# สาเหตุระหว่างอัตราแลกเปลี่ยน หนี้สาธารณะ และดุลการค้า
# The Causality Between Exchange Rate, Public Debt and Trade Balance

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## บทคัดย่อ

บทความนี้ มีวัตถุประสงค์เพื่อทดสอบสาเหตุระหว่างอัตราแลกเปลี่ยน หนี้สาธารณะ และดุลการค้า เพื่อเป็นหลักฐานของ สปป. ลาว โดยใช้ตัวแบบเวคเตอร์อัตราถดถอย (VAR) และการทดสอบสาเหตุของเกรนเจอร์ (Granger) ใช้ข้อมูลอนุกรมเวลาตั้งแต่ปี 1998 – 2021 ตัวแบบ VAR เผยให้เห็นว่าอัตราแลกเปลี่ยนและหนี้สาธารณะส่งผลกระทบอย่างมีนัยสำคัญต่อดุลการค้า โดยมีระดับนัยสำคัญทางสถิติที่ 1% และ 5% ตามลำดับ อัตราแลกเปลี่ยนก่อนหน้ามีผลเชิงบวกและสอดคล้องกับสมมติฐานที่ตั้งไว้ เป็นผลให้ความผันผวนของอัตราแลกเปลี่ยนเพิ่มขึ้น 1% ส่งผลให้ดุลการค้าเพิ่มขึ้น 0.863% หนี้สาธารณะของปีที่แล้วส่งผลกระทบอย่างมีนัยสำคัญต่อดุลการค้า 5% ซึ่งบ่งชี้ว่าหนี้สาธารณะที่เพิ่มขึ้น 1% ส่งผลให้ดุลการค้าเพิ่มขึ้น 0.994% นอกจากนี้ ผลการศึกษายังชี้ว่าความผันผวนของอัตราแลกเปลี่ยนครั้งก่อนส่งผลเสียต่อหนี้สาธารณะถึงระดับสำคัญที่ 1% ซึ่งบ่งชี้ว่าความผันผวนที่เพิ่มขึ้นนี้จะส่งผลให้หนี้สาธารณะลดลง 1.22%

ผลลัพธ์การทดสอบสาเหตุของเกรนเจอร์ ระหว่างหนี้สาธารณะและดุลการค้า มีความสัมพันธ์เชิงสาเหตุทิศทางเดียวระหว่างตัวแปร ซึ่งหมายความว่ามีสาเหตุทางเดียวที่ไหลผ่านหนี้สาธารณะไปยังดุลการค้า แต่ดุลการค้าไม่ทำให้เกิดหนี้สาธารณะ มิฉะนั้นเป็นหลักฐานจากผลลัพธ์ที่ยังมีสาเหตุทางเดียววิ่งผ่านอัตราแลกเปลี่ยนไปยังหนี้สาธารณะและดุลการค้า แต่ไม่ผ่านหนี้สาธารณะและดุลการค้าไปยังอัตราแลกเปลี่ยนหรือหนี้สาธารณะและดุลการค้าไม่ ไม่ทำให้เกิดความผันผวนของอัตราแลกเปลี่ยน

**คำสำคัญ:** อัตราแลกเปลี่ยน หนี้สาธารณะ ดุลการค้า ตัวแบบเวคเตอร์อัตราถดถอย

## ABSTRACT

This paper aims to test the causality between exchange rate, public debt and trade balance for the evidence of Lao PDR using the Vector Autoregressive model and Granger causality test. The time series data from 1998 – 2021 was used. The VAR model reveals that exchange rate and public debt significantly impact trade balance, with a 1% and 5% level of statistical significance, respectively. The previous of the exchange rate has a positive effect and align with the setting hypothesis. As the results, a 1% increase in exchange rate volatility led to a 0.863% increase in trade balance. The previous year's public debt significantly impacted trade balance by 5%, indicating that a 1% increase in public debt leads to a 0.994% increase in trade balance. Furthermore, the study indicates that previous exchange rate volatility negatively impacts public debt by a significant level of 1%, indicating that an increase in this volatility would result in a 1.22% decrease in public debt.

