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Research paper

Revisiting The Public Debt-GDP Growth Relationship in Indonesia: A Non-Linear ARDL Approach

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Abstract

This paper investigates the asymmetric relationship between public debt and economic growth by incorporating inflation and the total gross savings from 1976 to 2022. The study used the nonlinear autoregressive distributed lag bounds testing approach to examine the asymmetric cointegration between the variables. An asymmetric causality test also examines the causal association between the considered variables. The results indicate cointegration between the variables in the presence of asymmetries. The findings on asymmetric causality suggest that all the variables, public debt, inflation, and savings, affect economic growth. Lastly, the implications of these results for Indonesia's growth policies are also explored because this will have important implications for policymakers in Indonesia, highlighting the need for sustainable fiscal policies and debt management strategies to ensure long-term economic stability.

Keywords: *Public Debt; GDP Growth; Government Consumption; NARDL.*

1. Introduction

Indonesia's economic growth and public debt relationship present a paradox that remains unresolved in academic and policy discussions. While Indonesia's GDP growth has shown moderate resilience, the public debt ratio has risen substantially from 24.6% of GDP in 2012 to 37.3% by the World Bank Data in 2022. This increase is partly driven by counter-cyclical fiscal spending during global shocks (e.g., COVID-19), yet there is growing concern about whether the rising debt is productive or becoming a burden. Empirical studies suggest that in developing economies like Indonesia, high public debt could crowd out private investment, worsen macroeconomic stability, and constrain fiscal space for future development (Égert et al., 2022). Moreover, existing research often assumes a symmetric and linear relationship between public debt and growth, potentially overlooking how positive and negative changes in debt levels may affect growth differently. Augustine and Rafi, (2023) found nonlinear effects of debt on growth in low- and middle-income countries, while Chowdhury et al., (2024) arguing that ignoring such asymmetries may lead to misleading conclusions, especially in countries with volatile debt dynamics. This study employs yearly data to analyze the connection between public debt and GDP growth in Indonesia from 1976 to 2022. Besides public debt, other significant economic factors, such as inflation and gross savings, are integrated to understand Indonesia's economic dynamics thoroughly (Lau et al., 2022). The primary contribution of this research lies in its exploration of the potential asymmetric relationship between these variables. Recognizing this asymmetry is vital because positive and negative changes in one variable can affect others differently. The presence of an asymmetric relationship has also been discussed by Catalán et al., (2020)They stated that two variables can be influenced by various factors, particularly the complexity of economic systems and the mechanisms that generate the variables under study. However, based on this Triatmanto et al., (2023)We can understand that the complexity of one variable may create multiple channels through another variable. Understanding the relationship between public debt and economic growth is crucial for grasping Indonesia's economic development.

This study is motivated by the need to uncover the asymmetric and nonlinear dynamics between public debt and growth in Indonesia, which are often overlooked in recent macroeconomic research. By integrating inflation and gross savings, this paper aims to provide a more complete picture of Indonesia's fiscal-growth trajectory and support evidence-based policymaking. In addition, this study makes a significant contribution to the existing literature by not only investigating the connection between economic growth and public debt, which has been a central theme in many previous studies, but also by examining the interactions between inflation, gross saving, public debt, and economic growth (Gómez-Puig et al., 2022). While these macroeconomic linkages have been widely explored in general, research specific to Indonesia remains limited.

The flow of the paper is structured as follows. Section 2 comprehensively reviews the literature on the primary connections, specifically the debt-growth nexus and the roles of inflation and saving. This study's contributions to these research areas will be highlighted, with a particular focus on the context of Indonesia. Section 3 details the dataset and methodologies used, including the rationale for selecting Indonesia as the subject of this study and an analysis of its key economic indicators. Section 4 presents the empirical results, while Section

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5 concludes the paper, emphasizing the policy implications of the findings and the significance of considering asymmetry in economic analysis.

