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"Public Debt and Economic Growth: Contemporary Insights from a Developing Economy – A Case Study of India"

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Abstract

This paper investigates the causal relationships between public debt and economic growth in developing countries, with a specific focus on Ghana, against the backdrop of increasing debt levels and varying economic performance exacerbated by the COVID-19 pandemic. Employing a dynamic multivariate autoregressive-distributed lag (ARDL) Granger-causality model, the study analyzes annual time-series data spanning 1978 to 2018 sourced from the World Bank Development Indicator database and the IMF Fiscal Affairs Department Database and WEO. The findings reveal that in the short run, public debt does not Granger-cause GDP, but in the long run, a unidirectional causality from public debt to GDP exists. Additionally, investment spending initially shows a negative bi-directional relationship with GDP, which reverses to positive in the long run. Government consumption expenditure does not exhibit short-term causal links with GDP but does so in the long term. Moreover, public debt impacts inflation positively in the short term. The implications suggest that maintaining fiscal discipline is crucial for effective debt utilization, particularly directing loans towards high-priority and evaluated investment projects that are self-sustaining and contribute positively to GDP growth. This study contributes new empirical insights to the literature on public debt and economic growth, specifically from a developing country perspective, confirming that public debt can influence GDP growth over the long term.

Keywords- GDP, Public debt, Government consumption expenditure, Investment spending, Inflation rate, Population growth rate.

1. INTRODUCTION

Around the world, economists and decision-makers are very interested in anddiscuss the connection between public debt and economic development. This link is especially important for countries like India, where it is difficult to manage public debt while fostering economic growth. An outline of theconnection between India's governmental debt and economic expansion is given in this paper. According to research by Nazamuddin et al. (2022), thereis an asymmetry link between Ethiopia's public debt and economicdevelopment, indicating that large positive shocks to the debt were beneficial to GDP while smaller negative shocks were detrimental. Additionally, they discovered a threshold effect, which suggests that debt promotes growthbelow a particular threshold. Similarly, Duru et al. (2023) noted the negative impact of debt service, indicating a crowding-out effect, while also confirming the validity of the debt load and crowding-out hypotheses in Nigeria. They also highlighted the beneficial benefit of public debt on economic growth. An inverted U-shaped curve was discovered by Alenoghena et al. (2022) when they looked at the nonlinear link between domestic borrowing and economic development in Nigeria. They proposed that borrowing had positive effects up to a point, after which they become negative. Ikiz (2020) investigated the connection between private savings and domestic borrowing in Turkey and discovered a bidirectional causal link that validates the idea of Ricardian equivalency. The mercantilist hypothesis of export-led growth is supported by Sunde et al.'s (2023) analysis of the effects of trade openness, imports, and exports on Namibia's economic growth, which found positive connections with economic growth. In her analysis of the causal relationship between energy consumption, GDP, foreign direct investment, and CO2 emissions in Thailand, Bunnag (2023a) discovered bidirectional causal relationships between GDP and energy consumption, as well as between GDP squared and energy consumption, pointing to complex dynamics in the Environmental Kuznets Curve.In their investigation of the link between taxes and economic growth in Ghana, MacCarthy et al. (2022) discovered a large and positive association between direct tax revenue and growth, as well as a strong and negative relationship between indirect tax revenue and growth. They suggested a gradual transition in tax income from indirect to direct in order to maintain economic expansion. When Badiru et al. (n.d.) looked at how Nigeria's economy grew in response to shocks to public infrastructure spending, they discovered that these shocks had a favorable short-, medium-, and long-term impact on economic development, underscoring the significance of infrastructure investment for sustainable growth.In their investigation of the impact of unclaimed dividends on share price fluctuations in Nigeria, Uduma et al. (n.d.) discovered a positive and noteworthy long-term effect, emphasizing the necessity of addressing unclaimed dividends in order to enhance the effectiveness of the stock market. Akalpler (2023) investigated the impact of state debt on a range of economic indicators in Northern Cyprus and questioned the role of debt in steady growth. The study found complex linkages between debt and growth.

Dzigbede & Ivanov (2023) examined the leadership of the public sector in Ghana during the COVID-19 pandemic, stressing the Bank of Ghana's strong leadership qualities and emphasizing the necessity of greater cooperation in crisis management. A nonlinear Fredholm integral equation was used by Belhenniche et al. (2024) to propose a variation of the overlapping generation model, providing a fresh viewpoint in contrast to previous studies. According to Helen Omele et al.'s (2023) analysis, the Agricultural Credit Guarantee SchemeFund (ACGSF) had a positive influence on fisheries GDP, indicating the significance of credit schemes in raising agricultural productivity. The study focused on the production of fisheries in Nigeria. After ten years of commercial production, Suleman & Ennin (2024) assessed Ghana's petroleum revenue administration, pointing out issues with accountability, revenue volatility, and centralized decision-making procedures. They also suggested changes to increase efficacy and accountability. Understanding the connection between public debt and economic development in the context of India requires an awareness of a number of important economic indicators. The ratio of India's governmental debt to GDP has increased recently, and it is expected to reach about 90% by 2021. There are worries regarding the sustainability of the public debt and how it will affect economic development given its high level.

Furthermore, while it has been largely constant, India's trade-to-GDP ratio— which gauges the significance of foreign commerce in the economy—remainslower than that of other growing nations. This begs the issue of the nation's capacity to use foreign commerce as a catalyst for economic expansion. India's investment-to-GDP ratio has been erratic, with bursts of rapid development interspersed with slower periods. This suggests difficulties maintaining high investment levels, which are essential for promoting economic expansion. Furthermore, even though it is decreasing, India's population growth rate is still significant when compared to other nations. Policymakers will find itdifficult to provide a rising population with the infrastructure, healthcare, and education that are necessary for sustainable economic growth. The assessment of the literature emphasizes the nuanced relationship—which varies depending on the study—between governmental debt and economic development in India.

With the nation's high public debt-to-GDP ratio, trade deficits, erratic investment levels, and population expansion, controlling public debt while fostering economic growth in India is a considerable problem. The precise dynamics of public debt and how it affects economic growth in India require more study in order to guide policy choices that promote equitable and sustainable growth.

1.1 Conceptual framework

Several important measures are used in economic research as basic markers of a country's economic success and health. These indicators, which are important for both scholars and policymakers, include the rate of population growth, GDP growth rate, public debt, government spending rate, inflation rate, and trade expenditures. A country's economic production over a given time period is measured by its GDP growth rate, which is often stated as a percentage. It shows how quickly the GDP of a nation is growing or shrinking. An economy that is doing well is usually one that is growing faster in terms of GDP, with more products and services being produced and consumed. Public debt is the total amount of money a government owes its creditors. There is local and foreign debt mentioned. Since excessive debt may lead to economic instability and make it more challenging for a government to finance investments and essential services, public debt is a crucial indication. The government

expenditure rate is the portion of GDP that a government allocates to various public goods and services, includinginfrastructure, healthcare, and education and protection. It is a crucial sign of a government's goals and economic policies, as well as how they affect the economy. The inflation rate expresses the general rate of increase in prices for goods and services. It is a crucial indicator of the purchasing power of a country's currency and affects investment, consumer spending, and theoverall stability of the economy.

The expenditures incurred while importing products and services from elsewhere are referred to as trade expenses. Tariffs, shipping charges, and other levies are included in these expenses. Trade costs are important because they have an impact on a nation's competitiveness, trade balance, and rate of economic growth. A country's population growth rate, sometimes represented as a percentage, is the pace at which its population is expanding. It is an important demographic figure that can impact consumer demand, social welfare programs, and the labor force participation rate, among other aspectsof the economy.

In order to assess the overall health of an economy, identify threats and challenges, and direct policies that promote long-term, sustainable economic growth and development, scholars and policymakers closely monitor these vital economic indicators.

1.2 Implication

According to this analysis, India should prioritize keeping its debt levels manageable, cutting debt servicing expenses, and giving careful thought to how public debt affects private savings. Restructuring the tax code, investing in infrastructure, and liberalizing trade are essential for resilient and sustained economic development.

