International Journal of Accounting and Economics Studies, 13 (2) (2026) 455-463

International Journal of Accounting and Economics Studies

Website: www.sciencepubco.com/index.php/IJAES
https://doi.org/10.14419/18jnvf34
Research paper



The Public Debt Dynamics in The Philippines: Evidence from ARDL and VECM Models

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Received: January 1, 2026, Accepted: February 11, 2026, Published: March 10, 2026

Abstract

This study examines the dynamics of public debt in the Philippines using the Autoregressive Distributed Lag (ARDL) and Vector Error Correction Model (VECM) frameworks over the period 2005–2023. The empirical findings indicate that public debt dynamics are driven predominantly by short-run macro-financial shocks rather than long-run structural factors. Although government expenditure exhibits a positive coefficient in the long-run estimates, it is not statistically significant, suggesting that expenditure growth alone does not consistently explain long-term debt accumulation. In contrast, the short-run results reveal strong and persistent effects of government expenditure across multiple lag periods, highlighting its immediate role in shaping fiscal imbalances during crisis episodes and periods of elevated public spending. Exchange rate depreciation also emerges as a significant short-run determinant, intensifying debt burdens through the valuation effects of foreign-denominated liabilities. Inflation displays a nonlinear short-run impact, initially reducing the real value of debt but eventually exacerbating fiscal pressures when inflation persists. Meanwhile, stock market prices, government revenues, and interest rates do not exert statistically significant effects in either the short or long run, reflecting the limited transmission of capital market signals and the gradual nature of structural revenue adjustments in the Philippine context. The policy implications underscore the importance of improving expenditure efficiency, strengthening revenue mobilization, and reducing reliance on foreign-currency borrowing. The findings further high-light the need for credible inflation management and robust countercyclical fiscal buffers to mitigate the debt-creating effects of macroeconomic shocks. By identifying expenditure and exchange rate dynamics as key drivers of short-run debt fluctuations, this study contributes to the literature on fiscal sustainability in emerging economies and offers evidence-based insights for Philippine policymakers seeking to balance growth objectives with debt stability.

Keywords: *Public Debt; Stock Market Price; Government Expenditure; Government Revenue; Interest Rate; Exchange Rate; Inflation.*

1. Introduction

Public debt has become an increasingly significant concern in economic management, particularly in developing countries such as the Philippines. Governments often rely on borrowing to finance infrastructure, stimulate growth, and respond to macroeconomic shocks or crises. However, when debt accumulation outpaces revenue generation or economic growth, it can pose substantial risks to macroeconomic stability, investor confidence, and long-term development. In the Philippines, public debt has risen sharply over the past decade, especially following the COVID-19 pandemic. According to the Department of Finance (2023), the country's debt-to-GDP ratio exceeded 60% by the end of 2023 — surpassing pre-pandemic levels and raising renewed concerns over fiscal resilience and debt sustainability. Traditional macroeconomic theory highlights key variables that influence public debt dynamics, including GDP growth, inflation, interest rates, exchange rates, government expenditure, and government revenue (Checherita-Westphal & Rother, 2012). Among these, GDP growth is often considered the most crucial factor, as it expands the tax base and alleviates the relative burden of debt. However, GDP data is typically lagging and may not reflect real-time shifts in economic sentiment. In contrast, financial indicators — particularly stock market prices — are forward-looking and can offer timely signals about fiscal management, macroeconomic outlook, and perceived risk (Fama, 1981; Bernanke et al., 1999). Yet, many empirical studies in the Philippine context and broader emerging markets have largely omitted financial indicators from debt modeling frameworks.

For instance, studies by Manalo et al. (2022) explored the role of inflation, trade balance, and capital flows in shaping the Philippines' debt trajectory, while Shaari et al. (2023) employed a panel ARDL approach across ASEAN economies to link public debt with savings, investment, and environmental indicators. Despite their value, these studies have not incorporated stock market behavior as a determinant, which is a critical omission given its potential to reflect investor expectations and economic confidence. Stock market indices may thus serve as real-time barometers of fiscal credibility and risk — particularly relevant for the Philippines, where financial markets and public sector borrowing have become increasingly intertwined.

Moreover, most previous studies on Philippine public debt rely on linear or static models that are limited in distinguishing between short-run fluctuations and long-run equilibrium relationships. This is problematic for policymaking, especially in contexts where fiscal shocks

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may be transitory while debt accumulation has persistent effects. Advanced econometric techniques such as the Autoregressive Distributed Lag (ARDL) and Vector Error Correction Model (VECM) are well-suited for analyzing such dynamics, as they allow for the separation of immediate short-run effects from long-run cointegrating relationships. Despite their methodological robustness, these models remain underutilized in empirical research on Philippine debt dynamics.

This study therefore addresses a crucial gap in both academic and policy-oriented literature by investigating the short-run and long-run determinants of public debt in the Philippines using ARDL and VECM modeling approaches. Specifically, it explores whether stock market price along with government revenue, government expenditure, interest rate, exchange rate, and inflation significantly influence public debt behavior in the country. The central research question guiding this study is: What macro-financial factors significantly determine the short-run dynamics and long-run trajectory of public debt in the Philippines?