The results of the Granger causality between public debt and the trade balance there is a unidirectional causal relationship between the variables meaning that there is a one-way causality runs through public debt to the trade balance, but the trade balance does not cause public debt. Otherwise, it is evidence from the results that there is also one-way causality runs through the exchange rate to public debt and the trade balance, but not through public debt and the trade balance to the exchange rate or public debt and the trade balance does not cause the exchange rate volatility



**Keywords:** exchange rate, public debt, trade balance, VAR model

## 1.Introduction

Exchange rate fluctuations impact investments, imports, exports, and public debt costs. Countries with current trade surpluses have stronger currencies, while those with trade deficits have weaker ones. These changes in exchange rates lead to price changes, eliminating trade imbalances. Following the Asian financial crisis, many countries transitioned from fixed to managed floating systems, with central banks intervening in foreign exchange markets to address concerns about extreme fluctuations or investor market volatility (Waiquamdee et al, 2005).

Trade is crucial for maintaining global economic compatibility and lowering goods prices, as it stimulates innovation and promotes market specialization. It offers access to higher-quality goods and services at lower costs than domestic alternatives. Trade terms generally reflect changes in commodity prices, not export and import volumes (Spatafora and Tytell,2009). The terms of trade, which are the ratio of export prices to imports, are linked to the balance of payments between countries. A positive increase in export prices leads to higher export earnings, resulting in a higher currency value. Conversely, a smaller increase in export prices results in a depreciation of the currency against the trading partner's currency. The terms of trade also affect the exchange rate, as higher terms lead to higher exchange rates. Foreign trade, also known as international trade, significantly contributes to the economies of developing countries by boosting gross domestic earnings, employment generation, economic development, and poverty reduction (Okenna & Adesanya 2020). Over the years, researchers have studied the relationship between trade and exchange rates. Trade indirectly influences the international capital reserve, contributing to its growth. As the reserve expands, it reduces consumption, depreciates the real exchange rate, and enhances the current account balance in the short term (Fukuda & Yoshifumi, 2007).

The exchange rate significantly impacts the prices of imported and exported goods, with a devalued domestic currency causing higher foreign goods costs. A stronger domestic currency can reduce import costs, while exchange rate volatility affects the economy by affecting investment efficiency, interest rates, and inflation. However, the impact of exchange rate volatility on trade remains inconclusive in theoretical and empirical literature (Auboin & Ruta, 2013). Recent research indicates that firm-level characteristics, such as exporters' productivity, are crucial factors influencing exchange rate elasticity, as identified by Berman et al. (2012) and Li et al. (2015).

Public debt is a vital resource for government spending and budget shortfalls, allowing the government to control expenses without affecting individual and private wealth. It often yields better results than direct foreign investment. However, high interest rates can lead to high capital costs and hinder economic growth. The ratio of public debt to GDP affects the real rate of short-term bonds, inflation rate, and nominal exchange rate. Higher public debt to GDP leads to higher real rates of short-term bonds and inflation (Hsing, 2010).

Since 1986, Laos' kip has been rising against the US dollar and neighboring currencies due to its fragile economic system. The kip to dollar exchange rate increased from 14,530,545 kip in June 2022 to 16,862,318 kip in May 2023. Public debt as a percentage of GDP rose from 36.52% in 2012 to 68.01% in 2022, while the ratio of exports to imports remained low. Uncertainty, high exchange rate volatility, rising public debt, and a widening balance of payments deficit pose persistent challenges to the Lao PDR. The war in Ukraine has caused a surge in consumer prices, causing business stress and causing concerns about stability, exchange rate liquidity, and financial conditions. Despite government monetary policy measures, the actual return rate has varied, increasing pressure on the exchange rate. The reference exchange rate surged by nearly 30% in 2022 before dropping to 5% by year-end (International Monetary Fund. Asia and Pacific Dept, 2023). Additionally, the Lao PDR is grappling with debt resolution and liquidity challenges, with debt at around 110% of GDP in 2022, with the energy sector accounting for 37% of public debt in 2021. China holds roughly half of the public or foreign debt, which is due for repayment between 2023 and 2026 (World Bank, 2023). Therefore, during the eighth and ninth ordinary sessions of the National Assembly, financial and economic issues were placed at the forefront of the national agenda.

### Objective of study

This paper aims to examine the causality between exchange rate, public debt, and trade balance in Lao PDR using the VAR model and Granger causality test.

## 2. Literature reviews

An exchange rate, also known as a foreign-exchange rate, is the rate at which one currency is exchanged for another (Suvendu, 2021). The exchange rate is the price of one currency relative to another or a group of trading currencies, influenced by factors like interest rates, political stability, public debt, and balance of trade. Theories have been developed to determine the exchange rate between different currencies (Reserve Bank of Australia, 2022).