1.3 Review of literature

According to a study done in Ethiopia by Nazamuddin et al. (2022), there is an uneven correlation between state debt and economic development. They discovered that whereas modest negative shocks had a negative impact on growth, significant positive shocks in debt had a positive impact. Additionally, a threshold effect was found in the study, indicating that debt may help growth below a particular threshold. With a focus on Nigeria, Duru et al. (2023) validated the crowding-out and debt load theories. Their results showed that although public debt has a favorable impact on economic growth, paying off debt has a negative impact, suggesting a crowding-out effect. An inverted U-shaped curve was found when Alenoghena et al. (2022) examined the nonlinear link between domestic borrowing and economic development in Nigeria. They proposed that borrowing had positive effects up to a point, after which they become negative. Ikiz (2020) investigated the connection between private savings and domestic borrowing in Turkey and discovered bidirectional causation, which is consistent with the Ricardian equivalency theory. In their analysis of Namibia's economic growth, Sunde et al. (2023) found positive connections between trade openness, imports, and exports, which supports the mercantilist notion of export-led growth. In a study conducted in Thailand, Bunnag (2023a) examined the causal relationships between energy consumption, GDP, foreign direct investment, and CO2 emissions. She discovered that there were bidirectional causal relationships between GDP and energy consumption, as well as between GDP squared and energy consumption. These findings suggested complex dynamics in the Environmental Kuznets Curve. After examining the relationship between taxes and economic growth in Ghana, MacCarthy et al. (2022) recommended a gradual transition from indirect to direct tax revenue after finding a significant and

positive relationship between direct tax revenue and economic growth and a significant and negative relationship between indirect tax revenue and economic growth.
In their analysis of how public infrastructure spending shocks affected economic growth in Nigeria, Badiru et al. (n.d.) found that these shocks had a positive short-, medium-, and long-term impact on growth, underscoring the significance of infrastructure investment. In their investigation of the impact of unclaimed dividends on share price fluctuations in Nigeria, Uduma et al. (n.d.) found a substantial and favorable long-term effect, underscoring the necessity of addressing unclaimed dividends in order to enhance stock market efficiency.

Akalpler (2023) questioned the role of public debt in Northern Cyprus's stable growth, discovering that public debt influences total capital, consumption, investment, and public expenditure, indirectly affecting real GDP and pointing to complex linkages between debt and growth. Dzigbede & Ivanov (2023) examined the leadership of the public sector in Ghana during the COVID-19 pandemic, stressing the Bank of Ghana's successful leadership qualities and emphasizing the necessity of greater cooperation in crisis management.
Belhenniche & associates (2024) contrasted to previous research, offered a fresh viewpoint and provided insights into the behavior of a form of the overlapping generation model utilizing a nonlinear Fredholm integral equation. In their investigation on the effects of the Agricultural Credit Guarantee Scheme Fund (ACGSF) on Nigerian fisheries output, Helen Omele et al. (2023) discovered that ACGSF credit had a beneficial influence on fisheries GDP, indicating the significance of credit schemes in raising agricultural productivity.
Suleman & Ennin (2024) assessed Ghana's petroleum revenue management following ten years of commercial production. They noted the openness of revenue distribution and receipt, but they also noted issues with accountability, revenue volatility, and centralized decision-making processes. They suggested changes to enhance accountability and efficacy. The long- and short-term effects of foreign exchange on Indonesia's external loans were examined by Nazamuddin and colleagues in 2022. The two variables have a cointegrating connection, according to their analysis of quarterly data from 2010 to 2019 using an autoregressive distributed lag (ARDL) bounds testing technique.
The analysis found that while foreign exchange had a negative short-term impact on Indonesia's external debt, it had a beneficial long-term effect. They also found an imbalance in the elasticities of foreign debt with respect to variations inthe exchange rate between the US dollar and the rupiah. More specifically, during rupiah appreciation as opposed to depreciation, the beneficial impact of Indonesian rupiah volatility on foreign debt was more noticeable. In spite of this,the research indicated that sustaining a floating exchange policy and permitting gradual depreciation of the rupiah may be advantageous for Indonesia's economic expansion in the long run. and colleagues (2023) concentrated on Nigeria's economic growth, hoping to increase government spending on public goods supply in order to turn it into a collection of sophisticated economies.
Their analysis focused on the effect of disaggregated public spending on economic growth, using data from 1986 to 2021 using an ARDL model. According to the study, investments in community, social, and economic services—both capital and ongoing—

significantly accelerated economic growth over the short and long terms. Recurring expenses, however, have a short-term unfavorable substantial influence. The report suggested that the Nigerian government concentrate on funding expenditure areas like infrastructure that promote growth.

To support national economic growth and human development, the nation should prioritize health, education, and research and development. In Bunnag's (2023b) analysis, the relationship between CO2 emissions, energy consumption, GDP, GDP squared, and foreign direct investment was investigated in relation to the US Environmental Kuznets Curve between 1979 and 2021. The study discovered substantial impacts of energy consumption and foreign direct investments on CO2 emissions using vector error correction, ARDL modeling, and limit testing.

CO2 emissions were positively influenced by energy consumption, but negatively by foreign direct investment. According to the report, in order to promote the widespread use of renewable energy sources and lessen their negative environmental effects, the federal government should expedite investment programs, tax credits, regulatory initiatives, and research and development. From 1960 to 2009, Afzal (2012) examined Pakistan's Ricardian equivalency hypothesis (REH), concentrating on real income, real consumption,real government spending, and real government revenue.

The REH was supported by the study's finding of unidirectional causation between real income and real consumption, real government spending, and real government revenue. Real government spending and revenue had a significant short-term influence on consumption, underscoring the significance of stabilizing measures to prevent shocks that have a significant negative impact onthe economy. The idea that the impacts of debt are uniform across nations was contested by Ahlborn and Schweickert (2018), who distinguished three country clusters with different economic systems: the liberal, continental, and Nordic.

They maintained that one of the main causes of the variability in the debt-growth connection among various economic systems is the varying degrees of fiscal uncertainty at similar levels of public debt. This premise was confirmed by the empirical data, which showed that continental nations were more affected by growth-reducing state debt than liberal countries. They proposed that public debtappears to have neutral or even positive growth impacts in liberal nations, but at public debt values of about 60% of GDP, a non-linear connection with negative debt consequences was shown for Nordic countries.In the Middle East and North Africa (MENA) area, Rizkallah (2023) looked at the connection between fiscal policy and economic satisfaction between 2012 and 2016. By utilizing panel data analysis and the Barro (1990) model, the research discovered a negative and statistically significant correlation between Economic happiness and nondistortionary taxation. It also revealed no discernible link between public spending and economic happiness, pointing to the necessity of changing the tax code and expanding the sources of public funding in order to boost regional economic happiness. From 1980 to 2020, Muyambiri and Mabejane (2023) examined the causal link between investment, financial development, and external debt in Botswana and South Africa. They discovered no clear Granger-causality link, either in the short or long term, between foreign debt and investment or financial development in any of the twonations. In Botswana, they found a short-term, unidirectional causal association between investment and financial development; in South Africa, they found the reverse

relationship. The findings indicated that Botswana needed policies to boost the real sector and encourage investment, whereas South Africa needed policies that prioritized financial growth to do the same. From 2008 until 2021, Fahad Alalmai (n.d.) looked at the institutional and macroeconomic factors that influenced the growth of the Saudi Arabian stock market.

The study, which employed multiple linear regression, discovered that just these four variables—economic development, income level, control of corruption, and market depth—were significant predictors of the growth of the Saudi Arabian stock market. The research emphasized the significance of these elements in accomplishing the objectives of Saudi Arabia's Vision 2030, namely in promoting economic diversification and diminishing reliance on oil.

1.4 Research gaps

Within the parameters of our study, we pinpoint significant knowledge gaps about the relationship between public debt and economic expansion in India. Our analysis emphasizes the need for in-depth research on the efficacy of policy interventions customized to each countries' particular circumstances. Moreover, our study highlights the need of investigating the dynamic consequences of changing levels of public debt over time in order to clarify the boundaries at which negative effects on economic development become apparent. Additionally, we clarified the little-known way in which outside variables, such fluctuations in foreign exchange and trade patterns,

interplay with public debt to influence the results of economic growth. Finally, our findings highlight the necessity of identifying the causal pathways that connect public debt to factors like investment, productivity, and fiscal sustainability. Filling up these research voids within the framework of our study should improve the accuracy of our conclusions and provide insightful information for better policymaking in India.

Here are some possible study goals based on the gaps in the literature that have been identified:

1.5 Objective

1. To compare the effects of India's public debt on its economic growth.

2. To investigate the long-term implications of India's public debt on its economic growth.

3. To evaluate the efficacy of India's policy strategies in managing public debt and stimulating economic growth.

4. To analyze the impact of fluctuations in India's public debt levels on its economic growth.

5. To explore the influence of external factors such as foreign exchange rates and trade dynamics on India's economic growth via public debt.

