Souphanouvong University Journal of Multidisciplinary Research and Development
2026, Vol. 12, No. 02, 52-63
https://doi.org/10.69692/SUJMRD120252

The Causality Between Remittances, Debt Services and Economic Growth of Lao PDR

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Article Info:
Submitted: February 09, 2026
Revised: March 20, 2026
Accepted: April 07, 2026

Abstract

This study to determine the causal direction among remittances, debt service, and economic growth using the Granger causality test within the Vector Autoregression (VAR) model framework. It uses time-series data from 2000 to 2024, which are taken from the World Development Indicators (WDI) of the World Bank and the Sustainable Development Goal (SDG) Country Profile databases.

The empirical analysis shows that, in the growth equation, past economic growth)$Growth_{t-1}$ (has a statistically significant positive effect at the 0.01 level, with a coefficient of 0.6415, indicating growth persistence. Conversely, past remittances (REM_{t-1}) have a statistically significant negative effect at the 0.05 level with a coefficient of -0.8277, and past debt servicing (DS_{t-1}) also has a statistically significant negative effect at the 0.01 level on growth. In the remittance equation, REM_{t-1} shows a strong positive significance with a coefficient of 0.8695, while $Growth_{t-1}$ and DS_{t-1} are statistically insignificant. In the debt servicing equation. DS_{t-1} exerts a statistically significant positive influence at the 0.01 level, with a coefficient of 0.7732, while REM_{t-1} and $Growth_{t-1}$ remain insignificant.

The Granger causality test indicates that both remittances and external debt servicing have causal relationships with economic growth, but there is no evidence supporting causality in the opposite direction. This implies a unidirectional causality, where external financial flows (remittances and debt servicing) influence economic growth, but not the reverse – from growth to remittances or debt servicing.

Keywords: *Remittance, Debt services, economic growth*

1. Introduction

Economic growth is a fundamental goal for developing countries, as it underpins development, living standards, employment opportunities, and poverty reduction. In the Lao People's Democratic Republic (Lao PDR), sustaining economic growth remains challenging due to structural constraints, limited domestic capital accumulation, and a high dependence on foreign financing (Asian Development Bank, 2023). Among these external financial sources, two key components are particularly significant: international remittances and foreign debt servicing.

Remittances personal transfers from migrant workers abroad have become an important source of external finance for many developing countries. These inflows often exceed Foreign Direct Investment (FDI) and

Official Development Assistance (ODA), contributing to foreign exchange earnings, supporting household consumption, and promoting investment in education, health, and small enterprises (Adams & Cuecuecha, 2013 ; World Bank, 2023). For many low-income and emerging economies, inward remittances have become a vital financial lifeline, often surpassing both ODA and FDI as a share of GDP. Globally, total remittances to low- and middle-income countries amounted to over USD 626 billion in 2022, underscoring their growing significance in development finance (World Bank, 2023).

In Lao PDR, most remittances originate from cross-border workers in Thailand. Although their total value is modest (around 1–2% of GDP), these transfers play an important role in supporting rural households with limited access to formal financial services (World Bank, 2023). According to financial development theory, remittances can substitute for underdeveloped financial markets, ease liquidity constraints, and facilitate productive investment (Giuliano & Ruiz-Arranz, 2009).

Conversely, debt servicing – the repayment of principal and interest on foreign debt – can impose a significant macroeconomic burden. The Debt Overhang Hypothesis suggests that when debt levels are perceived as unsustainable, investment tends to decline due to expectations of higher future taxation or reduced fiscal space (Krugman, 1988; Sachs, 1989). Additionally, the Crowding-Out Effect posits that heavy debt obligations may divert government resources away from productive public investment towards debt repayment, thereby slowing economic growth (Clements et al., 2003). Recent debt sustainability assessments by the IMF (2023) indicate that Lao PDR faces rising debt distress, with the debt-to-revenue ratio reaching levels that threaten fiscal stability. The country's macroeconomic challenges have been exacerbated by global economic volatility, the COVID-19 pandemic, energy price fluctuations, and tighter global financial conditions, all of which have increased the debt burden for many developing nations.