The expected contributions of this study are both theoretical and practical. By offering a dynamic, evidence-based framework that captures the interaction between macro-financial variables and public debt, the findings can inform more adaptive and forward-looking debt management strategies. This is particularly urgent as the Philippines strives to meet the United Nations Sustainable Development Goals (SDGs). The study aligns with SDG 8 (Decent Work and Economic Growth) by promoting stable macroeconomic conditions essential for investment and employment. It also supports SDG 17 (Partnerships for the Goals) by contributing to more transparent and data-driven engagement with domestic policymakers, multilateral institutions, and international creditors.

Ultimately, this research provides a comprehensive and timely analysis of public debt dynamics in the Philippine context. By integrating stock market indicator into the modeling framework and applying both ARDL and VECM techniques, it captures the complex, multidimensional nature of fiscal behavior in an increasingly globalized financial environment. These insights will help policymakers to better understand fiscal vulnerabilities and design strategies that ensure debt sustainability while supporting inclusive economic recovery and growth.

2. Literature Review and Hypotheses Development

2.1. Theoretical framework

Understanding the behavior of public debt in an emerging market economy such as the Philippines requires an integrated approach that captures both macroeconomic fundamentals and financial market dynamics. Traditionally, economic growth is considered a key determinant of debt sustainability. However, this study substitutes GDP growth with stock market price to reflect real-time economic sentiment and financial conditions. This substitution is grounded in relevant theories of fiscal policy, financial market behavior, and public debt sustainability.

Instead of GDP growth, this study uses stock market price (SMP) to capture expectations about future economic performance, financial market sentiment, and fiscal prospects. Stock market indices (e.g., the PSEi) are forward-looking and reflect investor confidence in the real economy (Fama, 1981). According to the wealth effect theory, increases in SMP can boost household wealth and consumption, leading to higher tax revenues and stronger fiscal balances. This relationship aligns with financial accelerator models (Bernanke et al., 1999), which posit that asset prices influence credit conditions, investment, and overall economic dynamics — factors that ultimately affect public debt.

At its core, public debt evolves as a result of fiscal imbalances — the gap between government expenditure and revenue. From a Keynesian perspective, budget deficits — especially in times of economic stress — are necessary for counter-cyclical policy (Keynes, 1936). However, persistent deficits result in debt accumulation. The long-run sustainability of debt hinges on the government's ability to match or exceed these deficits with primary surpluses (Blanchard et al., 1990). From a fiscal perspective, higher government revenue lowers borrowing needs and higher government expenditure increases borrowing requirements.

Maintaining a sustainable primary balance is essential for debt reduction. Effective taxation, spending efficiency, and fiscal discipline form the foundation of long-run debt control (Elmendorf & Mankiw, 1999).

The cost of servicing public debt is directly affected by prevailing interest rates (IR). According to neoclassical growth theory, when the interest rate exceeds the economy's growth rate (or implied growth via SMP), the debt-to-output ratio worsens (Barro, 1979). Thus, interest rate increases are expected to positively correlate with debt levels.

For economies with significant foreign-denominated debt, the exchange rate (EXR) is crucial. Depreciation increases the local currency value of external obligations. In the short run, this raises debt servicing costs. In the long run, chronic depreciation reflects macroeconomic instability and increases sovereign risk premiums (Reinhart & Rogoff, 2004).

Inflation plays a dual role in public debt dynamics. In the short run, moderate inflation reduces the real burden of nominal debt. This aligns with the fiscal theory of the price level, which suggests that inflation can help stabilize debt under certain conditions (Sargent & Wallace, 1981). However, if inflation becomes excessive, it raises uncertainty and borrowing costs, increasing nominal debt in the long run.

2.2. Empirical evidence

The dynamics of public debt in emerging economies, particularly the Philippines, hinge upon complex interactions among financial market signals, fiscal policy, and macroeconomic conditions. Recent global research underscores how financial markets can influence fiscal behavior. Sy (2020) provides preliminary evidence of moderate sensitivity of Philippine public debt to investor expectations, but the direct linkage between stock prices and debt dynamics has yet to be fully explored. This gap suggests a need for more targeted research within the Philippine context, particularly as Adams et al. (2010) recommends leveraging forward-looking indicators, such as market volatility, in fiscal risk assessments.

Very much related to financial signals is the critical importance of fiscal balance. In the Philippines, Sy (2020), finds through time series analysis that larger deficits in the Philippine setting significantly increase public debt in both the short and long term. Structural vulnerabilities further compound these challenges, Diokno (2010) underscores declining tax effort and underinvestment in critical human capital sectors (e.g., health and infrastructure) as deeper root causes of fiscal imbalance — not mere cyclical fluctuations. Furthermore, a recent study by Debuque-Gonzales et al. (2023) highlights a distinct debt equation triggered by the COVID-19 pandemic, the debt-to-GDP ratio soared from 39.6% in 2019 to 54.5% in 2020 and 60.5% in 2021, spurred largely by a revenue collapse combined with accelerated spending rather than structural fiscal mismanagement — raising important questions about future fiscal space and sustainability. Specifically associated with fiscal balance are government revenue and expenditure patterns. Manalo et al. (2022) find — in the Philippine context — that foreign direct investment and capital formation play more significant roles in influencing public debt dynamics than inflation or trade balance. Dawood et al. (2021) provide evidence that government spending are positively associated with public debt. Sy (2020) empirically

supports these assertions, demonstrating that government expenditures are positively correlated with increases in public debt, while improvements in tax revenues (e.g., due to VAT reforms in the early 2000s) had a debt-mitigating effect. Adams et al. (2010) adds that delayed revenue mobilization following shocks can destabilize fiscal positions across Asia, underscoring the need for structural reforms.

