on interaction variables for different economic systems and debt levels. The empirical findings strongly confirmed that economic systems matter: Continental countries (Core EU member states) face significantly more growth-reducing public debt effects, which become acutely pronounced at debt levels above approximately 75% of GDP. In sharp contrast, public debt exhibited neutral or even positive growth effects for Liberal (Anglo-Saxon) countries, while Nordic countries demonstrated a non-linear relationship where negative effects emerged only at debt levels around 60% of GDP.

Taylor &Lokina (2025) investigated the dynamic relationship between public debt and economic growth in Tanzania, focusing explicitly on domestic debt to establish causal links and explore specific debt-to-GDP thresholds, thus contributing to the limited literature on low-income countries. The study utilized quarterly time series data spanning March 2005 to June 2022, gathering macroeconomic variables such as domestic debt, GDP, inflation, interest rates, and deficit from Tanzanian official sources, including the Bank of Tanzania (BOT) and the National Bureau of Statistics (NBS). Methodologically, the analysis first employed Augmented Dickey–Fuller (ADF) and breakpoint unit root tests, followed by Johansen's cointegration test to confirm a long-run equilibrium relationship, which then facilitated the use of the Vector Error Correction Model (VECM) and the Threshold Model (specifically TVECM). The core empirical findings established a significant positive long-term relationship between domestic debt and economic growth. Crucially, this positive impact was most pronounced when the domestic debt-to-GDP ratio fell within the 31.3% and 35.2% threshold, beyond which the relationship became statistically insignificant. Furthermore, the Granger causality test demonstrated a unidirectional causal link running from economic growth to domestic debt.

Alamro (2024) sought to address a crucial gap in the literature by specifically examining the moderating role of corruption in the nexus between public debt sustainability and economic growth within 28 European Union nations. Utilizing annual panel data spanning the period from 2012 to 2019, the researchers sourced key variables, including the Debt Sustainability Index (DTS) from euro area statistics and the Corruption Perception Index (CPI) from Transparency International. Methodologically, the study employed a dynamic panel approach, estimating the models using both the Fixed Effects (FE) technique and the Generalized Method of Moments (GMM), specifically the Arellano–Bover GMM, to manage potential endogeneity and address time-specific effects. The core empirical findings revealed a statistically significant interaction between debt sustainability and corruption, confirming that the impact of public debt on growth is conditional upon a country's corruption level. Crucially, the results indicated that public debt hinders economic growth in corrupt nations, evidenced by a positive and significant relationship between the CPI (where a higher score indicates lower corruption) and debt sustainability. This detrimental effect is attributed to corruption leading to the misallocation of resources and inefficient public spending, which reduces the capacity to service debt and jeopardizes fiscal viability.

Abotsi&Ampah (2024) examined the long-term impact of public debt accumulation on economic growth across 45 African countries, focusing specifically on how the control of corruption mediates this relationship. Using annual panel data spanning the period from 1999 to 2019, sourced from global databases including the World Development Indicators and Worldwide Governance Indicators, the research employed the robust System Generalized Method of Moments (System GMM) dynamic panel estimation technique to manage endogeneity and derive stable coefficients. The principal finding confirmed that general government gross debt percentage of GDP exerts a significant negative impact on economic growth per capita in the African context, whereby a 1% increase in debt decreases GDP per capita growth by 0.052%. Crucially, the analysis revealed a positive and significant interaction term between public debt and the control of corruption, demonstrating that the negative economic consequences of excessive debt accumulation are mitigated in nations with stronger anti-corruption frameworks. This finding ultimately implies that improving the control of corruption can help African governments offset the detrimental impact of rising public debt and ensure debt utilization is efficient.

The international and regional literature reviewed in the preceding sections establishes that the growth effects of public debt are inherently heterogeneous and strongly mediated by institutional quality, governance structures, and country-specific thresholds. By demonstrating that similar debt levels can generate markedly different outcomes across regions and economic systems, these studies underscore the limitations of linear and uniform analytical frameworks. At the same time, the diversity of findings points to the critical role of econometric methodology in shaping conclusions about debt sustainability, causality, and threshold effects. This

recognition naturally leads to a closer examination of the methodological advances and econometric strategies that have been employed to capture nonlinearity, endogeneity, heterogeneity, and asymmetric dynamics in the debt–growth relationship, which forms the focus of the following section.

V. Econometric Approaches, Nonlinearities, and Causality in the Public Debt–Growth Nexus

Recent scholarship on public debt and economic growth has increasingly emphasized the importance of robust econometric techniques to address the complex, nonlinear, and endogenous nature of the debt–growth nexus. Moving beyond conventional linear panel and time-series models, researchers have adopted advanced methodologies such as quantile regression, panel kink and threshold regressions, nonlinear ARDL frameworks, spatial models, and refined causality tests. These approaches allow for a more nuanced exploration of heterogeneous effects across countries, income levels, policy regimes, and institutional environments, while also accounting for asymmetric responses and feedback mechanisms between debt and growth. This section reviews key methodological contributions that not only reassess earlier empirical conclusions but also deepen understanding of why public debt exhibits varied growth effects across contexts.