According to the International Monetary Fund, Lao PDR is classified as a country at high risk of debt distress, with public external debt exceeding 80% of GDP and debt service payments consuming a large share of government revenues. This situation reflects not only the scale of borrowing, particularly for infrastructure projects, but also the country's limited export diversification and weak domestic revenue mobilization (International Monetary Fund, 2023).

Existing empirical studies have generally examined the effects of international remittances and foreign debt separately. For example, research on remittances often focuses on their role in reducing poverty, improving household welfare, and, under certain conditions, promoting investment-driven growth (Adams & Cuecuecha, 2013; Giuliano & Ruiz-Arranz, 2009). Studies on foreign debt, by contrast, emphasise the nonlinear relationship between debt and growth: moderate levels of debt can support development, but excessive debt may lead to a debt overhang and economic stagnation (Pattillo et al., 2002; Presbitero, 2012). However, only a limited number of studies simultaneously investigate the combined effects of international remittances and debt repayment obligations within a single analytical framework, especially in the case of small, low-income economies such as the Lao PDR. The Lao economy is an interesting case for such analysis because of its narrow production base, heavy reliance on external financing, and strong cross-border labour migration links, particularly with Thailand. These features highlight both the potential benefits of remittance inflows and the risks of unsustainable debt levels. Understanding how remittances and debt servicing interact to influence economic growth is therefore essential for designing policies that enhance economic resilience and sustain development gains. For example, if empirical evidence shows that remittances can mitigate the adverse effects of rising debt repayments, policies could focus on facilitating remittance flows through financial sector reforms. Conversely, if debt

repayment pressures outweigh the positive impacts of remittances, greater emphasis should be placed on debt restructuring and fiscal consolidation.

Hence, this study aims to fill an important gap in the literature by examining the relationship between international remittances, foreign debt servicing, and economic growth in Lao PDR using a Vector Autoregression (VAR) model. This approach allows for the identification of cyclical and dynamic relationships among variables, making it possible to capture the interdependencies and causal effects. By employing this method, the study seeks to provide clear empirical evidence on how remittances and external debt repayment influence the country's economic growth.

Therefore, the objective of this paper is to to determine the causal direction among remittances, debt service, and economic growth using the Granger causality test within the Vector Autoregression (VAR) model framework

2. Materials and Methods

2.1 Research Design

The conceptual framework for this study (Figure 1) is based on a synthesis of established theoretical and empirical literature. It draws on the Vector Autoregression (VAR) model introduced by Sims (1980); the conceptualizations of international remittances by Ratha (2013), the World Bank (2023), Giuliano and Ruiz-Arranz (2009), and Chami et al. (2005); and the theories of external debt repayment, debt overhang, and economic growth articulated by Krugman (1988), Sachs (1989), Pattillo, Poirson, and Ricci (2002), and Clements et al. (2003). The framework also incorporates the classical and neoclassical theories of economic growth advanced by Smith (1776/2003), Solow (1956), and Swan (1956), as well as the financial development theories proposed by Todaro and Smith (2020), Levine (2005), and Giuliano and Ruiz-Arranz (2009). Furthermore, the framework is supported by empirical research, including the works of Giuliano and Ruiz-Arranz (2009), Aggarwal et al. (2011), Adams and Cuecuecha (2013), Pattillo et al. (2002), Clements et al. (2003), and Rajan and Subramanian (2005).

2.2 Data Collection

This study uses annual time-series from 2000 to 2024, which are taken from internationally-recognized and publicly available databases. The economic growth (Growth), annual percentage change in real GDP, uses the World Development Indicators (WDI) of the World Bank. The data for both of these variables are derived from the Sustainable Development Goal (SDG) Country Profile databases: private remittance inflows as percentage of GDP and total debt service as percentage of exports of goods and services. In January 2025, the data were re-examined to ensure that all of the variables remained consistent. These sources are widely used in empirical macro research and provide reliable, comparable indicators appropriate for time series analysis.

2.3 Models

Vector Autoregressive in lap p can be written as:

$$Y_t = \alpha_0 + \alpha_1 Y_{t-1} + \alpha_2 Y_{t-2} + \cdots + \alpha_p Y_{t-p} + \varepsilon_t$$

Where Y_t : Endogenous vectors $(Growth_t, REM_t, DS_t)$; α_i: Coefficients; ε_t: Error term.