Interest rates are another critical determinant. Brandao-Marques et al. (2023) illustrate that interest rates exceeding GDP growth dramatically raise debt servicing burdens. In the Philippines, reliance on domestic borrowing makes the country particularly vulnerable to interest rate swings, as observed by Guinigundo (2012). Sy (2020) quantifies this effect: interest rate increases significantly elevate the debt-to-GDP ratio in the medium term. In line with these findings, Adams et al. (2010) recommends prudent debt maturity management strategies to buffer against interest rate shocks.

Exchange rate movements play a pivotal role in shaping external debt dynamics. Valencia et al. (2023) highlight rising exposure to foreign-currency-denominated debt among emerging economies post-pandemic, increasing vulnerability to depreciation. Sy (2020) corroborates these findings in the Philippine context, showing that peso depreciation significantly raises public debt levels due to large foreign-denominated liabilities.

Finally, inflation's impact on public debt is decidedly mixed. While moderate inflation may temporarily reduce the real value of nominal debt, sustained or unanchored inflation can undermine fiscal credibility and increase long-term borrowing costs. The IMF (2023) notes that in emerging markets, inflation's effect on debt servicing materializes gradually. Sy (2020) reaffirms this dynamic in the Philippines, showing that while moderate inflation offers short-term relief, prolonged high inflation erodes credibility and exacerbates fiscal stress.

2.3. Synthesis

The reviewed literature highlights three dominant strands in public debt research: (1) fiscal balance dynamics, particularly the role of government expenditure and revenue; (2) macroeconomic fundamentals such as interest rates, exchange rates, and inflation; and (3) growth-centered frameworks that emphasize GDP performance as the principal anchor of debt sustainability. In the Philippine context, existing empirical studies largely focus on deficit-driven debt accumulation and macroeconomic vulnerabilities, with GDP growth serving as the primary real-sector determinant.

However, relatively limited attention has been given to forward-looking financial market indicators as drivers of debt dynamics. While Sy (2020) and related studies acknowledge the role of investor sentiment and financial conditions, the direct incorporation of stock market prices as a proxy for economic expectations remains underexplored in Philippine debt modeling. This represents an important gap, particularly in an environment where capital market volatility and crisis-induced financial shocks increasingly shape fiscal responses.

By substituting GDP growth with stock market prices, this study extends the conventional debt sustainability framework to incorporate financial market expectations as a forward-looking determinant. Rather than replacing output-based analysis, the approach complements traditional models by recognizing that fiscal decisions may respond not only to realized economic growth but also to anticipated economic conditions reflected in asset prices.

Empirically, this study contributes by jointly estimating fiscal, macroeconomic, and financial market variables within an ARDL–ECM framework for the Philippines over a period marked by significant structural shocks, including the Global Financial Crisis and the COVID-19 pandemic. In doing so, it provides updated evidence on both long-run equilibrium relationships and short-run adjustment dynamics, thereby integrating fiscal theory with financial market channels in explaining public debt behavior.

2.4. Conceptual framework

The conceptual framework illustrated in Figure 1 hypothesizes the relationships between public debt and six key macro-financial indicators: stock market price, government revenue, government expenditure, interest rate, exchange rate, and inflation. This framework posits that these indicators exert significant influence on the level and trajectory of public debt in both the short-run and the long-run.

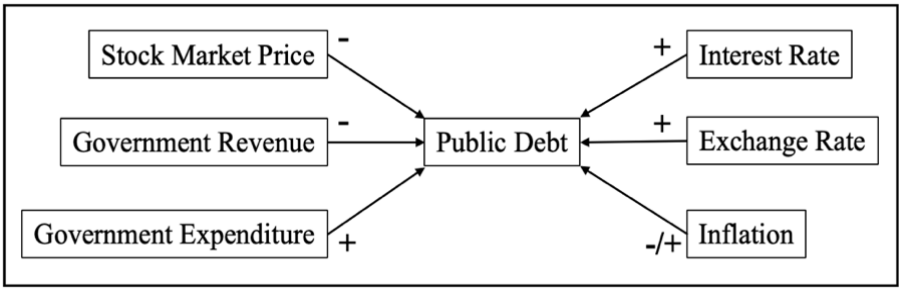


Fig. 1: Research Paradigm.

The stock market price functions as a proxy for investor confidence and broader capital market conditions. In the short run, a positive relationship is expected between stock market performance and public debt, as downturns in equity markets often necessitate debt-financed fiscal stimulus aimed at economic stabilization. Conversely, in the long run, the relationship is anticipated to be negative, given that sustained stock market growth typically reflects macroeconomic strength, reducing the need for expansionary borrowing. Government revenue reflects the state's capacity to finance public programs without relying on debt instruments. It is hypothesized to have a negative relationship with public debt in both the short and long-run. An increase in government revenue, particularly through tax reform and administrative efficiency, alleviates the fiscal pressure to borrow, especially when complemented by expenditure discipline and fiscal consolidation. In contrast, government expenditure denotes fiscal outflows on infrastructure, social services, and administrative functions. This variable is expected to have a positive relationship with public debt across both time horizons. When expenditures exceed revenues - especially during economic shocks or emergency responses - governments typically resort to borrowing to finance deficits, resulting in debt accumulation. The interest rate, representing the cost of borrowing in the financial system, is also expected to maintain a positive relationship with public debt. Rising interest rates elevate debt servicing costs, particularly for short-term and floating-rate debt instruments. Similarly, the exchange rate - defined as the peso's value relative to major foreign currencies - has a positive expected relationship with public debt. Specifically, currency depreciation increases the domestic currency value of foreign-denominated obligations, thereby amplifying public debt levels. Lastly, the inflation has an ambiguous effect on public debt. In the short run, moderate inflation may reduce the real value of outstanding

nominal debt, thereby offering temporary fiscal relief. However, in the long run, persistent or unanchored inflation undermines fiscal credibility, raises borrowing costs, and contributes to further debt accumulation. As such, the expected sign of the relationship varies depending on the time horizon and inflation dynamics.