Public debt is a crucial financing method for resource development in developing countries, where governments borrow to meet financial needs in deficit situations and bridge the gap between saving and investment (Abd Rahman etal.,2019). Knapkova et al. (2019) highlight that high public debt levels hinder effective fiscal policy implementation and financial resource acquisition through capital markets. The rise in government gross loan debt is influenced by contradicting data, making it crucial to analyze the connection between public debt and exchange rate.

The balance of trade, reflecting a country's demand for goods, can influence currency exchange rates. Countries with high demand tend to export more, increasing currency demand, while those with high imports see less currency demand. Trade announcements are crucial for traders, economists, and analysts as they indicate GDP, economic well-being, and growth

potential, and can also present trading opportunities due to fluctuations in currencies and equities (Lioudis, 2023).

The relationship between exchange rate, public debt, and trade balance is increasingly studied. Saheed et al. (2015) found that foreign debt significantly affects Nigeria's exchange rate, suggesting that government borrowing should be considered based on necessity and risk. Bunescu (2014) found that the exchange rate does not affect foreign debt in both public and private sectors due to severe and difficult-to-predict exchange rate movements. Both studies suggest that governments should consider the necessity of debt creation and borrowing to choose less risky sources. The study underscores the importance of considering the impact of foreign debt on economic stability. The SVAR model, used in predicting future exchange rates, has been found to be useful in predicting these rates. Razak & Masih (2018) found that public debt significantly impacts the exchange rate, with changes in public debt leading to a short-term weakening of the dollar and a negative effect on interest rates. These effects can be explained under the Ricardian Equivalence framework, although other explanations may also be considered. The study also found that changes in public debt can lead to a short-term weakening of the dollar. Samer fakre al-waeli (2013) explains that exchange rate changes impact domestic public debt through interest rates, which in turn affect the initial public offering (IPO) in local debt securities. Fiscal policy and monetary policy are linked, financing budget deficits through IPO in domestic public debt securities. This relationship impacts net government borrowing from the banking system, affecting domestic liquidity and the monetary base. However, Gemechu (2018) found the exchange rate's response to recurrent expenditure was small and negative, while capital expenditure had an insignificant effect on output. This could be due to administrative lag and contractual bottlenecks in capital projects, which may contribute to inflationary pressure. In the short term, interest rates responded negatively and the impact on exchange rate was insignificant. The study also found that indirect tax revenue shocks led to persistent increases in output and inflation. Direct taxes had little impact on output and inflation. The results suggest that the effects of fiscal shocks on macro variables are too small, except for real GDP, for government revenue shocks. Therefore, government debt dynamics should be considered in the model.

Razak & Masih (2018) study on the relationship between exchange rate and trade balance in Malaysia found a significant unidirectional relationship in the short-run and bidirectional relationship in the long-run. The study also found that the ratio of imports determines the value of the domestic currency or exchange rate. The exchange rate volatility coefficient showed a positive relationship with the long-term trade balance, except for certain industries like agriculture, textiles, clothing, appliances, electricity, electronics, car, and some Vietnam. As a developing country, tools to prevent market risk have high costs and are not yet developed to reduce business risk efficiently. Muenthaisong et al. (2018) found that the trade balance is linked to the exchange rate of the baht to the Malaysian ringgit. Cheema

(2006) noted that initially, the exchange rate leads to a trade deficit, but in the long run, it positively impacts trade, resulting in a trade balance. Simakova (2014) suggested that currency depreciation, which increases the real exchange rate, also affects the trade balance, as importers can increase their imports due to depreciated currency and lower goods prices. Samadneshan, et al. (2023) uses the NARDL estimation model to show that the exchange rate significantly impacts the trade balance of the agricultural sector in both short and long terms. The real exchange rate has a non-linear relationship with almost all sectors in both short and long terms. The trade balance reacts more to positive shocks in the effective exchange rate than negative shocks.

The current external debt is equal to the net present value of the future trade surplus, indicating a positive relationship with the trade balance. A study by Burhan & Hamdya (2023) found a direct relationship between domestic debt and the net trade balance, and an inverse relationship with external debt and the trade balance. An increase in external debt leads to a decrease in the net trade balance. The study recommends directing public debt funds to build and expand productive capacity.