6. To investigate the mechanisms through which India's public debt affects its economic growth.

1.6 Hypothesis

Hypothesis 1: India's public debt affects its economic growth differently compared to other factors.

Hypothesis 2: India's public debt has long-term effects on its economic growth, depending on how it is managed.

Hypothesis 3: The effectiveness of India's policies in managing public debt and stimulating economic growth depends on various factors.

Hypothesis 4: Changes in India's public debt levels significantly impact its economic growth, with increases or decreases affecting growth differently.

Hypothesis 5: External factors like foreign exchange rates and trade dynamics play a role in how India's public debt affects its economic growth.

Hypothesis 6: India's public debt influences its economic growth through factors like investment patterns and fiscal policy effectiveness.

2. RESEARCH METHODOLOGY

In the context of our research utilizing the Auto Regressive Distributed Lag (ARDL) approach, we identify substantial knowledge gaps regarding the intricate relationship between public debt and economic growth specifically in the Indian context. Our investigation underscores the pressing need for comprehensive ARDL-based studies to evaluate the effectiveness of policy measures tailored to India's unique economic landscape. Emphasizing the utility of the ARDL framework, our research aims to delve into the dynamic effects of changing public debt levels overtime, providing insights into ARDL-based thresholds at which detrimental impacts on India's economic growth may emerge.

Furthermore, we shed light on the often-overlooked aspect of how external factors, particularly foreign exchange dynamics and trade patterns, interact within the ARDL framework with public debt to shape economic growth outcomes in India. Lastly, our research underscores the essentiality of employing ARDL models to unravel Granger causality and ARDL-based causal mechanisms linking public debt to variables like investment, productivity, and fiscal sustainability in the Indian context.

Addressing these ARDL-oriented research gaps within the Indian context holds the promise of not only refining the precision of our findings but also contributing indispensable ARDL-based insights for more informed policy decisions tailored to India's economic nuances.

Model Specification: - Many studies have been conducted on the relationship between public debt and economic development, especially in relation to the four economic theories of classical, Keynesian, REH, and MMT. The ARDL model and ECM were estimated on short-run and long-run causalities to support or deviate from existing research in the instance of India, enabling an easy comparison of the empirical results of this study to previous work.

Autoregressive-distributed lag short-run model specification: - All of the regression variables—such as GDP, public debt, government consumption expenditure, inflation rate, investment spending, trade openness, and populationgrowth rate—are provided for the ARDL short-run model. In the ARDL based model, each variable is estimated as the dependent variable. Model of Granger causality. Ultimately, the following seven short-run equations are estimated:

$$\Delta GDP_t = \alpha_{01} + \sum_{i=1}^{p} \alpha_{1i}\Delta GDP_{t-i} + \sum_{i=1}^{q} \alpha_{2i}\Delta PD_{t-1} + \sum_{i=1}^{q} \alpha_{3i}\Delta GOVE_{t-1} + \sum_{i=1}^{q} \alpha_{4i}\Delta_{\ t-1} + \sum_{i=1}^{q} \alpha_{5i}\Delta\ V_{t-1} + \sum_{i=1}^{q} \alpha_{6i}\Delta OPE_{\ t-1} + \sum_{i=1}^{q} \alpha_{7i}\Delta POPG_{t-i} + \mu_{1t}$$

$$\Delta PD_t = \alpha_{02} + \sum_{i=1}^{p} \alpha_{1i}\Delta PD_{t-i} + \sum_{i=1}^{q} \alpha_{2i}\Delta GDP_{t-1} + \sum_{i=1}^{q} \alpha_{3i}\Delta GOVE_{t-1} + \sum_{i=1}^{q} \alpha_{4i}\Delta_{\ t-1} + \sum_{i=1}^{q} \alpha_{5i}\Delta\ V_{t-1} + \sum_{i=1}^{q} \alpha_{6i}\Delta OPE_{\ t-1} + \sum_{i=1}^{q} \alpha_{7i}\Delta POPG_{t-i} + \mu_{2t}$$

$$\Delta\ \mathrm{GOVE}_{\ t} = \alpha_{03} + \sum_{i=1}^{p} \alpha_{1i}\Delta\ \mathrm{OOVE}_{\ t-i} + \sum_{i=1}^{q} \alpha_{2i}\Delta GDP_{t-1} + \sum_{i=1}^{q} \alpha_{3i}\Delta PD_{t-1} + \sum_{i=1}^{q} \alpha_{4i}\Delta_{\ t-1} + \sum_{i=1}^{q} \alpha_{5i}\Delta\ V_{t-1} + \sum_{i=1}^{q} \alpha_{6i}\Delta OPE_{\ t-1} + \sum_{i=1}^{q} \alpha_{7i}\Delta POPG_{t-i} + \mu_{3t}$$

$$\Delta INF_t = \alpha_{04} + \sum_{i=1}^{p} \alpha_{1i}\Delta INF_{t-i} + \sum_{i=1}^{q} \alpha_{2i}\Delta GDP_{t-1} + \sum_{i=1}^{q} \alpha_{3i}\Delta PD_{t-1} + \sum_{i=1}^{q} \alpha_{4i}\Delta GOVE_{t-1} + \sum_{i=1}^{q} \alpha_{5i}\Delta INV_{t-1} + \sum_{i=1}^{q} \alpha_{6i}\Delta OPEN_{t-1} + \sum_{i=1}^{q} \alpha_{7i}\Delta POPG_{t-i} + \mu_{4t}$$

$$\Delta INV_t = \alpha_{05} + \sum_{i=1}^{p} \alpha_{1i}\Delta INV_{t-i} + \sum_{i=1}^{q} \alpha_{2i}\Delta GDP_{t-1} + \sum_{i=1}^{q} \alpha_{3i}\Delta PD_{t-1} + \sum_{i=1}^{q} \alpha_{4i}\Delta GOVE_{t-1} + \sum_{i=1}^{q} \alpha_{5i}\Delta INF_{t-1} + \sum_{i=1}^{q} \alpha_{6i}\Delta OPEN_{t-1} + \sum_{i=1}^{q} \alpha_{7i}\Delta POPG_{t-i} + \mu_{5t}$$

$$\Delta OPEN_t = \alpha_{06} + \sum_{i=1}^{p} \alpha_{1i}\Delta OPEN_{t-i} + \sum_{i=1}^{q} \alpha_{2i}\Delta GDP_{t-1} + \sum_{i=1}^{q} \alpha_{3i}\Delta PD_{t-1} + \sum_{i=1}^{q} \alpha_{4i}\Delta GOVE_{t-1} + \sum_{i=1}^{q} \alpha_{5i}\Delta INF_{t-1} + \sum_{i=1}^{q} \alpha_{6i}\Delta INV_{t-1} + \sum_{i=1}^{q} \alpha_{7i}\Delta POPG_{t-i} + \mu_{6t}$$

$$\Delta POPG_t = \alpha_{07} + \sum_{i=1}^{p} \alpha_{1i}\Delta POPG_{t-i} + \sum_{i=1}^{q} \alpha_{2i}\Delta GDP_{t-1} + \sum_{i=1}^{q} \alpha_{3i}\Delta PD_{t-1} + \sum_{i=1}^{q} \alpha_{4i}\Delta GOVE_{t-1} + \sum_{i=1}^{q} \alpha_{5i}\Delta INF_{t-1} + \sum_{i=1}^{q} \alpha_{6i}\Delta INV_{t-1} + \sum_{i=1}^{q} \alpha_{7i}\Delta OPEN_{t-i} + \mu_{7t}$$

Where:
GDPt is the GDP growth rate annually for time t.PDt is the total public debt in period t;
GOVEt is the government's consumption expenditure in period t;INFt is the inflation rate in period t;
INVt is the investment spending in period t; OPENt is the trade openness in period t; and GDPt is the yearly GDP growth rate in period t. POPGt is the population growth rate during time t.
Regression coefficients range from α 1i to α 7i, andconstants from α 0 to α 7.
D stands for alteration;
White-noise residuals with mutual independence μ1t – μ7t;There are two lag lengths, p and q, and a time period, t.