2.5. Hypotheses development

Based on the literature reviewed, the following null hypotheses are formulated in accordance with the Autoregressive Distributed Lag (ARDL) and Vector Error Correction Model (VECM) frameworks. These hypotheses are designed to test the absence of significant short-run and long-run relationships between public debt and key macro-financial indicators in the Philippine context:
H1: Stock market price does not have a significant long-run or short-run relationship with public debt in the Philippines.
H2: Government revenue does not have a significant long-run or short-run relationship with public debt in the Philippines.
H3: Government expenditure does not have a significant long-run or short-run relationship with public debt in the Philippines.
H4: Interest rate does not have a significant long-run or short-run relationship with public debt in the Philippines.
H5: Exchange rate does not have a significant long-run or short-run relationship with public debt in the Philippines.
H6: Inflation does not have a significant long-run or short-run relationship with public debt in the Philippines.

3. Research Methodology

This study employs a quantitative time series econometric approach to explore the short-run and long-run relationships between public debt (PD) and five key macro-financial indicators in the Philippines: stock market price (SMP), government revenue (GREV), government expenditure (GEXP), interest rate (IR), exchange rate (EXR), and inflation (INF). To model these dynamics effectively, the Autoregressive Distributed Lag (ARDL) bounds testing approach developed by Pesaran et al. (2001) is used. This method is well-suited for datasets with variables that are integrated of different orders—specifically I(0) and I(1)—and works effectively with relatively small to moderate samples. The Vector Error Correction Model (VECM) derived from the ARDL model is used to analyze short-run dynamics and the speed of adjustment toward long-run equilibrium.
The study utilizes monthly time series data from January 2005 to December 2023, resulting in 228 observations for each variable. The data are collected from credible national sources including the Bangko Sentral ng Pilipinas (BSP), Philippine Statistics Authority (PSA), Department of Finance (DOF), and Philippine Stock Exchange (PSE). Public debt (PD) is measured in Philippine pesos, representing total national government obligations. Stock market price (SMP) is proxied by the Philippine Stock Exchange Index (PSEi). Government revenue (GREV) and government expenditure (GEXP) are expressed in billions of pesos, while the interest rate (IR) refers to the monthly bank lending rate, the exchange rate (EXR) is the monthly average peso-to-dollar rate, and inflation is the consumer price index (CPI). Table 1 provides more details:

Table 1: Variable Description

Variable Name	Symbol	Description	Measurement
Public Debt	PD	National government outstanding debt	Billion PHP
Stock Market Price	SMP	Philippine Stock Exchange Index	Index points
Government Revenue	GREV	National government total revenues	Billion PHP
Government Expenditure	GEXP	National government total expenditure	Billion PHP
Interest Rate	IR	Bank average lending rate.	Percent
Exchange Rate	EXR	Average monthly Peso per US dollar exchange rate.	PHP/USD
Inflation	INF	All items Consumer price index (2018 = 100).	Index points

This study employs a log-linear modeling approach to examine the dynamic relationship between public debt and its key macro-financial determinants. PD, SMP, GREV, GEXP, EXR, and INF (CPI, 2018=100) variables are expressed in their natural logarithmic form (i.e., log-transformed) to facilitate elasticity-based interpretation, reduce heteroskedasticity, and linearize potential exponential growth trends inherent in economic time series. The transformation also aids in stabilizing variance and approximating normality, thereby enhancing the efficiency and robustness of the estimation procedure. The functional equation representing the relationship between public debt and its macro-financial determinants is expressed as:

$$\ln(PD_t) = f(\ln(SMP_t), \ln(GREV_t), \ln(GEXP_t), IR_t, \ln(EXRt), \ln(INFt) \quad (1)$$

where:
PD_t = Public debt at time t
SMP_t = Stock market price at time t
$GREV_t$= Government revenue at time t
$GEXP_t$ = Government expenditure at time t
IR_t = Interest rate at time t
EXR_t = Exchange rate at time t
INF_t= Inflation at time t
ln = natural logarithm

Equation (1) was then expanded in the ARDL context capturing both the autoregressive nature of public debt and the distributed lag effects of the independent variables. Before estimating the ARDL model, all variables are subjected to unit root tests to determine their order of integration. The Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests are applied. Only variables that are either I(0) or I(1) are included in the ARDL estimation; variables found to be I(2) are excluded to avoid invalid results. The optimal lag structure for the ARDL model is selected using the Akaike Information Criterion (AIC) and the Schwarz Bayesian Criterion (SBC). Once the appropriate lag length is determined, the ARDL bounds test for cointegration is conducted to verify the existence of a long-run relationship among the variables. The null hypothesis states that there is no cointegration (i.e., no long-run relationship), while the alternative hypothesis suggests the presence of a cointegrating relationship. If the computed F-statistic exceeds the upper bound critical value, the null hypothesis is rejected, indicating that a long-run relationship exists, that is, if F-statistic > upper bound → reject H_0 (cointegration exists).