Mudayen et al. (2025) aimed to clarify the varied relationship between public debt and economic growth across developing nations, uniquely integrating the influence of corruption. Utilizing panel data gathered from the World Development Indicators, the World Bank, and Transparency International, the analysis encompassed 127 developing countries over the period from 2012 to 2019, selecting these years to capture a consistent measurement of corruption and exclude the atypical economic period of the COVID-19 pandemic. Methodologically, the research employed the innovative combination of quantile regression with fixed effects and bootstrapping across the 10% to 90% economic growth quantiles, an approach selected for its robustness against outliers and capacity to address heterogeneity and cross-sectional dependence common in developing country data. The principal finding was that public debt significantly hinders economic growth in developing countries, particularly across the 30% to 90% quantile distribution, confirming that improper management inhibits economic progress. Furthermore, the study established that trade and net foreign direct investment act as significant positive drivers of growth, while inflation rates, government spending, and corruption are detrimental factors. Ultimately, the research emphasizes that public debt governance is critical for driving economic growth and necessitates prudent fiscal policy and institutional strengthening.

Ramos-Herrera &Sosvilla-Rivero, (2025) aimed to rigorously examine the causal relationships between public debt and economic growth, utilizing a robust panel methodology to explicitly control for known macroeconomic growth drivers. Analyzing annual panel data for 91 countries over the period from 1995 to 2020, sourced primarily from the World Bank's World Development Indicators, the research employed the novel homogeneous approach to testing for Granger non-causality in a heterogeneous panel. This advanced econometric technique, which is suited for moderate time dimensions and heterogeneous parameters, was augmented by the Half-Panel Jackknife (HPJ) estimator to correct for pooled estimator bias, and the Grouped Fixed Effect (GFE) estimator was used to classify countries based on heterogeneous debt-growth dynamics. The key empirical findings demonstrated that while simple pairwise comparisons often showed a unidirectional Granger-causality running from public debt to economic growth, the causality changed fundamentally when conditioning the analysis on other growth-explanatory variables, such as capital formation and trade openness. Specifically, when controlling for these variables, the results universally indicated bidirectional Granger-causality between public debt and economic growth in all country classifications, calling into question the findings of conventional panel models that fail to account for the inherent endogeneity of the public debt-to-GDP ratio.

The core contribution of Chen et al. (2024) was the investigation of the non-linear relationship between public debt and economic growth through a novel Panel Kink Regression (KTR) model incorporating latent group structures, an advanced econometric approach specifically designed to explore heterogeneous threshold effects based on unknown group patterns and overcome the limitations of assuming a homogeneous threshold effect across diverse countries. Utilizing a balanced panel dataset of forty countries, including twenty-one OECD members, the empirical analysis spanned the macroeconomic period from 1980 to 2010, relying on data sourced from Chudik et al. (2017). Methodologically, the study proposed a least squares estimator and demonstrated the consistency of estimating these group structures, integrating a continuous threshold effect to distinguish it from standard discontinuous threshold regression models. Empirically, the BIC-type information criterion identified the optimal structure as comprising three distinct groups, confirming the presence of a heterogeneous threshold level. Crucially, the results revealed that for the full sample, two of the groups significantly benefited from increasing public debt up to a certain threshold, after which the growth effect diminished. Furthermore, a major subgroup of OECD countries exhibited an inverse U-shaped relationship where the positive impact of debt accumulation turned significantly negative once the debt-to-GDP ratio exceeded 54.58%, thus indicating that mixed results in prior literature stem from neglecting these group-specific heterogeneous impacts.

Egert(2015) aimed to formally test the existence and robustness of a negative nonlinear relationship between public debt and economic growth, particularly scrutinizing the influential 90% debt-to-GDP threshold proposed by Reinhart and Rogoff. The study utilized a variant of the Reinhart-Rogoff central government debt dataset covering 1946 to 2009 for bivariate regressions, and a shorter general government debt dataset sourced from the OECD for 1960–2010 within a multivariate growth framework. Methodologically, the paper employed nonlinear threshold models, imposing exogenous thresholds derived from prior literature, alongside the rigorous approach of endogenously identifying thresholds using Hansen's (1999) procedure and testing stability via bootstrapping. For the multivariate analysis, Bayesian Model Averaging of Classical Estimates (BACE) was integrated to address model uncertainty. The core conclusion was that identifying a robust negative nonlinear relationship is extremely difficult and highly sensitive to modeling choices, data frequency, and definition of public debt. Crucially, in the rare instances where a negative nonlinear correlation was detected, it kicked in at significantly lower levels of public debt, typically between 20% and 60% of GDP, contradicting the predicted 90% tipping point. The findings often suggested that debt could have a positive effect at very low levels (e.g., below 20% of GDP for advanced countries) before turning negative, implying that the non-linearity is more complex and less universal than previously assumed.