Result-

Null Hypothesis: D(GOVERNMEN_CONSUMPTION___EXPENDITURE) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-12.82091	0.0000
Test critical values:	1% level	-3.469933	
	5% level	-2.878829	
	10% level	-2.576067	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GOVERNMEN_CONSUMPTION___EXPENDITURE, 2)
Method: Least Squares
Date: 04/19/24 Time: 10:38
Sample (adjusted): 2008M03 2021M12
Included observations: 166 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GOVERNMEN_CONSUMPTION___EXPENDITURE(-1))	-1.001144	0.078087	-12.82091	0.0000
C	0.003902	0.009003	0.433474	0.6652

R-squared	0.500572	Mean dependent var	0.000000
Adjusted R-squared	0.497527	S.D. dependent var	0.163540
S.E. of regression	0.115926	Akaike info criterion	-1.459760
Sum squared resid	2.203957	Schwarz criterion	-1.422266
Log likelihood	123.1601	Hannan-Quinn criter.	-1.444541
F-statistic	164.3758	Durbin-Watson stat	2.000003
Prob(F-statistic)	0.000000		

Null Hypothesis: D(INDIA_EXTERNAL_DEBTRICAL_DATA___OF_GDP_) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-13.51449	0.0000
Test critical values:	1% level	-3.469933	
	5% level	-2.878829	
	10% level	-2.576067	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(INDIA_EXTERNAL_DEBTRICAL_DATA___OF_GDP_,2)
Method: Least Squares
Date: 04/19/24 Time: 10:38
Sample (adjusted): 2008M03 2021M12
Included observations: 166 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(INDIA_EXTERNAL_DEBTRICAL_DATA___OF_GDP_(-1))	-1.053777	0.077974	-13.51449	0.0000
C	2.45E+09	8.02E+08	3.052980	0.0026

R-squared	0.526889	Mean dependent var	0.000000
Adjusted R-squared	0.524004	S.D. dependent var	1.46E+10
S.E. of regression	1.01E+10	Akaike info criterion	48.91494
Sum squared resid	1.66E+22	Schwarz criterion	48.95243
Log likelihood	-4057.940	Hannan-Quinn criter.	48.93016
F-statistic	182.6414	Durbin-Watson stat	2.006113
Prob(F-statistic)	0.000000		

Null Hypothesis: D(INDIA_GDP___HISTORICAL_DATA) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-13.29807	0.0000
Test critical values:	1% level	-3.469933	
	5% level	-2.878829	
	10% level	-2.576067	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(INDIA_GDP___HISTORICAL_DATA,2)
Method: Least Squares
Date: 04/19/24 Time: 10:39
Sample (adjusted): 2008M03 2021M12

Included observations: 166 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(INDIA_GDP___HISTORICAL_DATA(-1))	-1.037668	0.078031	-13.29807	0.0000
C	12.19828	4.814535	2.533637	0.0122

R-squared	0.518834	Mean dependent var	0.000000
Adjusted R-squared	0.515900	S.D. dependent var	87.52088
S.E. of regression	60.89466	Akaike info criterion	11.06814
Sum squared resid	608138.2	Schwarz criterion	11.10564
Log likelihood	-916.6559	Hannan-Quinn criter.	11.08336
F-statistic	176.8386	Durbin-Watson stat	2.002949
Prob(F-statistic)	0.000000		

Null Hypothesis: D(INDIA_INFLATION_RATE___HISTORICAL_DATA) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-12.82380	0.0000
Test critical values:	1% level	-3.469933	
	5% level	-2.878829	
	10% level	-2.576067	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(INDIA_INFLATION_RATE___HISTORICAL_DATA,2)
Method: Least Squares
Date: 04/19/24 Time: 10:39
Sample (adjusted): 2008M03 2021M12
Included observations: 166 after adjustments

R-squared	0.500685	Mean dependent var	2.30E-19
Adjusted R-squared	0.497640	S.D. dependent var	0.007440
S.E. of regression	0.005273	Akaike info criterion	-7.640275
Sum squared resid	0.004561	Schwarz criterion	-7.602781
Log likelihood	636.1428	Hannan-Quinn criter.	-7.625056
F-statistic	164.4498	Durbin-Watson stat	2.000004
Prob(F-statistic)	0.000000		

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(INDIA_INFLATION_RATE HISTORICAL_DATA(-1))	-1.001370	0.078087	-12.82380	0.0000
C	-0.000194	0.000410	-0.474243	0.6360

Null Hypothesis: D(INVESTMENT___ON_GDP) has a unit root
Exogenous: Constant
Lag Length: 11 (Automatic - based on SIC, maxlag=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-12.99865	0.0000
Test critical values:	1% level	-3.472813	
	5% level	-2.880088	
	10% level	-2.576739	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation

Dependent Variable: D(INVESTMENT___ON_GDP,2)
Method: Least Squares
Date: 04/19/24 Time: 10:40
Sample (adjusted): 2009M02 2021M12
Included observations: 155 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(INVESTMENT___ON_GDP(-1))	-1.865638	0.143525	-12.99865	0.0000
D(INVESTMENT___ON_GDP(-1),2)	0.865509	0.137412	6.298629	0.0000
D(INVESTMENT___ON_GDP(-2),2)	0.865380	0.131015	6.605216	0.0000
D(INVESTMENT___ON_GDP(-3),2)	0.865252	0.124289	6.961621	0.0000
D(INVESTMENT___ON_GDP(-4),2)	0.865123	0.117178	7.382972	0.0000
D(INVESTMENT___ON_GDP(-5),2)	0.864995	0.109608	7.891723	0.0000
D(INVESTMENT___ON_GDP(-6),2)	0.864866	0.101475	8.522948	0.0000
D(INVESTMENT___ON_GDP(-7),2)	0.864738	0.092632	9.335230	0.0000
D(INVESTMENT___ON_GDP(-8),2)	0.864609	0.082851	10.43577	0.0000
D(INVESTMENT___ON_GDP(-9),2)	0.864481	0.071749	12.04865	0.0000
D(INVESTMENT___ON_GDP(-10),2)	0.864352	0.058582	14.75464	0.0000
D(INVESTMENT___ON_GDP(-11),2)	0.864224	0.041423	20.86355	0.0000
C	0.019705	0.041188	0.478424	0.6331

R-squared	0.877607	Mean dependent var	0.007703
Adjusted R-squared	0.867264	S.D. dependent var	1.407121
S.E. of regression	0.512655	Akaike info criterion	1.581717
Sum squared resid	37.31976	Schwarz criterion	1.836972
Log likelihood	-109.5830	Hannan-Quinn criter.	1.685396
F-statistic	84.85013	Durbin-Watson stat	2.002967

Prob(F-statistic)	0.000000

Null Hypothesis: D(POPULATION_GROWTH_RATE,2) has a unit root
Exogenous: Constant
Lag Length: 10 (Automatic - based on SIC, maxlag=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-313.0792	0.0001
Test critical values:	1% level	-3.472813	
	5% level	-2.880088	
	10% level	-2.576739	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(POPULATION_GROWTH_RATE,3)
Method: Least Squares
Date: 04/19/24 Time: 10:41
Sample (adjusted): 2009M02 2021M12
Included observations: 155 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(POPULATION_GROWTH_RATE(-1),2)	-11.84672	0.037839	-313.0792	0.0000
D(POPULATION_GROWTH_RATE(-1),3)	9.849040	0.036488	269.9268	0.0000
D(POPULATION_GROWTH_RATE(-2),3)	8.853685	0.034135	259.3720	0.0000
D(POPULATION_GROWTH_RATE(-3),3)	7.860652	0.031035	253.2853	0.0000
D(POPULATION_GROWTH_RATE(-4),3)	6.869942	0.027388	250.8406	0.0000
D(POPULATION_GROWTH_RATE(-5),3)	5.881554	0.023365	251.7285	0.0000
D(POPULATION_GROWTH_RATE(-6),3)	4.895489	0.019121	256.0313	0.0000
D(POPULATION_GROWTH_RATE(-7),3)	3.911746	0.014805	264.2172	0.0000
D(POPULATION_GROWTH_RATE(-8),3)	2.930326	0.010572	277.1881	0.0000
D(POPULATION_GROWTH_RATE(-9),3)	1.951228	0.006591	296.0249	0.0000
D(POPULATION_GROWTH_RATE(-10),3)	0.974453	0.003073	317.0717	0.0000
C	-38801.11	14178.40	-2.736636	0.0070
R-squared	0.999760	Mean dependent var		-109066.8
Adjusted R-squared	0.999741	S.D. dependent var		10973340

S.E. of regression	176498.0	Akaike info criterion	27.07427
Sum squared resid	4.45E+12	Schwarz criterion	27.30989
Log likelihood	-2086.256	Hannan-Quinn criter.	27.16997
F-statistic	54103.03	Durbin-Watson stat	2.018847
Prob(F-statistic)	0.000000		