## 3. Methodology

The paper analyzes data from 1998-2021 on the exchange rate of kip to dollar, export value, import value, and public debt from the Asian Development Bank and Bank of Lao PDR, using a Vector Autoregressive (VAR) model which written as below:

$$Y_t = A_i X_t + \varepsilon_t \quad (1)$$

Where A is the matrix coefficient and $\boldsymbol{\varepsilon_t}$ is an error term

From equation (1) we can write in matrix form as follows:

$$\begin{bmatrix} LnER_t \\ LnPD_t \\ LnTR_t \end{bmatrix} = \begin{bmatrix} \alpha_0 \\ \alpha_1 \\ \alpha_2 \end{bmatrix} + \begin{bmatrix} b_{11}\ b_{12}\ b_{13} \\ c_{21}\ c_{22}\ c_{23} \\ d_{31}\ d_{32}\ d_{33} \end{bmatrix} \begin{bmatrix} LnER_{t-i} \\ LnPD_{t-i} \\ LnTR_{t-i} \end{bmatrix} + \begin{bmatrix} u_t \\ v_t \\ z_t \end{bmatrix} \quad (2)$$

$LnER_t$: The logarithm of the exchange rate of kip per dollar in period t.

$LnPD_t$: The logarithm of the public debt in period t.

$LnTR_t$: The logarithm of trade balance in period t.

$\alpha_0, \alpha_1, \alpha_2$: Constants.

$b_{ij}, C_{ij}, d_{ij}$: The coefficients of independent variables such as core inflation, crude oil and exchange rate.

$u_t, v_t, z_t$: error terms metric.

Hypothesis:

- ✓ $b_{11} > 0$ The previous exchange rate has a positive influence on the current exchange rate.
- ✓ $b_{12} > 0$ The previous public debt has positive influence on the exchange rate.
- ✓ $b_{13} < 0$ The trade balance in previous year has a negative influence on the current exchange rate.

- ✓ $c_{21} < 0$ The previous exchange rate has a negative influence on the current public debt.
- ✓ $c_{22} < 0$ The previous public debt has negative influence on the current public debt.
- ✓ $c_{23} < 0$ The previous trade balance has a negative influence on the current public debt.
- ✓ $d_{31} > 0$ The previous exchange rate has a positive influence on the current trade balance.
- ✓ $d_{32} > 0$ The previous public debt has positive influence on the current trade balance.
- ✓ $d_{33} < 0$ The previous trade balance has a negative influence on the current trade balance.

**1.1 Unit Root Test**

The Dickey Fuller test is utilized to test the stationarity of time series data, as it is necessary for the conditional VECM analysis to be stationary first order:

- For none intercept and trend: $\Delta y_t = \theta y_{t-1} + \sum_{t=1}^{p} \emptyset_i \, \Delta y_{t-i} + u_i$ (3)
- For Intercept: $\Delta y_t = \alpha + \theta y_{t-1} + \sum_{t=1}^{p} \emptyset_i \, \Delta y_{t-i} + u_i$ (4)
- For Intercept and Trend: $\Delta y_t = \alpha + \beta t + \theta y_{t-1} + \sum_{t=1}^{p} \emptyset_i \, \Delta y_{t-i} + u_i$ (5)

Where, $y_t$: the series at t period, $t$–i: the lag length reduced by 1,
$\alpha, \beta, \theta, \emptyset$: the coefficients, $t$: trend, $u_i$: error term

**1.2 Cointegration Test**

The Johansen cointegration test (Johansen, 1988) is used to assess the short-term and long-term relationships between variables.

$$Y_t = \alpha_1 Y_{t-1} + \cdots + \alpha_p Y_{t-p} + \beta X_t + \varepsilon_t \quad (6)$$

Where $Y_t$ : vector of endogenous variables.

$\alpha_p$ are the autoregressive matrices

$X_t$is the deterministic vector

$\beta$ are the parameter matrices

$p$ is the lag order

$\varepsilon_t$ : vector of innovation

Hypothesis: $H_0$**:** There is no cointegration means that construct only the short-run causality.

$H_1$**:** There is cointegration, construct both short-run and long-run causality.

If the null hypothesis is rejected, the model should incorporate residuals from the vectors, indicating long-run causality, and a Vector Error Correcting Model (VECM) should be run.