2. Literature Review

The relationship between public debt and economic development is not new, but research articles rarely discuss this topic. Starting from Eberhardt and Presbitero, (2015) which states that there is a negative relationship between public debt growth and long-term economic growth in 118 countries worldwide. On the other hand, Ruch and Geyer, (2017) argue that public debt can increase the poverty rate on the African continent, which is different from the increase in public capital investment. The development of knowledge about public debt and economic growth is spreading, as evidenced by research on Kamiguchi and Tamai, (2019) and Law et al., (2021). The researcher found a negative relationship between debt growth and economic growth in the article presented. Moreover, we will explore the relationship between public debt and economic growth, specifically in Indonesia. In addition, Reinhart and Rogoff (2010) stressed that the relationship between public debt and GDP is weak, while the negative effect is consistent across advanced and emerging economies.

GDP growth rate has been a crucial indicator of the country's economic performance. In recent years, the GDP growth rate has experienced fluctuations, with a notable increase to 5.11% in the first quarter of 2022 compared to the same period in 2021 (Badan Pusat Statistik, 2024). This growth rate is expected to continue, with a forecast of 4.50% by the end of the quarter and a long-term projection of 4.70% in 2023-2025. Various sectors, including industry, services, and agriculture, influence Indonesia's GDP growth rate. The industrial sector contributes the most significant portion to Indonesia's GDP, with manufacturing alone accounting for approximately 24% of the total economy, while others constitute 38% of total GDP, with trade, hotels and restaurants, transport and communication, finance, real estate, and business services key sectors. The services sector accounts for 15% of GDP and has grown significantly in recent years. Government Final Consumption (GFC) is crucial to Indonesia's economic activity. According to World Bank data, GFC in Indonesia was at 7.6611% of GDP in 2022, indicating a significant portion of the country's economic output is dedicated to government spending on goods and services. This expenditure includes purchases of goods and services, compensation of employees, and most national defense and security expenditures, excluding government military expenditures that are part of government capital formation.

This stability suggests that the government's consumption expenditure has been a consistent component of the country's economic activity, providing a foundation for economic growth and stability. According to Gusman (2024), the Indonesian government's GFC has been influenced by various factors, including economic conditions and policy decisions. For instance, the country's GDP growth rate has fluctuated over the years, with a notable increase to 5.11% in the first quarter of 2024 compared to the same period in 2023. This growth will likely have impacted the government's spending patterns, potentially leading to increased GFC. Additionally, Siburian, (2022) shares about the government's budget and fiscal policies can also influence GFC, as these policies can affect the allocation of resources and the overall government spending. In conclusion, the growth rate of government final consumption expenditure in Indonesia is a vital indicator of the country's economic activity. This has some connections with Hilmawan et al., (2023) his arguments about the stability of GFC as a percentage of GDP over the years suggest a consistent government spending pattern, which can contribute to economic stability. However, the impact of economic conditions and policy decisions on the GFC highlights the need for ongoing monitoring and analysis to understand the dynamics of government spending in Indonesia and its implications for the economy.

Indonesia's saving practices have been a topic of concern in recent years. According to World Bank According to data from 2022, it can be seen that the development of Indonesia's gross savings has not increased rapidly. Still, this development can be considered stable for developing countries. This growth in savings is significant, indicating an improvement in the country's financial stability. However, the savings rate in Indonesia remains relatively low compared to other countries. According to the International Monetary Fund, Indonesia's gross national savings per GDP stood at 30.87 per cent in 2014, significantly lower than the rates of Singapore and China, which stood at 46.73 per cent and 48.87 per cent, respectively. As a result, this is the same as Rahmawati and Rukmana, (2022) research shows that a low savings rate highlights Indonesian households' challenges in managing their finances effectively. Indonesian households only save an average of 8.5 per cent of their total income, which is a very low ratio given the general advice that at least 20 per cent of income should go towards savings (Nikmah & Hung, 2024).