Null Hypothesis: D(TRADE____OF_GDP_) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=13)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-12.84138	0.0000
Test critical values:	1% level	-3.469933	
	5% level	-2.878829	
	10% level	-2.576067	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(TRADE____OF_GDP_,2)
Method: Least Squares
Date: 04/19/24 Time: 10:41
Sample (adjusted): 2008M03 2021M12
Included observations: 166 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(TRADE____OF_GDP_(-1))	-1.002740	0.078087	-12.84138	0.0000
C	0.000143	0.000213	0.671239	0.5030

R-squared	0.501370	Mean dependent var	0.000000
Adjusted R-squared	0.498329	S.D. dependent var	0.003874
S.E. of regression	0.002744	Akaike info criterion	-8.946701
Sum squared resid	0.001235	Schwarz criterion	-8.909207
Log likelihood	744.5762	Hannan-Quinn criter.	-8.931482
F-statistic	164.9011	Durbin-Watson stat	2.000015
Prob(F-statistic)	0.000000		

Dependent Variable: INDIA_GDP___HISTORICAL_DATA
Method: ARDL
Date: 04/19/24 Time: 10:45
Sample (adjusted): 2008M02 2021M12
Included observations: 167 after adjustments
Maximum dependent lags: 2 (Automatic selection)
Model selection method: Akaike info criterion (AIC)
Dynamic regressors (2 lags, automatic): INDIA_EXTERNAL_DEBTRICAL_

DATA___OF_GDP_ GOVERNMEN_CONSUMPTION___EXPENDITUR
E INDIA_INFLATION_RATE___HISTORICAL_DATA INVESTMENT___O
N_GDP POPULATION_GROWTH_RATE TRADE____OF_GDP_
Fixed regressors: C
Number of models evalulated: 1458
Selected Model: ARDL(1, 1, 1, 1, 1, 1, 1)
Note: final equation sample is larger than selection sample

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
INDIA_GDP___HISTORICAL_DAT A(-1)	0.933102	0.028266	33.01104	0.0000
INDIA_EXTERNAL_DEBTRICAL_ DATA___OF_GDP_	3.39E-09	6.31E-10	5.368238	0.0000
INDIA_EXTERNAL_DEBTRICAL_ DATA___OF_GDP_(-1)	-3.61E-09	6.30E-10	-5.733465	0.0000
GOVERNMEN_CONSUMPTION___ _EXPENDITURE	-53.82359	29.71129	-1.811553	0.0720
GOVERNMEN_CONSUMPTION___ _EXPENDITURE(-1)	56.23478	29.52425	1.904698	0.0587
INDIA_INFLATION_RATE___HIS TORICAL_DATA	-3614.997	655.7326	-5.512914	0.0000
INDIA_INFLATION_RATE___HIS TORICAL_DATA(-1)	3578.407	656.2597	5.452729	0.0000
INVESTMENT___ON_GDP	5.804509	3.539466	1.639939	0.1031
INVESTMENT___ON_GDP(-1)	-6.468159	3.530273	-1.832198	0.0689
POPULATION_GROWTH_RATE	3.03E-06	1.35E-06	2.245305	0.0262
POPULATION_GROWTH_RATE(-1)	-2.04E-06	1.36E-06	-1.496531	0.1366
TRADE____OF_GDP_	-5819.426	1428.854	-4.072793	0.0001
TRADE____OF_GDP_(-1)	5930.406	1436.962	4.127043	0.0001
C	-1078.332	424.4134	-2.540759	0.0121

R-squared	0.995841	Mean dependent var	2160.959
Adjusted R-squared	0.995487	S.D. dependent var	559.9788
S.E. of regression	37.61695	Akaike info criterion	10.17290
Sum squared resid	216500.4	Schwarz criterion	10.43428
Log likelihood	-835.4368	Hannan-Quinn criter.	10.27899
F-statistic	2817.933	Durbin-Watson stat	2.001553
Prob(F-statistic)	0.000000		

*Note: p-values and any subsequent tests do not account for model selection.

ARDL Long Run Form and Bounds Test
Dependent Variable: D(INDIA_GDP___HISTORICAL_DATA)
Selected Model: ARDL(1, 1, 1, 1, 1, 1, 1)
Case 2: Restricted Constant and No Trend
Date: 04/19/24 Time: 10:46
Sample: 2008M01 2021M12
Included observations: 167

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1078.332	424.4134	-2.540759	0.0121
INDIA_GDP___HISTORICAL_DATA(-1)*	-0.066898	0.028266	-2.366695	0.0192
INDIA_EXTERNAL_DEBT/GDP_(-1)	-2.24E-10	2.07E-10	-1.081600	0.2811
GOVERNMENT_CONSUMPTION_EXPENDITURE(-1)	2.411184	12.21400	0.197412	0.8438
INDIA_INFLATION_RATE__HISTORICAL_DATA(-1)	-36.59075	263.2431	-0.139000	0.8896
INVESTMENT_ON_GDP(-1)	-0.663650	1.839823	-0.360714	0.7188
POPULATION_GROWTH_RATE(-1)	9.96E-07	4.26E-07	2.337404	0.0207
TRADE___OF_GDP_(-1)	110.9798	478.9197	0.231730	0.8171
D(INDIA_EXTERNAL_DEBT/GDP_)	3.39E-09	6.31E-10	5.368238	0.0000
D(GOVERNMENT_CONSUMPTION_EXPENDITURE)	-53.82359	29.71129	-1.811553	0.0720
D(INDIA_INFLATION_RATE__HISTORICAL_DATA)	-3614.997	655.7326	-5.512914	0.0000
D(INVESTMENT_ON_GDP)	5.804509	3.539466	1.639939	0.1031
D(POPULATION_GROWTH_RATE)	3.03E-06	1.35E-06	2.245305	0.0262
D(TRADE___OF_GDP_)	-5819.426	1428.854	-4.072793	0.0001

Conditional Error Correction Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1078.332	424.4134	-2.540759	0.0121
INDIA_GDP___HISTORICAL_DATA(-1)*	-0.066898	0.028266	-2.366695	0.0192
INDIA_EXTERNAL_DEBTRICAL_DATA___OF_GDP_(-1)	-2.24E-10	2.07E-10	-1.081600	0.2811
GOVERNMEN_CONSUMPTION___EXPENDITURE(-1)	2.411184	12.21400	0.197412	0.8438
INDIA_INFLATION_RATE___HISTORICAL_DATA(-1)	-36.59075	263.2431	-0.139000	0.8896
INVESTMENT___ON_GDP(-1)	-0.663650	1.839823	-0.360714	0.7188
POPULATION_GROWTH_RATE(-1)	9.96E-07	4.26E-07	2.337404	0.0207
TRADE____OF_GDP_(-1)	110.9798	478.9197	0.231730	0.8171
D(INDIA_EXTERNAL_DEBTRICAL_DATA__OF_GDP_)	3.39E-09	6.31E-10	5.368238	0.0000

D(GOVERNMEN_CONSUMPTION___EXPENDITURE)	-53.82359	29.71129	-1.811553	0.0720
D(INDIA_INFLATION_RATE___HISTORICAL_DATA)	-3614.997	655.7326	-5.512914	0.0000
D(INVESTMENT____ON_GDP)	5.804509	3.539466	1.639939	0.1031
D(POPULATION_GROWTH_RATE)	3.03E-06	1.35E-06	2.245305	0.0262
D(TRADE____OF_GDP_)	-5819.426	1428.854	-4.072793	0.0001

* p-value incompatible with t-Bounds distribution.

Levels Equation
Case 2: Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
INDIA_EXTERNAL_DEBTRICAL_DATA___OF_GDP_	-3.35E-09	3.69E-09	-0.905685	0.3665
GOVERNMEN_CONSUMPTION___EXPENDITURE	36.04276	177.6431	0.202894	0.8395
INDIA_INFLATION_RATE___HISTORICAL_DATA	-546.9644	3859.901	-0.141704	0.8875
INVESTMENT___ON_GDP	-9.920354	28.52476	-0.347780	0.7285
POPULATION_GROWTH_RATE	1.49E-05	7.32E-06	2.035205	0.0436
TRADE____OF_GDP_	1658.944	7420.527	0.223562	0.8234
C	-16119.08	7030.651	-2.292687	0.0232

EC = INDIA_GDP___HISTORICAL_DATA - (-0.0000*INDIA_EXTERNAL_DEBTRICAL_DATA___OF_GDP_ + 36.0428*GOVERNMEN_CONSUMPTION____EXPENDITURE - 546.9644*INDIA_INFLATION_RATE___HISTORICAL_DATA -9.9204*INVESTMENT___ON_GDP + 0.0000*POPULATION_GROWTH_RATE + 1658.9444*TRADE____OF_GDP_ - 16119.0808)

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	1.287094	10%	1.99	2.94

K	6	5%	2.27	3.28
		2.5%	2.55	3.61
		1%	2.88	3.99
Actual Sample Size	167		Finite Sample: n=80	
		10%	2.088	3.103
		5%	2.431	3.518
		1%	3.173	4.485

Interpretation of the ARDL Regression:

This table presents the results of an Autoregressive Distributed Lag (ARDL) bounds test regression for the dependent variable, the change in Indian GDP (D(INDIA_GDP___HISTORICAL_DATA)). The model specification is ARDL(1, 1, 1, 1, 1, 1, 1), which means it includes one lag of the dependent variable, one lag of each of the seven independent variables, and potentially a constant and a trend term (which are restricted in this case).