When cointegration is confirmed, a Vector Error Correction Model (VECM) derived from the ARDL model is estimated to capture the short-run dynamics and the speed of adjustment toward long-run equilibrium. The ECM quantifies the speed of adjustment, that is, how quickly public debt corrects deviations from its long-run equilibrium following short-term shocks to the independent variables. Several post-estimation diagnostic tests are performed to ensure robustness and reliability. These include the Breusch-Godfrey serial correlation LM test, the Ramsey RESET test is applied to verify the functional form of the model, White Heteroskedasticity test for possibility of heteroskedasticity, and CUSUM and recursive residuals plot are used to check the structural stability of the estimated coefficients over time.

4. Results and Discussion

Prior to the estimation of ARDL and VECM, it is essential to ascertain the stationarity properties of the time series variables to avoid spurious regressions. The Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests were employed to determine the order of integration for each variable under three model specifications: constant only, constant with linear trend, and none. The results in Table 2 reveal that all variables - log-transformed public debt (ln(PD)), stock market price (ln(SMP)), government revenue (ln(GREV)), government expenditure (ln(GEXP)), exchange rate (ln(EXR)), inflation rate (ln(INF)), and the level form of interest rate (IR) - are non-stationary at levels but become stationary after first differencing, indicating that they are integrated of order one, I(1). For instance, ln(PD) was found to be non-stationary in levels, with the ADF statistic failing to reject the null of a unit root under all specifications, but achieved stationarity at first difference with a statistically significant ADF statistic under the trend specification (-5.16^{***}). Similarly, ln(SMP), ln(GREV), and ln(GEXP) all exhibited non-stationarity at levels, but stationarity was confirmed at first differences with highly significant test statistics (e.g., -14.80^{***}, -4.30^{***}, and -7.93^{***}, respectively). The PP test results reinforce these findings, offering robustness against potential autocorrelation and heteroskedasticity in the error terms. Notably, PP results for ln(GREV) and ln(GEXP) under the trend specification suggest borderline stationarity at levels; however, given the consistency of first-difference stationarity across specifications and methods, the variables are conservatively classified as I(1). Crucially, none of the variables are integrated of order two, I(2), which satisfies the fundamental requirement of the ARDL bounds testing procedure. Hence, the combined evidence supports the use of ARDL modeling to capture both the short-run dynamics and long-run equilibrium relationships among the variables without violating underlying statistical assumptions.

Table 2: Stationary Test Results

Variable	Augmented Dickey-Fuller (ADF) Levels			First Difference		
	Constant	Constant, Linear Trend	None	Constant	Constant, Linear Trend	None
ln(PD)	2.17	-0.99	2.04	-2.54	-5.16^{***}	-1.55
ln(SMP)	-1.85	-1.29	1.33	-14.80^{***}	-14.88^{***}	-14.71^{***}
ln(GREV)	-1.17	-2.49	4.02	-4.30^{***}	-4.32^{***}	-3.06^{***}
ln(GEXP)	0.19	-1.97	5.45	-7.93^{***}	-7.93^{***}	-3.53^{***}
IR	-1.83	-0.64	-0.98	-15.86^{***}	-16.10^{***}	-15.87^{***}
ln(EXR)	-1.35	2.24	-0.01	-14.13^{***}	-14.31^{***}	-14.16^{***}
ln(INF)	-0.27	-1.90	2.99	-3.64^{***}	-3.63^{**}	-1.58
Variable	Phillips-Perron (PP) Levels			First Difference		
	Constant	Constant, Linear Trend	None	Constant	Constant, Linear Trend	None
ln(PD)	3.08	-0.57	6.22	-16.82^{***}	-17.80^{***}	-15.89^{***}
ln(SMP)	-1.85	-1.47	1.20	-14.87^{***}	-14.93^{***}	-14.85^{***}
ln(GREV)	-2.64	-14.18^{***}	1.69	-50.35^{***}	-50.82^{***}	-43.41^{***}
ln(GEXP)	-1.91	-14.76^{***}	4.20	-82.60^{***}	-85.12^{***}	-40.78^{***}
IR	-2.57	-1.88	-1.24	-27.16^{***}	-27.90^{***}	-24.25^{***}
ln(EXR)	-1.48	-2.25	-0.01	-14.12	-14.31^{***}	-14.15^{***}
ln(INF)	-0.91	-2.01	9.01	-9.95^{***}	-9.95^{***}	-6.92^{***}

Note: *** stationary at 1% level and ** stationary at 5% level.

The ARDL bounds testing procedure, developed by Pesaran et al. (2001), is employed to investigate the existence of a long-run equilibrium relationship among the variables in the model. In Table 3, the ARDL bounds test confirms the presence of a long-run equilibrium relationship, as the computed F-statistic (4.94) exceeds the 1% upper bound critical value (3.99). This provides strong evidence of cointegration among public debt and the selected macro-financial variables. The result justifies the estimation of both the long-run coefficients and the vector error correction model (VECM) to capture the short-run dynamics and speed of adjustment toward the long-run equilibrium.