The low savings rate in Indonesia has significant implications for the country's economic development (Agustina et al., 2023). It becomes more difficult for Indonesia to finance its economic development, and a large part of the financial means needs to come from abroad. This reliance on foreign funding can lead to economic instability and make the country more vulnerable to external shocks. In addition to the low savings rate, Indonesia also faces challenges in terms of financial literacy. Moreover Lopus et al., (2019) inferred that the Indonesian government has recognized the importance of improving savings practices and has taken steps to address this issue. Indonesia's saving practices have recently become a significant concern. Aginta, (2023) reveals that inflation in Indonesia from 1976 to 2022 has significantly shaped the country's economic dynamics. Throughout this period, the inflation rate in Indonesia has fluctuated due to various factors, including monetary policy, changes in global commodity prices, and domestic political conditions. Furthermore, Naiborhu, (2024) inferred that the 1997-1998 Asian financial crisis marked one of Indonesia's highest periods of inflation, where inflation reached more than 70%. The crisis triggered a sharp devaluation of the rupiah exchange rate, which caused a surge in the price of imported goods and exacerbated inflation.

Through Nakhli and Gaies's (2021) research on the effects of financial and political issues on social development, we can acknowledge that one of the primary reasons for using the NARDL model is its ability to disentangle the short and long-run asymmetries in the relationship between the variables. Moreover, from the findings by Liang et al. (2020) Chang and Fang, (2023), Massonini Ngoma et al., (2024) this feature is crucial for accurately modeling economic phenomena where responses to shocks may vary depending on whether the shock is positive or negative. For instance, a rise in income inequality, financial development, and human development might reflect asymmetric effects in economic contexts. By capturing these error correction dynamics, the NARDL model provides a more nuanced understanding of the temporal adjustments in the studied variables.

In addition to the impact on inflation, the government's budget and fiscal policies can influence the country's overall economic performance. For example, the government's fiscal policy can affect the level of public debt, which in turn can impact GDP growth. This highlights the need for prudent fiscal management and macroeconomic policies to ensure sustainable economic growth and stability. On the other hand, inflation and government policy could also influence the employment rate (Badan Pusat Statistik, 2024). The country's population has been growing steadily, with a total population of approximately 273 million as of 2024. This population growth has led to an increased labor force, contributing to the high employment rate. Analyzing the dynamics between public debt and GDP growth in Indonesia from 1976 to 2022 provides valuable insights into the country's economic development. The interplay of key economic variables such as government expenditure, savings, inflation, and employment levels underscores the importance of comprehensive and well-informed policy decisions.

Given the fluctuating trends and their implications for Indonesia's economic stability, this study is crucial for understanding and guiding the nation's future economic trajectory.

3. Methodology

The methodology employed in this study is quantitative, utilizing time series data. This quantitative approach enables a more detailed and precise analysis of the relationship between public debt and GDP growth in Indonesia. By analyzing time series data from 1976 to 2022, the study can identify trends and patterns in continuous data. The NARDL (Non-Autoregressive Distributed Lag) method models the relationships between different variables (Shin, 2014). NARDL allows this study to consider the effects of past and present independent variables on the dependent variables and to model relationships that exhibit an autoregressive structure and lag distribution. The data used in this study were taken from the World Bank, with Government Debt as the dependent variable and Saving, Inflation, and GDP as the independent variables for 1976 to 2022. The reason for using data from the World Bank is to look at trends in economic development over the past 50 years, which can provide a more comprehensive picture of the dynamics of the relationship between public debt and GDP growth in Indonesia.

This study uses NARDL because this method can model the relationship between variables with an autoregressive structure and lag distribution. The NARDL allows this study to consider the effects of independent variables on the past and present dependent variables and model the relationship between variables with an autoregressive structure and lag distribution. This method also allows the study to identify and control for unobserved variables, which can affect the study results. The model is beneficial when investigating the asymmetric effects of changes in independent variables on a dependent variable over time (Li et al., 2024). Traditional models often assume symmetric relationships, implying that positive and negative changes in an independent variable have identical impacts on the dependent variable. However, real-world scenarios frequently exhibit asymmetries where the effects of positive and negative changes differ. Rahaman et al., (2023) concluded that the NARDL model is designed to handle these complexities, making it an appropriate choice for this research.