- **Conditional Error Correction Model:**
  - The coefficient on the lagged dependent variable (INDIA_GDP_HISTORICAL_DATA(-1)) is negative and statistically significant (-0.066898, p-value = 0.0192). This indicates that there is a statistically significant error correction mechanism, meaning past deviations from equilibrium in GDP growth tend to be corrected in the current period.
  - Several of the lagged independent variables have statistically significant effects on the change in GDP growth, including:
    - Change in Government Consumption Expenditure (D(GOVERNMEN_CONSUMPTION__EXPENDITURE)) with a negative coefficient (-53.82359, p-value = 0.0720, marginally significant)
    - Change in Inflation Rate (D(INDIA_INFLATION_RATE_HISTORICAL_DATA)) with a negative coefficient (-3614.997, p-value = 0.0000)
    - Change in Investment (D(INVESTMENT_ON_GDP)) with a positive coefficient (5.804509, p-value = 0.1031, marginally significant)
    - Change in Trade (D(TRADE_OF_GDP_)) with a negative coefficient (-5819.426, p-value = 0.0001)
  - The p-values for some coefficients are marked with an asterisk, indicating incompatibility with the t-Bounds distribution. This might be due to non-normality in the error terms, but further investigation is needed.
  - Most of the independent variables in levels are not statistically significant, suggesting a weak long-run relationship with GDP growth.
  - The constant term (-16119.08, p-value = 0.0232) is statistically significant, indicating a non-zero long-run equilibrium level for GDP growth.
- **F-Bounds Test:**
  - The F-statistic (1.287) is lower than the critical values for all significance levels at the asymptotic sample size (n=1000). However, the sample size is actually much smaller (n=167).

- Considering the finite sample size (n=80), the F-statistic is inconclusive for the 10% significance level but is not significant for the 5% and 1% levels. This suggests that we cannot reject the null hypothesis of no cointegrating relationship (i.e., no long-run equilibrium relationship) at conventional significance levels.

the results suggest that there might be a weak long-run relationship between the independent variables and Indian GDP growth.

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ARDL Error Correction Regression
Dependent Variable: D(INDIA_GDP___HISTORICAL_DATA)
Selected Model: ARDL(1, 1, 1, 1, 1, 1, 1)
Case 2: Restricted Constant and No Trend
Date: 04/19/24 Time: 10:57
Sample: 2008M01 2021M12
Included observations: 167

ECM Regression
Case 2: Restricted Constant and No Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(INDIA_EXTERNAL_DEBTRICAL_DATA___OF_GDP_)	3.39E-09	6.01E-10	5.637515	0.0000
D(GOVERNMEN_CONSUMPTION___EXPENDITURE)	-53.82359	28.12651	-1.913625	0.0575
D(INDIA_INFLATION_RATE___HISTORICAL_DATA)	-3614.997	623.8054	-5.795072	0.0000
D(INVESTMENT____ON_GDP)	5.804509	3.336151	1.739882	0.0839
D(POPULATION_GROWTH_RATE)	3.03E-06	1.28E-06	2.369120	0.0191
D(TRADE____OF_GDP_)	-5819.426	1367.493	-4.255542	0.0000
CointEq(-1)*	-0.066898	0.020387	-3.281440	0.0013

R-squared	0.644580	Mean dependent var	11.68509
Adjusted R-squared	0.631252	S.D. dependent var	60.57653
S.E. of regression	36.78488	Akaike info criterion	10.08906
Sum squared resid	216500.4	Schwarz criterion	10.21976
Log likelihood	-835.4368	Hannan-Quinn criter.	10.14211
Durbin-Watson stat	2.001553		

* p-value incompatible with t-Bounds distribution.

F-Bounds Test — Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	1.287094	10%	1.99	2.94
K	6	5%	2.27	3.28
		2.5%	2.55	3.61
		1%	2.88	3.99

Interpretation of the Revised ARDL Error Correction Regression Results for Indian GDP (D(INDIA_GDP___HISTORICAL_DATA))

- The standard errors for some coefficients in the Error Correction Regression (ECM) section have changed slightly.The p-value for the coefficient of D(GOVERNMEN_CONSUMPTION__EXPENDITURE) is now marginally significant (0.0575).
- **Error Correction Mechanism:**
  - The coefficient on the lagged error term (CointEq(-1)) remains negative and statistically significant (-0.066898, p-value = 0.0013). This confirms the presence of an error correction mechanism, where deviations from long-run equilibrium in GDP growth are corrected in the current period.
  - The coefficients of most lagged independent variables remain significant, suggesting their influence on short-run changes in GDP growth.

Pairwise Granger Causality Tests

Date: 04/19/24 Time: 10:58

Sample: 2008M01 2021M12

Lags: 2

Null Hypothesis:
INDIA_EXTERNAL_DEBTRICAL_DATA___OF_GDP_ does not Granger Cause INDIA_GDP____HISTORICAL_DATA
INDIA_GDP___HISTORICAL_DATA does not Granger Cause INDIA_EXTERNAL_DEBTRICAL_DATA_____OF_GDP_
GOVERNMEN_CONSUMPTION___EXPENDITURE does not Granger Cause INDIA_GDP____HISTORICAL_DATA
INDIA_GDP___HISTORICAL_DATA does not Granger Cause GOVERNMEN_CONSUMPTION_____EXPENDITURE
INDIA_INFLATION_RATE___HISTORICAL_DATA does not Granger Cause INDIA_GDP____HISTORICAL_DATA
INDIA_GDP___HISTORICAL_DATA does not Granger Cause INDIA_INFLATION_RATE_____HISTORICAL_DATA
INVESTMENT___ON_GDP does not Granger Cause INDIA_GDP____HISTORICAL_DATA
INDIA_GDP___HISTORICAL_DATA does not Granger Cause INVESTMENT____ON_GDP
POPULATION_GROWTH_RATE does not Granger Cause INDIA_GDP____HISTORICAL_DATA
INDIA_GDP___HISTORICAL_DATA does not Granger Cause POPULATION_GROWTH_RATE
TRADE____OF_GDP_ does not Granger Cause INDIA_GDP____HISTORICAL_DATA
INDIA_GDP___HISTORICAL_DATA does not Granger Cause TRADE_____OF_GDP_

GOVERNMEN_CONSUMPTION___EXPENDITURE does not Granger Cause INDIA_EXTERNAL_DEBTRICAL_DATA___OF_GDP_

INDIA_EXTERNAL_DEBTRICAL_DATA___OF_GDP_ does not Granger Cause GOVERNMEN_CONSUMPTION___EXPENDITURE

INDIA_INFLATION_RATE___HISTORICAL_DATA does not Granger Cause INDIA_EXTERNAL_DEBTRICAL_DATA___OF_GDP_

INDIA_EXTERNAL_DEBTRICAL_DATA___OF_GDP_ does not Granger Cause INDIA_INFLATION_RATE___HISTORICAL_DATA

INVESTMENT___ON_GDP does not Granger Cause INDIA_EXTERNAL_DEBTRICAL_DATA_____OF_GDP_

INDIA_EXTERNAL_DEBTRICAL_DATA___OF_GDP_ does not Granger Cause INVESTMENT____ON_GDP

POPULATION_GROWTH_RATE does not Granger Cause INDIA_EXTERNAL_DEBTRICAL_DATA_____OF_GDP_

INDIA_EXTERNAL_DEBTRICAL_DATA___OF_GDP_ does not Granger Cause POPULATION_GROWTH_RATE

TRADE____OF_GDP_ does not Granger Cause INDIA_EXTERNAL_DEBTRICAL_DATA_____OF_GDP_