We can write the VAR(p) model in matrix form in the case where the lag order is p=1:

$$\begin{bmatrix} Growth_t \\ REM_t \\ DS_t \end{bmatrix} = \begin{bmatrix} C_1 \\ C_2 \\ C_3 \end{bmatrix} + \begin{bmatrix} \gamma_{11}\ \gamma_{12}\ \gamma_{13} \\ \gamma_{21}\gamma_{22}\ \gamma_{23} \\ \gamma_{31}\ \gamma_{32}\ r_{33} \end{bmatrix} \begin{bmatrix} Growth_{t-1} \\ REM_{t-1} \\ DS_{t-1} \end{bmatrix} + \begin{bmatrix} u_{1t} \\ u_{2t} \\ u_{3t} \end{bmatrix}$$

$Growth_t$: Economic growth of Lao PDR is measured by the annual percentage change in real GDP; REM_t: Remitance inflow to Lao PDR as percentage of GDP; DS_t: The total external debt service expressed as a percentage of exports of goods and services; γ_{ij}: denotes the impact of the j^{th} component of variable k at the i^{th} lag; u_{it}: Error Terms.

Hypothesis:

$\gamma_{11} > 0$: A positive coefficient indicates that past economic growth has a positive and reinforcing effect on current economic growth, demonstrating persistence in the growth process.

$\gamma_{12} > 0$ or $\gamma_{12} < 0$: The coefficient on remittances in the growth equation may be positive or negative, indicating that remittance inflows can either stimulate or dampen economic growth depending on their use and the macroeconomic context.

$\gamma_{13} < 0$: The negative coefficient indicates that debt services have a contractionary effect on economic growth, potentially due to reduced liquidity or capital outflows.

$\gamma_{21} > 0$ or $\gamma_{21} < 0$: Economic growth may influence remittance flows in either direction: positively, if higher growth attracts remittances through improved confidence, or negatively, if higher domestic income reduces the need for remittances.

$\gamma_{22} > 0$: A positive coefficient suggests persistence in remittance behaviour, where past remittance inflows positively affect current remittance levels.

$\gamma_{23} < 0$: The negative sign indicates that foreign debt servicing reduces remittance inflows, possibly due to tighter foreign exchange availability or declining household disposable income.

$\gamma_{31} > 0$: Economic growth positively influences foreign debt repayment, implying that higher economic performance enhances a country's capacity to service its debt.

$\gamma_{32} < 0$: The negative relationship suggests that increased remittance inflows may reduce the pressure or necessity to repay foreign debt, possibly due to substitution effects in foreign currency inflows.

$r_{33} < 0$: The negative coefficient indicates mean-reverting behaviour in debt services (foreign debt repayments), where high repayment levels in the previous period are followed by a decline in the subsequent period.

2.4 Data Analysis

The empirical analysis applied a regular time-series econometric technique and it was conducted employing Stata (version 17). The stationarity for all the variables was examined by Augmented Dickey–Fuller (ADF) unit root test. Conventional AIC (Akaike's Information Criterion) and SBC (Schwarz Bayesian Criterion) were employed to determine the optimal lags for the system.

Cointegration tests were then carried out on the variables to ascertain whether there were any long-run equilibrium relationships. According to cointegration estimates, we also estimate a Vector Autoregression (VAR) model to capture short-run dynamics. We then applied Granger causality tests to discover the direction of the causal effects between variables.

We applied diagnostic tests such as the Lagrange Multiplier (LM) test for residual autocorrelation, and stability tests relying on the eigenvalues and on the roots of the characteristic polynomial to examine the goodness-of‐fit of our model and its stability. Finally, Impulse Response Functions (IRFs) were employed to examine the dynamics between various components of the system across time. Thereafter, there was used the Forecast Error Variance Decomposition (FEVD) in which the shocks affect variability of the endogenous variables.