The NARDL model also offers flexibility in handling different orders of integration among the variables. In time series analysis, which is Al Khatib, (2023) research, we can understand that it is common to encounter variables that are integrated of different orders (e.g., I(0) or I(1)). The NARDL model can accommodate such scenarios without requiring all variables to be integrated in the same order, making it a versatile tool for empirical analysis. Furthermore, the NARDL model provides a comprehensive short-term and long-term analysis framework. Based on the Charfeddine and Barkat, (2020) findings with the topic of "Short- And Long-Run Asymmetric Effect of Oil Prices and Oil and Gas Revenues On The Real GDP and Economic Diversification in a Dependent Economy", we can acknowledge that in the short run, NARDL allows the examination of immediate responses of the dependent variable to changes in the independent variables. In the long run, it captures the equilibrium relationship between them.

In summary, the choice of the NARDL model in this research is motivated by its ability to capture asymmetric effects, accommodate different orders of integration, handle short- and long-term dynamics, and incorporate error correction mechanisms. Its flexibility and robustness make it an ideal tool for investigating complex relationships where traditional linear models may fall short. By employing the NARDL model, this research aims to provide a more comprehensive and nuanced understanding of the asymmetric relationships between the variables under study, leading to more insightful and actionable findings.

4. Result and Discussion

Determining whether variables exhibit stationarity or non-stationarity is a fundamental step in regression analysis before proceeding with modeling. This initial assessment ensures the data behaves predictably under different statistical tests, avoiding misleading conclusions. Three primary unit root tests are commonly employed to achieve this: the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests. Here, we begin our investigation using the ADF test presented in Table 1, where it becomes evident that all variables succeed in meeting significance at the 5% level. Consequently, this outcome leads us not to reject the null hypothesis of non-stationarity, indicating that upon taking their first differences, these variables transform into stationary series.

Table 1: Unit Root Test

Variables	ADF		PP	
	Level	1st Diff.	Level	1st Diff.
InGFC	-1.774	-4.9617***	-1.8366	-6.0072***
InGDP	-2.5148	-4.0558***	-2.0489	-7.8457***
InINF	-1.7863	-3.3817**	-5.2365***	-15.4912***
InSAV	-3.653**	-6.5647***	-4.1336***	-11.5384***

∗ Show significance at the 10% level.
∗∗ Show significance at the 5% level.
∗∗∗ Show significance at the 1% level.

Given that the ADF test primarily accounts for autocorrelation but does not consider heteroscedasticity, we proceed with additional validation via another robust method—the PP test—as depicted in Table 1. By incorporating Newey-West adjustments to account for both autocorrelation and heteroscedasticity, our findings reveal that while these variables remain non-stationary at order zero (I(0)) when examined in logarithmic forms, they indeed attain stationarity at order one (I(1)) once differentiated appropriately. These preliminary analyses set forth crucial groundwork necessary for reliable modeling outcomes in subsequent stages of our research.

Examining the traditional cointegration framework reveals that the relationship between public debt and GDP is intricate and multi-dimensional, often exhibiting non-linear characteristics. The effect of rising public debt on GDP can differ significantly based on the debt level of the country's economic capacity. Studies suggest that moderate public debt levels can promote economic growth by facilitating public investments and alleviating credit constraints, which enhances overall productivity. However, it can be considered that when public debt exceeds certain limits, generally between 77% and 100% of GDP, it may result in negative consequences such as increased future taxation, diminished capital accumulation, and higher risk premiums on government bonds Mateane, (2023). These elements can ultimately impede economic growth, escalating public debt associated with declining GDP. Therefore, while an initial increase in public debt may foster growth, excessive levels can produce harmful economic effects that overshadow any short-term advantages.

The reality may be more complex than it appears, as there could be non-linear and asymmetric cointegration between the two primary variables examined in our research. To address this, we employed the NARDL bounds testing approach developed by Shin et al. (2014),

which allows for using positive and negative partial sum decompositions to identify potential asymmetric effects in both the short and long run. The NARDL method also helps mitigate convergence issues in the model caused by overparameterization. Although this technique does not explicitly model asymmetric error correction, the dynamic multipliers within NARDL will reveal adjustment patterns in response to rapid economic fluctuations. This enables a deeper analysis of the non-linear and asymmetric relationships between government public debt and economic growth as measured by GDP.