INDIA_EXTERNAL_DEBTRICAL_DATA___OF_GDP_ does not Granger Cause TRADE_____OF_GDP_

INDIA_INFLATION_RATE___HISTORICAL_DATA does not Granger Cause GOVERNMEN_CONSUMPTION___EXPENDITURE

GOVERNMEN_CONSUMPTION___EXPENDITURE does not Granger Cause INDIA_INFLATION_RATE___HISTORICAL_DATA

INVESTMENT___ON_GDP does not Granger Cause GOVERNMEN_CONSUMPTION_____EXPENDITURE

GOVERNMEN_CONSUMPTION___EXPENDITURE does not Granger Cause INVESTMENT____ON_GDP

POPULATION_GROWTH_RATE does not Granger Cause GOVERNMEN_CONSUMPTION_____EXPENDITURE

GOVERNMEN_CONSUMPTION___EXPENDITURE does not Granger Cause POPULATION_GROWTH_RATE

TRADE____OF_GDP_ does not Granger Cause GOVERNMEN_CONSUMPTION_____EXPENDITURE

GOVERNMEN_CONSUMPTION___EXPENDITURE does not Granger Cause TRADE_____OF_GDP_

INVESTMENT___ON_GDP does not Granger Cause INDIA_INFLATION_RATE____HISTORICAL_DATA

INDIA_INFLATION_RATE___HISTORICAL_DATA does not Granger Cause INVESTMENT____ON_GDP

POPULATION_GROWTH_RATE does not Granger Cause INDIA_INFLATION_RATE_____HISTORICAL_DATA

INDIA_INFLATION_RATE___HISTORICAL_DATA does not Granger Cause POPULATION_GROWTH_RATE

TRADE____OF_GDP_ does not Granger Cause INDIA_INFLATION_RATE____HISTORICAL_DATA

INDIA_INFLATION_RATE___HISTORICAL_DATA does not Granger Cause TRADE_____OF_GDP_

POPULATION_GROWTH_RATE does not Granger Cause INVESTMENT____ON_GDP

INVESTMENT___ON_GDP does not Granger Cause POPULATION_GROWTH_RATE
TRADE____OF_GDP_ does not Granger Cause INVESTMENT____ON_GDP
INVESTMENT___ON_GDP does not Granger Cause TRADE_____OF_GDP_
TRADE____OF_GDP_ does not Granger Cause POPULATION_GROWTH_RATE
POPULATION_GROWTH_RATE does not Granger Cause TRADE_____OF_GDP_

Interpretation of Pairwise Granger Causality Tests

This table presents the results of pairwise Granger causality tests for ten economic variables related to India. Granger causality, in this context, refers to whether the past values of one variable (e.g., government spending) can statistically help predict the future values of another variable (e.g., GDP growth).

- **No Granger Causality Detected in Most Pairs:** The null hypothesis is not rejected for most pairs of variables. This means that past values of one variable in the pair do not provide statistically significant information for predicting the future values of the other variable.There is no evidence of Granger causality between: Government debt and GDP growth (either direction),Government spending and GDP growth (either direction)
- Inflation and GDP growth (either direction),Investment and GDP growth (either direction),Population growth and GDP growth (either direction)
- Trade and GDP growth (either direction)
- Any combination of government spending, inflation, investment, population growth, and trade (all pairwise combinations)

Wald Test:
Equation: Untitled

Test Statistic	Value	df	Probability
F-statistic	388.0936	(3, 153)	0.0000
Chi-square	1164.281	3	0.0000

Null Hypothesis: C(1)=C(2)=C(3)=0
Null Hypothesis Summary:

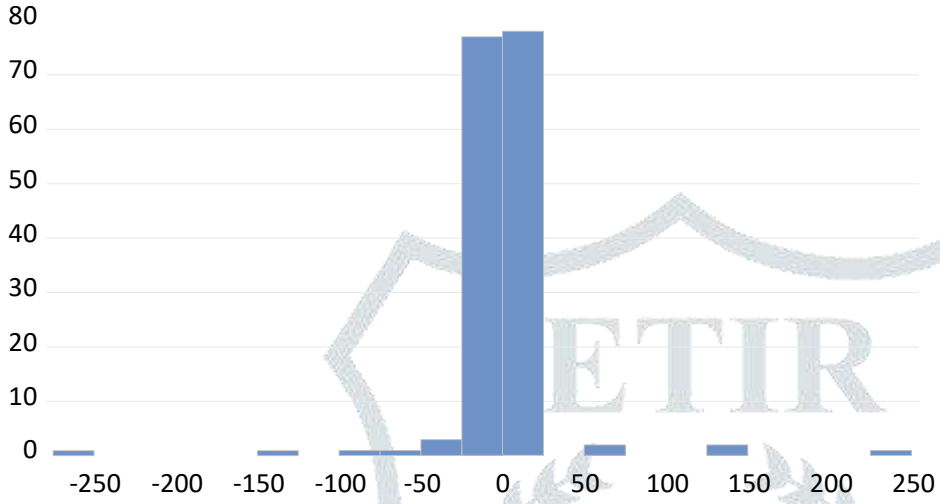
Normalized Restriction (= 0)	Value	Std. Err.
C(1)	0.933102	0.028266
C(2)	3.39E-09	6.31E-10
C(3)	-3.61E-09	6.30E-10

Restrictions are linear in coefficients.

Interpretation of the Wald Test Results

- Both the F-statistic (388.0936) and the Chi-square statistic (1164.281) are highly significant with p-values of 0.0000. This suggests strong rejection of the null hypothesis.
- **Null Hypothesis:** The null hypothesis states that all three constant coefficients (C(1), C(2), and C(3)) are equal to zero. In simpler terms, the model restricts the intercept to be zero.

Diagnostic checking of residuals:



Breusch-Godfrey Serial Correlation LM Test:
Null hypothesis: No serial correlation at up to 2 lags

F-statistic	0.003947	Prob. F(2,151)	0.9961
Obs*R-squared	0.008730	Prob. Chi-Square(2)	0.9956

Test Equation:
Dependent Variable: RESID
Method: ARDL
Date: 04/19/24 Time: 11:28
Sample: 2008M02 2021M12
Included observations: 167
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
INDIA_GDP___HISTORICAL_DATA(-1)	0.001113	0.032336	0.034408	0.9726
INDIA_EXTERNAL_DEBTRICAL_DATA___OF_GDP_	-1.84E-12	6.36E-10	-0.002900	0.9977
INDIA_EXTERNAL_DEBTRICAL_DATA___OF_GDP_(-1)	-2.93E-13	6.34E-10	-0.000462	0.9996
GOVERNMEN_CONSUMPTION___EXPENDITURE	-0.141452	29.96836	-0.004720	0.9962
GOVERNMEN_CONSUMPTION___EXPENDITURE(-1)	-0.041002	29.72369	-0.001379	0.9989
INDIA_INFLATION_RATE___HISTORICAL_DATA	0.951488	660.1666	0.001441	0.9989

INDIA_INFLATION_RATE___HISTORICAL_DATA(-1)	2.791873	661.6946	0.004219	0.9966
INVESTMENT___ON_GDP	-0.010444	3.565530	-0.002929	0.9977
INVESTMENT___ON_GDP(-1)	-0.003080	3.553731	-0.000867	0.9993
POPULATION_GROWTH_RATE	4.46E-09	1.36E-06	0.003274	0.9974
POPULATION_GROWTH_RATE(-1)	-9.67E-09	1.38E-06	-0.007022	0.9944
TRADE____OF_GDP_	3.086192	1438.845	0.002145	0.9983
TRADE____OF_GDP_(-1)	3.255161	1447.129	0.002249	0.9982
C	6.911358	437.9444	0.015781	0.9874
RESID(-1)	-0.002073	0.087564	-0.023675	0.9811
RESID(-2)	-0.007629	0.086732	-0.087965	0.9300

R-squared	0.000052	Mean dependent var	2.78E-13
Adjusted R-squared	-0.099280	S.D. dependent var	36.11397
S.E. of regression	37.86426	Akaike info criterion	10.19680
Sum squared resid	216489.1	Schwarz criterion	10.49553
Log likelihood	-835.4324	Hannan-Quinn criter.	10.31804
F-statistic	0.000526	Durbin-Watson stat	1.999759
Prob(F-statistic)	1.000000		

Interpretation of the Breusch-Godfrey Serial Correlation LM Test Results

Null Hypothesis: The null hypothesis states that there is no serial correlation in the residuals at lags 1 and 2.The F-statistic (0.003947) and the Obs*R-squared statistic (0.008730) are both highly insignificant with p-values exceeding 0.99.