2. Results

The results of the Augmented Dickey-Fuller (ADF) unit root tests show that, before first differencing, the test statistics for Growth, REM, and DS exceed the critical values at the 1%, 5%, and 10% significance levels. This indicates that the null hypothesis of a unit root cannot be rejected, implying that these variables are non-stationary in levels. Similarly, the MacKinnon p-values exceed conventional significance thresholds, further confirming the non-stationarity of the variables. After first differencing, the test statistics for D. Growth, D. REM, and D.DS fall well below the 1% critical values. These results indicate that all variables become stationary after differencing (Table 1).

The lag-order selection criteria were applied to determine the appropriate number of lags for inclusion in the VAR model. At lag 0, the log-likelihood (LL) was -117.116, and the associated information criteria – AIC, HQIC, and SBIC – were relatively high, with a large Final Prediction Error (FPE), indicating that a zero-lag specification is unsuitable. At lag 1, the VAR model

showed substantial improvement. The log-likelihood increased to -76.449, and the likelihood ratio (LR) test statistic was 81.335, which is statistically significant, suggesting that including one lag significantly improves model performance compared to lag 0. Furthermore, FPE, AIC, HQIC, and SBIC reached their minimum values at lag 1, confirming that this lag length is optimal according to all criteria. At lag 2, the log-likelihood increased slightly to -72.803; however, the LR test was not statistically significant, and the FPE, AIC, HQIC, and SBIC were all less favorable than at lag 1. These results indicate that lag 1 is the most appropriate specification for the VAR model, as it minimizes forecast errors and enhances estimation stability (Table 2).

The results of the Johansen (1988) cointegration test were used to assess whether long-run equilibrium relationships exist among the variables in the system. At rank 0 (no cointegration), the trace statistic is 17.9380, which is below the 5% critical value of 29.68, indicating that the null hypothesis of no cointegration cannot be rejected. At rank 1 (one cointegrating vector), the trace statistic is 5.6743, also below the 5% critical value of 15.41, so the null hypothesis of at most one cointegrating vector cannot be rejected. At rank 2, the trace statistic is 0.6698, which is less than the 5% critical value of 3.76. At rank 3, the test finds no further evidence of cointegration, as all trace statistics remain below the 5% critical values. These results show that there is no statistically significant evidence of long-run cointegration among the variables. In other words, the variables do not display stable long-term equilibrium relationships, and their interdependencies are more appropriately modelled using a VAR specification rather than a Vector Error Correction Model (VECM) (Table 3).

Results from the VAR model simulation indicate that in the Growth specification, the lagged value of past growth (0.6416) has a clear and statistically significant effect, demonstrating the persistence of economic growth – countries that have grown in the past tend to continue growing. Specifically, if all else remains constant, a 1% increase in economic growth in the previous year results in a 0.6415% increase in the current year. Conversely, past REM (−0.8277) has a statistically significant negative impact at the 0.05 level, indicating that if cross-border remittances increase by 1%, economic growth decreases by 0.8277%. This may be because such remittances are largely used for consumption rather than productive investment. Similarly, past DS (−0.2859) negatively affects Growth, showing that higher debt servicing in the previous period reduces current economic growth by 0.2859%, which is consistent with expectations (Table 4).

In the REM specification, the lagged value of REM (0.8695) is highly statistically significant, indicating that past remittance inflows strongly affect current remittance inflows. Holding other factors constant, a 1% increase in past remittances results in a 0.8695% increase in current remittances. In contrast, the lagged values of Growth and DS are not statistically significant, indicating that past economic growth and foreign debt servicing have little influence on current remittance inflows.

Nonetheless, in the DS specification, the lagged value of DS is 0.7732 and highly significant, indicating that if past foreign debt servicing increases by 1%, current foreign debt servicing increases by 0.7732%. However, the lagged values of REM and Growth are not statistically significant, implying that DS is mostly explained by its own past values.

Overall, the VAR model appears appropriate: R^2 values are relatively high across all specifications (DS model $R^2 = 0.53$, REM $R^2 = 0.81$, Growth $R^2 = 0.76$), and chi-squared tests are highly statistically significant, confirming the model's explanatory power. Furthermore, criteria such as Final Prediction Error (FPE), AIC, HQIC, and SBIC indicate that the selected lag order is appropriate.