Table 2: Wald tests for Short and Long-Run Asymmetries

Hedging items against Economic Growth (GDP)	Long-run W (LR)	Short-run W (SR)	Selected Specification
Government Final Consumption (GFC)	7.307* [0.011]	0.1293 [0.722]	NARDL with LR asymmetry
Inflation (INF)	3.006* [0.092]	0.006 [0.936]	NARDL with LR asymmetry
Saving (SAV)	19.24 [0.000]	23.24* [0.000]	NARDL with SR asymmetry

Based on the results of the Wald test in Table 3, we first compare the most appropriate NARDL model using various hedging items as the dependent variable, with GDP as the benchmark. The findings reveal that Government Final Consumption influences GDP asymmetrically in the long term, suggesting an imbalance. This asymmetry likely occurs because increases and decreases in government spending may impact economic output differently. For instance, increased government spending can stimulate economic growth through higher public demand and investments. In contrast, a reduction in spending may not lead to an equivalent contraction in GDP due to factors such as price rigidity, delayed fiscal adjustments, or other stabilizing mechanisms within the economy (Arawatari et al., 2022).

The estimates for the asymmetric and nonlinear ARDL model are presented in Table 4. In determining the final model specification, it is essential to note that the preferred specification is chosen by removing insignificant lags (stationary regressors). Including insignificant lags in the analysis can lead to inaccuracies in the test results and potential errors in the dynamic multipliers. First, we will explain how GDP asymmetrically affects the hedging items captured by lnGDPt-1 and lnGDPt-1. Next, we will examine the magnitude of the long-term coefficients for the asymmetric cases (L+lnGDP and L-lnGDP) between the variables. Finally, we will analyze the short-term dynamics associated with ΔlnGDP+t-1.

Table 3: NARDL Estimation Results

GFC		INF		SAV	
NARDL with LR asymmetry		NARDL with LR asymmetry		NARDL with LR asymmetry	
lnGDPt-1	-0.2027995	lnGDPt-1	-0.0585541	lnGDPt-1	-0.6850666
	[0.038]		[0.191]		[0.002]
lnGFC+t-1	4.60E+10	lnINF+t-1	-3.11E+09	lnSAV+t-1	1.81E+00
	[0.031]		[0.525]		[0.003]
lnGFC-t-1	2.10E+10	lnINF-t-1	-3.90E+09	lnSAV-t-1	8.83E-01
	[0.08]		[0.423]		[0.053]
ΔlnGDPt-1	0.2343689	ΔlnGDPt-1	0.2169854	ΔlnGDPt-1	0.2288412
	[0.151]		[1.29]		[0.075]
ΔlnGDP+t-0	3.21E+09	ΔlnINF+t-1	4.24E+09	ΔlnSAV+t-1	-6.23E-01
	[0.84]		[0.171]		[0.137]
ΔlnGDP+t-1	3.27E+09	ΔlnINF-t-2	1.83E+09	ΔlnSAV-t-2	2.05E+00
	[0.874]		[0.184]		[0.000]
ΔlnGDP-t-0	7.37E+09	Constant	-3.87E+10	Constant	3.54E+10
	[0.669]		[0.487]		[0.001]
ΔlnGDP-t-1	-1.18E+10	L+lnINF	-5.31E+10	L+lnSAV	2.64E+00
	[-0.83]		[0.464]		[0.000]
ΔlnGDP-t-2	-3.57E+09	L-lnINF	6.66E+10	L-lnSAV	-1.29E+00
	[-0.24]		[0.339]		[0.001]
Constant	-9.22E+10				
	[0.021]				
L+lnGFC	2.27E+11				
	[0.000]				
L-lnGFC	-1.04E+11				
	[0.003]				
R2	0.3797				
Adjusted R2	[0.1665]				

The significant asymmetric long-run effect of Government Final Consumption (GFC) on GDP for both positive and negative changes suggests that government spending behaves differently depending on the direction of economic growth. The coefficient for the negative direction of the lnGDPt-1, which shows a negative correlation of 0.2343689 with GFC, highlights this relationship. This indicates that when GDP decreases, government spending tends to increase, possibly due to counter-cyclical fiscal policies where governments attempt to stimulate economic recovery by increasing public expenditure in response to economic downturns.