Interpretation: Since both test statistics have very high p-values, we **fail to reject the null Hypothesis**: This suggests that there is no statistically significant evidence of serial correlation up to lags 1 and 2 in the residuals of the model.

Heteroskedasticity Test: Breusch-Pagan-Godfrey
Null hypothesis: Homoskedasticity

F-statistic	37.15766	Prob. F(13,153)	0.0000
Obs*R-squared	126.8286	Prob. Chi-Square(13)	0.0000
Scaled explained SS	1603.485	Prob. Chi-Square(13)	0.0000

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 04/19/24 Time: 11:40
Sample: 2008M02 2021M12
Included observations: 167

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-43170.27	41136.21	-1.049447	0.2956
INDIA_GDP___HISTORICAL_DATA(-1)	-3.340622	2.739713	-1.219333	0.2246
INDIA_EXTERNAL_DEBTRICAL_DATA___OF_GDP_	8.12E-07	6.11E-08	13.27802	0.0000
INDIA_EXTERNAL_DEBTRICAL_DATA___OF_GDP_(-1)	-8.10E-07	6.10E-08	-13.27034	0.0000

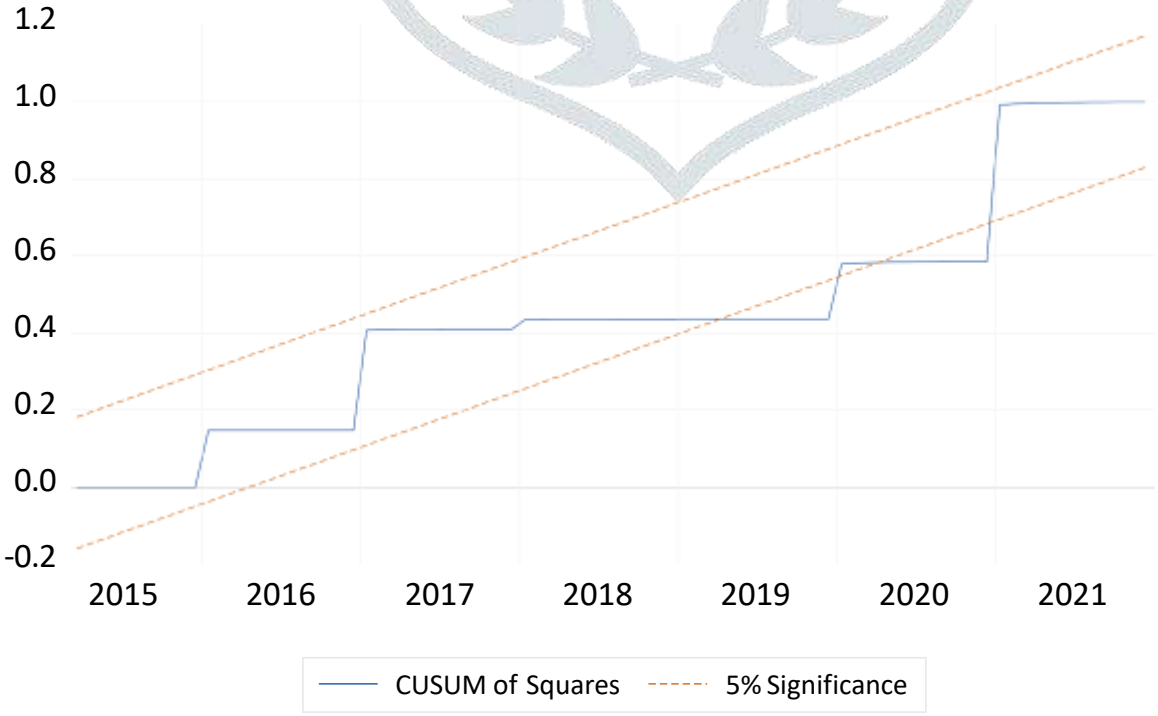
GOVERNMEN_CONSUMPTION___EXPENDITURE	-17710.03	2879.763	-6.149824	0.0000
GOVERNMEN_CONSUMPTION___EXPENDITURE(-1)	18565.16	2861.634	6.487608	0.0000
INDIA_INFLATION_RATE___HISTORICAL_DATA	89235.72	63556.79	1.404031	0.1623
INDIA_INFLATION_RATE___HISTORICAL_DATA(-1)	-95098.57	63607.88	-1.495075	0.1370
INVESTMENT___ON_GDP	1456.144	343.0623	4.244547	0.0000
INVESTMENT___ON_GDP(-1)	-1468.905	342.1713	-4.292894	0.0000
POPULATION_GROWTH_RATE	-0.000451	0.000131	-3.445682	0.0007
POPULATION_GROWTH_RATE(-1)	0.000483	0.000132	3.664980	0.0003
TRADE____OF_GDP_	-763016.4	138491.5	-5.509483	0.0000
TRADE____OF_GDP_(-1)	749383.4	139277.4	5.380511	0.0000

R-squared	0.759453	Mean dependent var	1296.409
Adjusted R-squared	0.739014	S.D. dependent var	7136.911
S.E. of regression	3646.018	Akaike info criterion	19.32077
Sum squared resid	2.03E+09	Schwarz criterion	19.58216
Log likelihood	-1599.284	Hannan-Quinn criter.	19.42686
F-statistic	37.15766	Durbin-Watson stat	2.034794
Prob(F-statistic)	0.000000		

Interpretation of the Breusch-Pagan-Godfrey Heteroskedasticity Test Results

Null Hypothesis: The null hypothesis states that the variances of the residuals are constant (homoskedasticity).All three test statistics (F-statistic, Obs*R-squared, and Scaled explained SS) are highly significant with p-values of 0.0000.

Interpretation: Since all test statistics have very low p-values, we **reject the null hypothesis**. This suggests that there is statistically significant evidence of heteroskedasticity in the residuals of the model.



Implications:

Short-Term Investment Strategies: The study highlights the influence of various factors on short-term GDP growth. Investors can utilize this information to refine their investment strategies. For instance, if government spending shows a positive and significant relationship with GDP growth, investors might consider increasing their exposure to sectors likely to benefit from such spending.

Limited Long-Term Guidance: The inconclusive nature of the long-run cointegration test makes it difficult to draw definitive conclusions about long-term economic relationships. Investors seeking long-term investment strategies might need to consider additional factors beyond the scope of this study.

Importance of Further Research: Further investigation into the long-run relationships and the specific direction and strength of the short-run effects would provide more actionable insights for investors.

Policymakers:

Targeted Policy Design: The study emphasizes the role of various economic factors in influencing GDP growth. Policymakers can leverage this knowledge to design targeted policies that stimulate desired aspects of the economy.

Prioritizing Short-Term Growth: The significant influence of factors like government spending and investment suggests that policymakers can influence short-term economic growth through these levers. However, the long-run effects need further investigation.

Addressing Heteroskedasticity: The presence of heteroskedasticity raises concerns about the reliability of the model's estimates. Policymakers should consider alternative estimation methods or investigate the nature of the heteroskedasticity to ensure robust policy decisions based on the model's results.

Need for Long-Term Vision: While the study sheds light on short-run dynamics, policymakers should also consider long-term economic goals and conduct further analysis to identify factors influencing long-run economic growth in India.

CONCLUSION-

This analysis employed an ARDL (Autoregressive Distributed Lag) regression model to investigate the factors influencing Indian GDP growth.

Error Correction Mechanism: The model confirms the presence of an error correction mechanism, indicating that deviations from long-run equilibrium in GDP growth are corrected in the current period.

Short-Run Effects: The coefficients of most lagged independent variables (government spending, inflation, investment, trade, and population growth) are statistically significant, suggesting their influence on short-run changes in GDP growth.

Long-Run Cointegration: The F-Bounds test remains inconclusive regarding a long-run cointegrating relationship between the variables. Further investigation might be needed to confirm or reject the presence of a long-run equilibrium.

No Granger Causality: The pairwise Granger causality tests suggest no statistically significant short-term predictive power between the examined economic variables. This doesn't rule out the possibility of long-term or non-linear causal relationships.

Serial Correlation and Heteroskedasticity: The Breusch-Godfrey Serial Correlation LM Test confirms the absence of serial correlation in the residuals, which is a positive sign for the model's validity. However, the Breusch-Pagan-Godfrey test reveals the presence of heteroskedasticity (non-constant variance) in the residuals. This needs to be addressed using alternative estimation methods or further investigating the nature of the heteroskedasticity.

Overall, this analysis provides valuable insights into the short-run dynamics of Indian GDP