The results of the Granger causality test show that both remittances and debt service have a Granger-causal relationship with economic growth, while no evidence

was found of reverse causality. Specifically, the results indicate that past values of REM and DS are statistically significant predictors of economic growth at the 5% level. Additionally, the joint exclusion test strongly rejects the null hypothesis at the 1% significance level, confirming that the combined effect of remittances and debt service significantly explains variations in economic growth. Conversely, the REM model shows no evidence of causality from economic growth or debt service, including in the joint test. This indicates that remittance inflows to Laos are exogenous to domestic economic performance and debt conditions, consistent with the countercyclical nature of remittance flows, where migrants continue to send money regardless of short-term domestic economic fluctuations. In the case of Laos, remittances may be driven more by labour migration and cross-border household obligations than by domestic economic performance. Similarly, in the DS model, no Granger-causal relationship was found between economic growth or remittances and debt service. The joint exclusion test confirms that past movements in economic growth and remittances cannot predict debt service outcomes. This indicates that Laos's external debt repayments are largely determined by fixed schedules and international financial agreements, rather than by short-term economic performance. Secondly, the analysis shows that remittances have a Granger-causal effect on economic growth, meaning that remittance inflows play an important role in determining economic performance. However, according to the VAR analysis, this effect could be negative if remittances are primarily used for consumption rather than productive investment, consistent with the "remittance curse" argument, which posits that unproductive use of remittances can harm economic growth by reducing labour participation and entrepreneurial activity (Table 5).

The Lagrange Multiplier (LM) test shows no evidence of serial correlation in the residuals at lag 1. The Chi-square statistic and p-value are higher than conventional significance levels (1%, 5%, or 10%). Similarly, at lag 2, the Chi-square statistic and p-value are also higher than the critical significance level. Therefore, in both cases, the null hypothesis of "no autocorrelation" cannot be rejected, confirming that the residuals of the VAR model are free from serial correlation. This finding is important econometrically because it validates the appropriateness of the selected lag length and ensures that the VAR estimates are efficient and unbiased, supporting the reliability of subsequent dynamic analysis (Table 6).

The reported eigenvalues have moduli of 0.8616, 0.7341, and 0.7341, all of which lie strictly within the unit circle (i.e., less than 1). This indicates that the VAR model is dynamically stable and stationary, meaning that when the system is subjected to shocks, their effects gradually diminish over time instead of persisting indefinitely (Table 7).

Impulse Response Functions (IRFs) provide evidence of dynamic interactions between DS, REM, and growth within the estimated VAR model over a 10-period horizon. The impulse response of economic growth to changes in foreign debt repayment (IRF, DS → Growth) indicates a negative short-term impact, with growth initially falling below zero after a shock. This negative effect persists for several periods but gradually diminishes, eventually trending towards a medium- to long-term equilibrium. The results suggest that increases in external debt initially exert downward pressure on growth, but this effect is temporary and fades over time. The impulse response of growth to its own shocks (IRF, Growth → Growth) shows a strong initial positive impact, which gradually decreases, reflecting a mean-reverting property of economic growth within the VAR system. This indicates that growth stocks are short-lived and the system returns to its long-term equilibrium. Similarly, the impulse response of economic growth to remittance shocks (IRF, REM → Growth) shows a clear and persistent positive effect, peaking around the fifth period before gradually declining. This demonstrates that cross-

border remittances generally stimulate consumption and investment, although the impact on growth may be moderated by structural constraints or leakages from productive sectors. In summary, the IRFs indicate that shocks from foreign debt have only a small and temporary effect on economic growth, whereas remittance shocks produce stronger and more persistent positive effects (Figure 2). These findings highlight the asymmetric transmission of external and internal economic shocks on growth performance.