Table 3: ARDL-Bounds Test for Cointegration Results

Dependent variable	Independent variables			F-statistic	Cointegration
ln(PD)	ln(SMP), ln(GREV), ln(GEXP), IR, ln(EXR), ln(INF)			4.94^{***}	Cointegrated
Asymptotic critical values (restricted constant and no trend)					
I(0)			1(1)		
10%	5%	1%	10%	5%	1%
1.99	2.27	2.88	2.94	3.28	3.99

***denotes statistical significance at 1% level.

Following the confirmation of a long-run equilibrium relationship among the variables, the Autoregressive Distributed Lag (ARDL) model was subsequently estimated. The optimal lag structure for the ARDL model was determined using the Akaike Information Criterion (AIC), which prioritizes model parsimony while maintaining explanatory adequacy. Based on the AIC minimization approach, the optimal ARDL specification selected for the model was ARDL (3, 2, 0, 4, 0, 1, 3). This configuration corresponds to the lag lengths for the dependent and independent variables, respectively. The estimated coefficients are presented in Table 4.

Table 4: ARDL Long-Run Estimates

Regressors	Dependent variable: ln(PD) Coefficient	t-statistic	Prob.
C	7.77	1.79	0.08
ln(SMP)	-0.48	-0.99	0.32
ln(GREV)	-0.33	-0.69	0.49
ln(GEXP)	2.05	1.48	0.14
IR	0.05	0.47	0.64
ln(EXR)	-1.62	-0.92	0.36
ln(INF)	-0.56	-0.23	0.82

The long-run ARDL estimates in Table 4 indicate that none of the individual regressors attain statistical significance at conventional levels, despite the bounds test confirming the presence of cointegration. This implies that while a long-run equilibrium relationship exists among the variables, the model does not provide sufficient evidence to attribute statistically significant long-run elasticities to any single explanatory variable in isolation. Government expenditure (lnGEXP = 2.05, p = 0.14) exhibits the largest positive coefficient among the regressors. Although economically sizable, the estimate is not statistically significant at the 5% level. Consequently, it cannot be interpreted as a confirmed structural determinant of long-run debt accumulation. The magnitude of the coefficient may reflect the historical association between fiscal expansion and rising debt levels in the Philippines, particularly during crisis-induced spending episodes (Debuque-Gonzales et al., 2023). However, this interpretation remains economically suggestive rather than econometrically validated within the present specification. Government revenue (lnGREV = –0.33, p = 0.49) carries a negative but statistically insignificant coefficient. While consistent with fiscal sustainability theory—where stronger revenue mobilization reduces borrowing requirements—the absence of statistical significance indicates that this stabilizing role is not empirically established in the long-run ARDL estimates. Structural limitations in revenue elasticity or persistent fiscal imbalances may contribute to this outcome (Diokno, 2010), but such explanations remain inferential. Stock market prices (lnSMP = –0.48, p = 0.32), the lending rate (IR = 0.05, p = 0.64), the exchange rate (lnEXR = –1.62, p = 0.36), and inflation (lnINF = –0.56, p = 0.82) likewise do not exhibit statistically significant long-run coefficients. Although several signs align with theoretical expectations, the lack of statistical significance implies that these macro-financial indicators do not exert independently identifiable long-run effects on public debt within the sample period. Their influence may instead operate through short-run dynamics or through joint equilibrium adjustments rather than through stable long-run elasticities.

The combination of confirmed cointegration and individually insignificant long-run coefficients suggests that public debt dynamics in the Philippines are characterized by system-level equilibrium relationships rather than dominant single-variable effects. In this context, the long-run equilibrium appears to arise from the collective interaction of fiscal and macro-financial variables, with no regressor demonstrating standalone statistical dominance. From a hypothesis-testing perspective, the null hypotheses of no significant long-run relationship cannot be rejected for any individual explanatory variable at conventional significance levels. Accordingly, interpretations of economic relevance should be distinguished from econometric confirmation.

The short-run ARDL–ECM results reveal important dynamics in Philippine public debt adjustment. The lagged dependent variables indicate debt inertia and cyclical correction. The coefficient of Δln(PD(-1)) is negative and significant (–0.18, $p < 0.01$), suggesting partial short-run correction of prior debt increases, while Δln(PD(-2)) is positive and significant (0.13, $p < 0.05$), indicating oscillatory adjustment rather than monotonic convergence. Stock market effects are delayed. Although the contemporaneous change in stock prices is insignificant, the one-period lag Δln(SMP(-1)) is negative and significant (–0.03, $p < 0.05$), implying that market downturns precede higher public borrowing. This supports the view that financial market volatility indirectly influences fiscal responses (Sy, 2020). Government expenditure emerges as the most consistent short-run driver. The contemporaneous and lagged coefficients of Δln(GEXP) are statistically significant across periods ($p < 0.01$), indicating that increases in fiscal outlays are associated with immediate and persistent rises in public debt. This pattern reflects crisis-driven fiscal expansion observed during major economic disruptions (Debuque-Gonzales et al., 2023). Exchange rate movements also exert a significant short-run effect. The positive coefficient of Δln(EXR) (0.25, $p < 0.01$) suggests that peso depreciation increases the domestic currency value of foreign-denominated liabilities, thereby raising public debt levels. Inflation displays lag-dependent effects. While the contemporaneous change is insignificant, the first lag is negative and significant (–0.66, $p < 0.05$), and the second lag turns positive and significant (0.73, $p < 0.01$). This indicates a short-lived debt-eroding effect followed by upward pressure as inflation persists, consistent with nonlinear inflation–debt dynamics in emerging economies (IMF, 2023). Overall, the short-run results indicate that government expenditure (H3) and exchange rate movements (H5) exert statistically significant effects on public debt. Inflation (H6) demonstrates a dynamic and lagged relationship, while stock market prices (H1) show delayed influence. Government revenue (H2) and interest rates (H4) do not exhibit statistically significant short-run impacts.