Maruf et al. (2023) in their empirical study aimed to provide updated findings on the dynamic relationship between public debt and economic growth in Indonesia, specifically focusing on the asymmetric effects of macroeconomic variables by incorporating inflation and total gross savings. Utilizing annual time-series data, including GDP growth, public debt, and inflation, sourced partially from the World Bank, the investigation spanned a robust period from 1976 to 2022. Methodologically, the research employed the rigorous Nonlinear Autoregressive Distributed Lag (NARDL) bounding test approach to analyze asymmetric cointegration, a choice justified by its ability to capture non-linearities and the mixed order of integration among variables. The analysis confirmed the presence of a long-run cointegration relationship, with findings establishing that public debt, inflation, and savings significantly affect economic growth. Crucially, the asymmetric results demonstrated that decreases in Government Final Consumption (GFC) significantly hinder economic growth in the long run, suggesting that government spending acts as a stabilizing mechanism during economic contractions. Furthermore, the long-run coefficient for total gross savings was confirmed as a positive determinant of economic expansion. The study ultimately underscores the need for sound fiscal management and long-term debt strategies for Indonesia.

Ngcobo et al. (2025) attempted to test the dynamic impact of public debt on economic growth across newly democratized African countries (South Africa and Namibia) and newly democratized European countries (Germany and Ukraine), explicitly comparing the debt-growth nexus under macroprudential and non-macroprudential policy regimes across the period 1990–2022. Utilizing annual panel data primarily sourced from the World Development Indicators (WDI) and policy measures from established databases, the research employed the innovative Bayesian Spatial Lag Panel Smooth Transition Regression (BSLPSTR) model to account for heterogeneity, spatial correlation, and non-linearity. Pre-estimation tests, including the Wild Cluster Bootstrap-Lagrange Multiplier (WCB-LM) test, confirmed the existence of a nonlinear relationship characterized by two transitions. The major findings demonstrated that the debt-growth relationship is characterized by an S-shape, signifying a shift beyond the U-shape curve. Crucially, the fiscal policy thresholds were estimated at 65% of GDP for the African group and 72% of GDP for the European group, with public debt universally exerting a negative impact on growth once these levels are surpassed. Furthermore, the analysis confirmed that the implementation of macroprudential policies significantly influences the relationship, shifting the nonprudential regime's U-shape to an inverted U-shape in the prudential regime for both country groups.

The studies reviewed in this section highlight that empirical conclusions regarding the public debt–growth relationship are highly sensitive to methodological choices, model specifications, and the treatment of nonlinearity, heterogeneity, and endogeneity. Evidence from advanced econometric frameworks reveals that debt effects often vary across growth distributions, institutional settings, and policy regimes, with threshold levels that are neither universal nor stable over time. Moreover, the presence of bidirectional causality, asymmetric adjustments, and regime-dependent dynamics challenges simplistic interpretations of debt as uniformly growth-enhancing or growth-inhibiting. Taken together, these methodological insights reinforce the need for context-specific, institutionally informed, and methodologically rigorous analyses when assessing public debt sustainability. In the Indian context, these lessons provide a critical foundation for synthesizing the diverse strands of evidence reviewed across sections and for drawing informed conclusions on how public debt can be managed to support sustainable economic growth.

VI. Summary & Conclusion

The literature reviewed across the four sections of this paper underscores that the relationship between public debt and economic growth is complex, non-linear, and highly contingent on economic structure, institutional capacity, and policy orientation. The first section highlights sustainability concerns, threshold

effects, and regional heterogeneity within India, revealing that debt outcomes vary significantly across states and fiscal regimes. The second section, drawing on India-specific time-series evidence, largely points to adverse long-run growth effects of rising public debt, particularly when debt servicing burdens increase and borrowing is directed toward non-productive expenditure, though some studies note growth-supportive effects under favorable conditions. Extending beyond the Indian context, the third section demonstrates that debt–growth dynamics are shaped by institutional quality, governance, and economic systems, with clear evidence of threshold effects and heterogeneous outcomes across regions and countries. Finally, the fourth section shows that empirical conclusions are strongly influenced by econometric methodology, with advanced models revealing asymmetric, regime-dependent, and bidirectional relationships that challenge simplistic interpretations of debt effects. Taken together, the review suggests that public debt is neither inherently growth-enhancing nor uniformly growth-retarding; rather, its impact depends on how much is borrowed, how it is used, and the institutional and policy environment in which it is managed. For India, these insights point to the critical importance of prudent fiscal management, productive use of borrowed resources, and strong institutions in ensuring that public debt supports sustainable economic growth rather than undermines it.

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