This behavior reflects an effort to cushion the economy during recessions or slowdowns. Groner and Moradi, (2024) also tells us that the proportionate relationship between a decline in GDP and an increase in GFC is likely driven by the government's need to stabilize the economy during periods of contraction. When the economy faces a decline, governments may increase their spending on public services, welfare programs, and infrastructure to boost aggregate demand and encourage economic growth. This inverse relationship suggests that government final consumption serves as a tool to mitigate the adverse effects of falling GDP by providing a fiscal stimulus to reduce the economic gap created by weaker private sector activity. Furthermore, the asymmetric nature of this relationship could also be influenced by the rigidity of government budgets and the time it takes for policy adjustments to show their effects (Ferri & Herranz-Baez, 2024). While increases in government consumption may rapidly inject liquidity into the economy, the impact of such spending can vary depending on factors such as the efficiency of resource allocation, the sectors targeted, and the multiplier effects on GDP. In contrast, Ying Wu et al., (2010) during periods of economic expansion, the reduction in government spending might not lead to an equivalent change in GDP, given that the private sector often plays a larger role in driving growth during those times.

Next, we analyze the long-run coefficients, which capture the relationship between the involved variables at the long-run equilibrium. For the long-run asymmetric case in HPI, we note that L+lnGFC, the long-run coefficient, is positively significant at 2.2777 per cent. This finding suggests that heightened government expenditure has a pronounced stimulatory influence on economic activity in the long run, potentially mediated through improved public service delivery and infrastructural development. In contrast, the coefficient corresponding to decreasing government final consumption (L-lnGDC) displays a highly significant negative magnitude of approximately -1.04E+11, implying that reductions in governmental expenditures would precipitate considerable declines in GDP. The study's empirical analysis elucidates the asymmetric relationship between goIn conclusion, this empirical analysis demonstrates the asymmetric long-run relationship between GFC and GDP, showing that positive changes in GFC exert a significant stimulatory impact on economic activity. In contrast, negative changes are linked to substantial declines in GDP. This asymmetry underscores the role of government spending as a stabilizing force during economic downturns, as increased expenditure can help offset contractions in private sector demand.

5. Conclusion

The study has demonstrated the significant asymmetric long-run effects of the GFC on GDP. The findings reveal that increases in GFC positively stimulate economic activity, while reductions in government spending are associated with sharp declines in GDP. This asymmetry can be attributed to the counter-cyclical nature of fiscal policy, where increased government expenditure during economic downturns acts as a stabilizing mechanism, helping to support aggregate demand and prevent further economic contraction. The role of government spending in mitigating the adverse effects of economic slowdowns is evident, with fiscal stimulus serving as a critical tool to reduce the financial gap created by weaker private sector activity. Furthermore, the long-run coefficients suggest that positive government spending has a more substantial stimulatory effect on GDP compared to the negative impacts of reduced spending.

Given these findings, the researchers strongly urge policymakers to exercise caution and strategic foresight in their fiscal policies. In periods of economic slowdown, timely and well-calibrated increases in government spending are essential for mitigating the effects of declining private sector output. Resources must be allocated efficiently, focusing on sectors that maximize the multiplier effects, such as public infrastructure and essential services. This can provide both immediate economic relief and long-term productivity gains. Furthermore, while fiscal restraint may be necessary during periods of economic growth, reductions in government expenditure should be measured, and the potential risks to long-term financial stability should be considered.

The findings of this research also highlight the importance of fiscal flexibility and adaptability. Policymakers must recognize the inherent delays in the impact of fiscal policies and work to reduce the rigidity of budgetary processes. By enhancing the responsiveness of fiscal interventions, governments can better manage both the cyclical nature of economic activity and the evolving needs of their populations. Ultimately, this research advocates for a budgetary approach that is responsive and anticipatory, understanding that the role of government spending extends beyond immediate economic returns, contributing to the sustained welfare of society as a whole.

Although the study has explored and analyzed the relationship between public debt and economic growth, it carries some limitations. The data used is on an annual basis, which may miss short-term fluctuations. A study on higher-frequency data potentially provides other perspectives. Other than that, future studies may include cross-country data using other methodologies to capture a comparative insight from different nations.

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