More importantly, the error correction term (ECM–1) is negative and highly significant (–0.01, $p < 0.01$), confirming dynamic stability in the adjustment process. The negative sign indicates that deviations from long-run equilibrium are corrected over time, while the magnitude implies a gradual speed of adjustment, with approximately 1% of disequilibrium corrected per period. Although statistically robust, this relatively slow convergence suggests that fiscal adjustment in the Philippines occurs incrementally rather than rapidly.

Such gradual adjustment may reflect institutional rigidities, including budgetary inflexibilities, multi-year expenditure commitments, and political constraints that limit abrupt fiscal consolidation. In addition, the absence of a strictly binding fiscal rule or automatic stabilizing mechanisms may slow the pace at which deviations from sustainable debt paths are corrected. Governance quality, revenue administration efficiency, and debt management strategies can therefore influence the speed of convergence, as stronger institutional frameworks typically facilitate quicker fiscal realignment.

Taken together, the results indicate that while no single macro-financial variable emerges as a statistically dominant long-run determinant, Philippine public debt operates within a stable but slowly adjusting fiscal–macroeconomic system characterized by institutional inertia and gradual equilibrium correction.

Table 5: ECM and Short-Run Coefficients

Regressors	Dependent variable: Δln(PD) Coefficient	t-statistic	Prob.
Δln(PD(-1))	-0.18	-2.98	0.00***
Δln(PD(-2))	0.13	2.20	0.03**
Δln(SMP)	-0.02	-1.38	0.17
Δln(SMP(-1))	-0.03	-2.02	0.04**

Δln(GEXP)	-0.01	-2.46	0.01***
Δln(GEXP(-1))	-0.03	-4.68	0.00***
Δln(GEXP(-2))	-0.03	-4.27	0.00***
Δln(GEXP(-3))	-0.01	-2.84	0.00***
Δln(EXR)	0.25	4.44	0.00***
Δln(INF)	-0.28	-1.14	0.25
Δln(INF(-1))	-0.66	-2.39	0.02**
Δln(INF(-2))	0.73	2.90	0.00***
ECM(-1)	-0.01	-6.39	0.00***
R-squared	0.35	Mean dependent var	0.01
Adjusted R-squared	0.31	S.D. dependent var	0.01
S.E. of regression	0.01	Akaike info criterion	-5.94
Sum squared resid	0.03	Schwarz criterion	-5.74
Log likelihood	677.73	Hannan-Quinn criter.	-5.86
Durbin-Watson stat	1.99		

*** and **denotes statistical significance at 1% and 5% level, respectively.

The diagnostic tests presented in Table 5 and 6 provide further evidence of the reliability and robustness of the estimated model. The diagnostic statistics reinforce the robustness of the short-run model. The R^2 value of 0.35 and adjusted R^2 of 0.31 indicate moderate explanatory power, reasonable for high-frequency macroeconomic data. The Durbin-Watson statistic of 1.99 rules out autocorrelation, and the information criteria (AIC = -5.94, SC = -5.74, HQC = -5.86) point to a well-specified model.

Table 6: Additional Diagnostic Tests

Test	F-statistic	Prob.
Ramsey RESET Test	1.90	0.17
Breusch-Godfrey Serial Correlation LM Test	0.04	0.96
White Heteroskedasticity Test	1.32	0.08

The substitution of GDP growth with stock market prices reflects an effort to capture forward-looking macro-financial conditions rather than contemporaneous output effects. While GDP remains central in debt sustainability literature, stock market indices may proxy investor expectations, capital market conditions, and financial stress—factors that influence borrowing behavior, particularly in emerging markets. Nevertheless, this specification should be interpreted as complementary rather than a replacement for output-based debt models, and robustness checks incorporating GDP growth may further strengthen inference.

The Ramsey RESET test yields an F-statistic of 1.90 (p = 0.17), indicating no evidence of functional form misspecification. The Breusch–Godfrey LM test reports an F-statistic of 0.04 (p = 0.96), suggesting the absence of serial correlation in the residuals. These results support the adequacy of the ARDL–ECM specification and the reliability of short-run coefficient estimates. The White heteroskedasticity test produces an F-statistic of 1.32 (p = 0.08). Although marginal at the 10% level, the null hypothesis of homoskedasticity cannot be rejected at 5%, indicating no strong evidence of heteroskedasticity. As a precaution, the use of robust standard errors may further reinforce inference, particularly given macroeconomic volatility during the Global Financial Crisis and the COVID-19 pandemic. These results enhance confidence in the estimated dynamics, while interpretations of long-run coefficients remain subject to previously noted statistical limitations.

Figure 2 presents the CUSUM and recursive residual stability tests. The CUSUM statistic remains within the 5% critical bounds throughout the sample period (2005–2023), indicating parameter stability and no evidence of structural instability. This suggests that the estimated long-run equilibrium relationship is stable across major economic episodes, including the 2008–2009 Global Financial Crisis and the 2020–2021 pandemic period. Importantly, stability does not imply that any single regressor is statistically dominant, but rather that the system-level equilibrium relationship remains intact.