The results from the Forecast Error Variance Decomposition (FEVD) provide detailed information on the relative contributions of different shocks – Growth, REM, and DS – to the variability of output over time. In the initial period (step 0), all changes in growth are explained solely by its own shocks, as expected. In step 1, the variation in growth remains entirely explained (100%) by its own shocks, with REM and DS contributing nothing. However, from step 2 onwards, the proportion of growth explained by its own shocks gradually declines, from about 87.9% in step 2 to approximately 47.1% in step 10. Meanwhile, the contribution of remittance shocks increases steadily, from 2.5% in step 2 to 24.6% in step 10, indicating that external remittance shocks progressively exert greater influence on growth variance over the forecast horizon. Similarly, shocks from foreign debt repayment account for about 9.6% of the variation in step 2, with their contribution rising to around 28.3% by step 10. These results show that while growth shocks dominate in the short term, the medium- to long-term variance of economic growth is increasingly determined by cross-border remittances and foreign debt shocks. Among these, foreign debt repayment has a stronger influence than remittances, highlighting the importance of external capital inflows and debt in shaping the persistence of economic growth (Table 8).

3. Discussion

The empirical findings from the Vector Autoregression (VAR) and Granger causality analyses reveal several important dynamics between remittances, debt servicing, and economic growth in the Lao PDR. Consistent with previous studies (Giuliano & Ruiz-Arranz, 2009; Adams & Cuecuecha, 2013; Akinlo, 2020), the results indicate that both remittances and debt servicing significantly influence economic growth, but the direction and nature of these effects differ.

First, the study finds that remittances exert a statistically significant negative effect on economic growth. This suggests that remittance inflows, while important for household consumption and welfare, may not contribute effectively to productive investment in the Lao context. Similar results were reported by Chami et al. (2005), who argued that remittances can create moral hazard effects when they primarily finance consumption rather than entrepreneurial activities. The "remittance curse" hypothesis Barajas et al. (2011) posits that such unproductive uses of remittances may discourage labor market participation and reduce incentives for investment, thus weakening long-term growth. In Laos, remittance inflows are largely used for subsistence consumption, education, and health expenditures rather than for capital formation or enterprise development (International Labour Organization, 2019; World Bank, 2023). Consequently, while remittances provide a short-term safety net for households, their macroeconomic impact appears limited in sustaining growth.

Second, debt servicing has a negative and statistically significant relationship with economic growth, confirming the debt overhang hypothesis (Krugman, 1988; Sachs, 1989). As external debt repayments increase, the fiscal space for productive public investment narrows, leading to slower growth. This aligns with findings by Clements et al. (2003) and Pattillo et al. (2002), who observed that excessive debt burdens reduce investment incentives and crowd out essential government expenditures. In Lao PDR, high debt service ratios combined with weak revenue generation and limited export diversification—have contributed to fiscal strain and heightened vulnerability to external shocks

(International Monetary Fund, 2023; Asian Development Bank, 2023). The VAR results suggest that these debt pressures not only dampen current economic performance but also have lingering effects that persist over time.

Third, the Granger causality results indicate a unidirectional causal flow from remittances and debt servicing to economic growth, with no reverse causality. This implies that Laos's economic growth is heavily influenced by external financial factors, rather than domestic output driving remittance inflows or debt repayment behavior. The exogeneity of remittances supports the countercyclical nature of migrant transfers, which often increase during economic downturns as migrants support families back home (Ratha, 2013; World Bank, 2022). Similarly, debt servicing appears to be governed more by international contractual obligations than by domestic economic performance, which limits the government's flexibility in managing fiscal policy.

Moreover, the impulse response and variance decomposition analyses indicate that remittance shocks have a more persistent positive effect on economic growth than debt shocks, which tend to be short-lived. This finding implies that, although remittances are not always growth-enhancing in the short term, they can play a stabilizing role in mitigating external shocks. This result echoes the arguments of Acosta et al. (2009), who found that remittances can act as automatic stabilizers by smoothing consumption during economic volatility. Conversely, debt shocks, while initially contractionary, tend to dissipate over time as economies adjust through fiscal consolidation and monetary stabilization mechanisms (Elmendorf & Mankiw, 1999). Overall, remittances provide household-level stability and partial insulation against macroeconomic instability; on the other hand, excessive debt obligations threaten to undermine fiscal sustainability and crowd out development expenditure. The findings suggest that for remittances to contribute meaningfully to long-term growth, policies should focus on promoting financial inclusion, channeling remittance savings into productive investment, and strengthening domestic capital markets (Aggarwal et al., 2011). Likewise, effective debt management strategies such as restructuring, prioritizing concessional borrowing, and improving revenue mobilization are crucial to mitigating the adverse effects of debt servicing on growth (Asian Development Bank, 2023; International Monetary Fund, 2023).

In summary, while external financial inflows remain vital to the Lao economy, their effectiveness in promoting sustainable growth depends largely on domestic policy responses. A balanced approach that enhances the productive use of remittances and maintains debt sustainability can help the country transition from dependence on external financing toward a more resilient, investment-driven growth model.

4. Conclusion

The results from the VAR model indicate the following relationships between remittances (REM), Debt services (DS), and economic growth (Growth) found that: In the Growth equation, past growth has a statistically significant and persistent effect, indicating that economic growth tends to be continuous. In contrast, past REM has a statistically significant negative effect. This may be because much of the remittance is used for consumption rather than productive investment. For past DS, the effect on Growth shows that higher foreign debt repayment in the previous period reduces current economic growth, which is consistent with expectations. In the REM equation, past REM has a strong statistically significant influence current remittance inflow. Past Growth and DS do not have statistically significant effects.

Granger causality tests indicate that both remittances and debt services Granger-cause economic growth, but there is no evidence of reverse causality. This suggests that Laos's economic growth is largely determined by external capital inflows and foreign debt obligations, consistent with the view that external finance is important for a small open economy. Conversely, the REM equation shows no evidence that economic growth

causes remittances, indicating that remittance inflows to Laos are exogenous to domestic economic performance and debt conditions. In the DS equation, there is no Granger causality from economic growth or remittances, suggesting that foreign debt repayment in Laos is primarily determined by scheduled debt service and international agreements, rather than by current economic growth or short-term financial inflows.

In this study, the researcher used only data from Laos for analysis, which may make it difficult to draw conclusive or comparable results. Therefore, in future studies on this topic, it is recommended to use data from multiple countries for a joint analysis.

5. Conflict of Interest

We certify that there is no conflict of interest with any financial organization regarding the material discussed in the manuscript.

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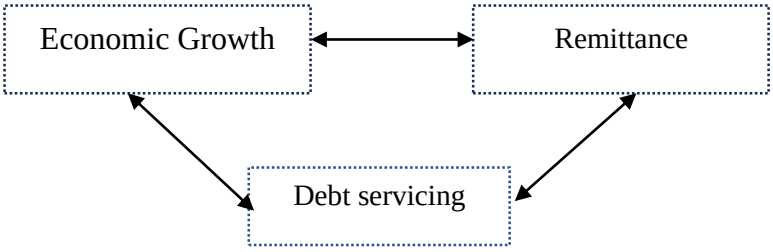

Figure 1: Concept Frameworks

Table 1: Unit root test

Dickey-Fuller Critical Value					
		Before 1st Difference			
Variables	**Test Statistic**	**1%**	**5%**	**10%**	**MacKinnon P-Value**
Growth	-1.344	-3.750	-3.000	-2.630	0.6088
REM	-1.370	-3.750	-3.000	-2.630	0.5968
DS	-1.884	-3.750	-3.000	-2.630	0.3395
		After 1st Difference			
D.Growth	-5.323	-3.750	-3.000	-2.630	0.0000***
D.REM	-5.393	-3.750	-3.000	-2.630	0.0000***
D.DS	-4.512	-3.750	-3.000	-2.630	0.0002***

Note: ***,**,* Statistical significance levels of 0.01, 0.05 and 0.1 respectively

Table 2: Lag order

Lag-order selection criteria								
Lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-117.116				6.899	10.4449	10.4821	10.593
1	-76.449	81.335*	9	0.000	0.44408*	7.6912*	7.8402*	-8.2836*
2	-72.803	7.291	9	0.607	0.74294	8.1568	8.4175	9.1935

Note: * Optimal lag

Table 3: Johansen cointegration test

Johansen tests for cointegration					
Rank	**Params**	**LL**	**Eigenvalue**	**Trace Statistic**	**Critical Value 5%**
0	12	-81.7718		17.9380*	29.68
1	17	-75.6399	0.41328	5.6743	15.41
2	20	-73.1377	0.19554	0.6698	3.76
3	21	-72.8028	0.0287		