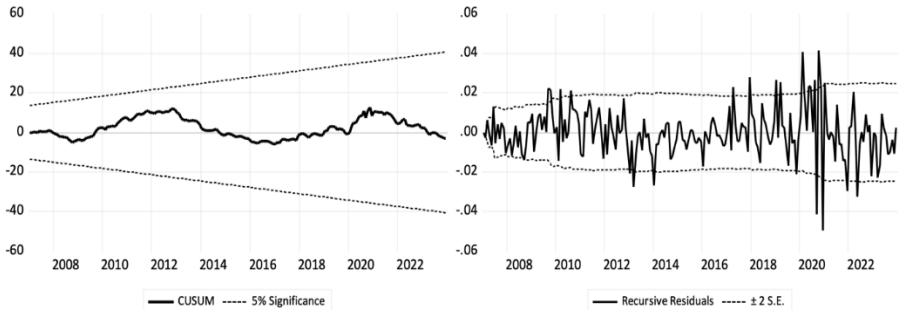


Fig. 2: Plot of CUSUM and Recursive Residuals.

The recursive residuals plot further supports model reliability, with residuals oscillating randomly around zero and remaining within the ±2 standard error bands. Although noticeable volatility occurs around 2019–2020, coinciding with the pandemic-driven fiscal response, these deviations are short-lived and mean-reverting rather than structural. Importantly, the short-run dynamics highlight the role of stock market prices (SMP). The significant negative coefficient for SMP suggests that equity downturns tend to trigger compensatory debt-financed fiscal responses. This was evident during the 2008 Global Financial Crisis, when steep declines in the Philippine Stock Exchange Index (PSEi) coincided with increased reliance on external borrowing to support domestic liquidity, and again in 2020, when a sharp pandemic-induced market collapse was followed by Bayanihan stimulus programs funded largely through debt. These episodes underscore how financial market weakness constrains private capital formation, forcing the government to step in through borrowing to stabilize both the economy and investor sentiment.

Taken together, the evidence from the CUSUM and recursive residual tests validates the robustness of the ARDL and VECM framework, confirming that both long-run and short-run dynamics are stable. Philippine public debt is structurally tied to expenditure growth, while short-run fluctuations are significantly influenced by exchange rate volatility, inflation dynamics, and financial market conditions. These

findings emphasize the dual challenge for policymakers: ensuring fiscal consolidation and sustainable revenue generation to address structural long-run debt drivers, while also strengthening financial market resilience to mitigate short-run shocks that amplify borrowing needs.

5. Conclusion and Policy Implications

The ARDL and VECM results indicate that Philippine public debt operates within a stable long-run equilibrium framework, but short-run macro-fiscal shocks play a more visibly measurable role in shaping debt fluctuations. While the bounds test confirms cointegration, none of the individual long-run coefficients attain statistical significance at conventional levels. In contrast, several short-run dynamics—particularly government expenditure and exchange rate movements—exhibit statistically significant effects.

Government expenditure emerges as the most consistent short-run determinant of debt accumulation. Although its long-run coefficient is positive but statistically insignificant, the short-run estimates reveal persistent effects across multiple lags, suggesting that fiscal expansion—especially during crisis episodes—translates quickly into higher borrowing requirements. Government revenue does not exhibit statistically significant effects in either horizon, indicating that its contribution to debt sustainability may operate gradually through structural fiscal capacity rather than immediate adjustments.

Exchange rate depreciation significantly increases public debt in the short run, reflecting valuation effects on foreign-currency-denominated liabilities. Inflation demonstrates lag-dependent and nonlinear effects, consistent with the view that moderate price increases may temporarily reduce real debt burdens, while sustained inflation can undermine fiscal credibility. Stock market prices and interest rates, although theoretically relevant, do not emerge as statistically significant independent drivers within the estimated framework.

Importantly, the error correction term is negative and highly significant (-0.01, $p < 0.01$), confirming long-run stability. However, the magnitude implies that only about 1% of disequilibrium is corrected per period, indicating a slow speed of fiscal adjustment. This gradual convergence may reflect institutional rigidities, including multi-year expenditure commitments, political constraints on rapid consolidation, and limited automatic fiscal stabilizers. The absence of a strictly binding fiscal rule or hard debt anchor may further contribute to incremental rather than rapid adjustment. Stronger governance mechanisms—such as expenditure ceilings, medium-term fiscal frameworks, or legislated debt thresholds—could accelerate convergence by reducing policy inertia and enhancing fiscal credibility.

From a policy standpoint, the findings suggest that improving expenditure quality is as important as controlling expenditure growth. Prioritizing productive investments while limiting recurrent spending pressures can reduce debt vulnerability without constraining development objectives. Strengthening revenue administration and broadening the tax base remain essential for expanding fiscal space over time. Reducing exposure to foreign-currency liabilities and maintaining adequate reserve buffers can mitigate exchange rate–induced debt volatility. Finally, institutionalizing countercyclical fiscal buffers and credible fiscal rules would not only dampen short-run borrowing pressures but may also enhance the speed at which debt returns to its long-run equilibrium path.

Thus, Philippine public debt dynamics appear stable but institutionally gradual, shaped by short-run macro-financial shocks within a slowly adjusting fiscal framework. Strengthening governance structures and fiscal institutions is therefore central to enhancing long-run debt sustainability.

Acknowledgement

This research received no specific grant from any funding agency in public, commercial or not-for-profit sectors.

Conflict of Interest Statement

The author declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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