Table 4: Results of VAR Model

Independent Variables	Models		
	$Growth_t$	REM_t	DS_t
$Growth_{t-1}$	0.6415***	0.0082	0.0952
	(5.38)	(0.26)	(0.55)
REM_{t-1}	-0.8277**	0.8695***	0.2064
	(-2.46)	(9.63)	(0.42)
DS_{t-1}	-0.2859**	-0.0217	0.7732
	(-2.55)	(-0.72)	(4.72)
$Cons$	4.9945***	0.2698	0.8552
	(3.34)	(0.67)	(0.39)
$P > Chi2$	0.0000	0.0000	0.0000
R^2	0.7637	0.8123	0.5302
Log likelihood		-79.0411	
FPE		0.3995	
Sigma		0.1456	
AIC		7.5867	
HQIC		7.7430	
SBIC		8.1757	
Number of Obs		24	

Note: ***,**,* Statistical significance levels of 0.01, 0.05 and 0.1 respectively

Table 5: Granger Causality Test

Equation	Excluded	chi2	df	Prob > chi2
Growth	REM	6.0759	1	0.014**
	DS	6.4783	1	0.011**
	ALL	10.096	2	0.006***
REM	Growth	0.0664	1	0.797
	DS	0.5175	1	0.472
	ALL	1.0414	2	0.594
DS	Growth	0.3001	1	0.584
	REM	0.1781	1	0.673
	ALL	0.38041	2	0.827

Note: ***,**,* Statistical significance levels of 0.01, 0.05 and 0.1 respectively

Table 6: Diagnostic Checks by LM test

Lagrange-multiplier test			
lag	chi2	df	Prob > chi2
1	5.1790	9	0.81843
2	8.6915	9	0.46622
H_0: no autocorrelation at lag order			

Table 7: Diagnostic Checks by Eigenvalue

Eigenvalue	Modulus
0.8616242	0.8616
0.7113561 + 0.1816871i	0.7341
0.7113561 - 0.1816871i	0.7341

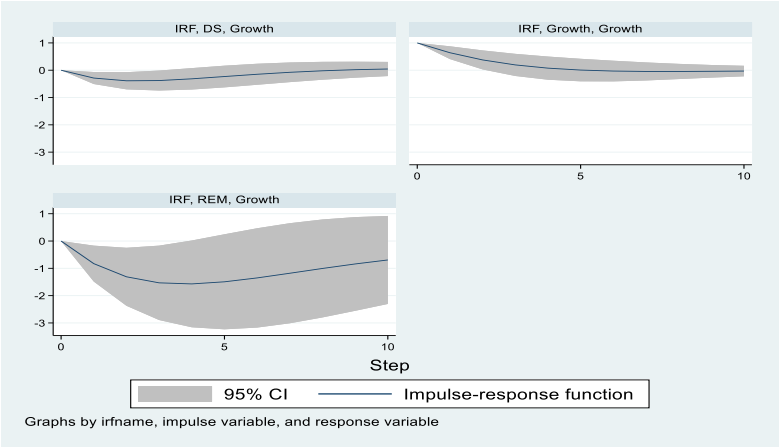

Figure 2: The Impulse Response Function (IRF)

Table 8: the Forecast Error Variance Decomposition (FEVD)

Step	(1) fevd	(2) fevd	(3) fevd
0	0	0	0
1	1	0	0
2	0.87916	0.02519	0.09565
3	0.73786	0.06516	0.19698
4	0.63270	0.10654	0.26077
5	0.56498	0.14421	0.29082
6	0.52403	0.17633	0.29964
7	0.49999	0.20224	0.29776
8	0.48585	0.22197	0.29219
9	0.47714	0.23614	0.28672
10	0.47132	0.24577	0.28291

(1) irfname = IRF, impulse = Growth, and response = Growth.

(2) irfname = IRF, impulse = REM, and response = Growth.

(3) irfname = IRF, impulse = DS, and response = Growth.