**1.3 Lagrange Multiplier Test**

The Lagrange Multiplier Test (LM test) is a statistical method used to examine the auto correlation between variables:

$$\Delta y_t = \alpha \hat{E}_t + \sum_{i=1}^{p-1} \tau_i \Delta y_{t-i} + \epsilon_t \quad (7)$$

Where $\tau_i$ : the coefficients

$p-1$: a VAR lags where the endogenous variables have been first-differenced

$\widehat{E_t}$ : augmented with the exogenous variables

Hypothesis: $H_0$: there is no auto correlation at lags order

$H_1$: there is auto correlation at lags order

**1.4 Jarque-Bera Test**

The Jarque-Bera test is a method used to evaluate the autocorrelation of a model, as defined by Jarque and Bera in 1987.

$$JB = \frac{n}{6}(S^2 + \frac{1}{4}(K-3)^2) \quad (8)$$

Where n is the number of observations, S is the sample of Skewness and K is the sample of Kurtosis.

$$K = \frac{1}{N}\sum_{i=1}^{N}(\frac{y_i - \bar{y}}{\hat{\sigma}})^4 \quad (9)$$

$\hat{\sigma}$: the biased estimator for the variance

Hypothesis: $H_0$: Residual are normally distributed or P-value > 0.05

$H_1$: Residual are not normally distributed or P-value < 0.05

**1.5 Granger Causality Test**

The researcher utilized the Granger test method to determine the direction of the relationship between variables (Engle & Granger, 1987).

$$Y_t = \beta_1 + \sum_{j=1}^{n} \theta_i X_{t-1} + \sum_{j=1}^{m} \gamma_j Y_{t-j} + e_t \quad (10)$$

where $\beta$ is the constant coefficient, $\gamma$ is the lag coefficient of the dependent variable, and $\theta$ is the coefficient of the independent variable.

Hypothesis: $H_0: \theta_i = 0$ X and Y are related

$H_1: \theta_i \neq 0$ X and Y are not related

## 4. Empirical Results

### 1.1 Unit root test

The Augment Dickey Fuller test indicates that each variable is stationary at I(1), as the MacKinnon value after the first difference of all variables is smaller than the critical values of 0.05 and 0.01, as the following table shows:

**Table 1.** Unit Root Test

| $H_0$: has unit root | | $H_1$: Stationary or do not have unit root | | | |
|---|---|---|---|---|---|
| | | Before difference | | | |
| | | Interpolated Dickey-Fuller | | | |
| | Test Statistic | 1% Critical Value | 5% Critical Value | 10% Critical Value | MacKinnon (Sig. Level) |
| $LnER_t$ | -1.227 | -3.750 | -3.000 | -2.630 | 0.6617 |
| $LnPD_t$ | 0.695 | -3.750 | -3.000 | -2.630 | 0.9897 |
| $LnTR_t$ | -1.109 | -3.750 | -3.000 | -2.630 | 0.7115 |
| | | After 1st differences | | | |
| $D.LnER_t$ | -3.039 | -3.750 | -3.000 | -2.630 | 0.0314* |
| $D.LnPD_t$ | -4.634 | -3.750 | -3.000 | -2.630 | 0.0001** |
| $D.LnTR_t$ | -5.009 | -3.750 | -3.000 | -2.630 | 0.0000** |

Note: *,**Statistically significance at the level of 0.05 and 0.01 respectively

### 1.2 Cointegration Test

The study used the VECM model to test the relationship between variables, as the long-run correlation test using the Johansen method showed a trace statistic above the critical value of 5%, rejecting the null hypothesis that the models have no long-run relationship.

**Table 2**. Cointegration Test

| rank | LL | Eigenvalue | Trace statistic | Critical Value 5% |
|---|---|---|---|---|
| 0 | 72.091859 | | 29.5903* | 29.68 |
| 1 | 81.641915 | 0.58029 | 10.4902 | 15.41 |
| 2 | 86.561064 | 0.36058 | 0.6519 | 3.76 |
| 3 | 86.887006 | 0.02920 | | |

Note: * selected rank

### 1.3 Lag Selection Test

The test results for indicators FPE, AIC, and HQIC are in lag (2), while the SBIC criteria are in lag (1), indicating a relationship between core inflation rate, crude oil, and exchange rate in the Lao People's Democratic Republic.

**Table 3.** optimal lag

| Lag-order selection criteria | | | | |
|---|---|---|---|---|
| lag | FPE | AIC | HQIC | SBIC |
| 0 | 0.000071 | -1.03264 | -0.997593 | -.883862 |
| 1 | 6.6e-07 | -5.73154 | -5.59135 | -5.13643* |
| 2 | 5.4e-07* | -5.98973* | -5.74439* | - 4.94828 |

Note: * optimal lag

### 1.4 Empirical Analysis

**Table 4.** Empirical Analysis by VAR

| Independent Variables | Models | | |
|---|---|---|---|
| | $LnER_t$ | $LnPD_t$ | $LnTR_t$ |
| $\boldsymbol{LnER_{t-1}}$ | 0.997 | -1.022 | 0.863 |
| | (6.03)** | (4.43)** | (2.42)* |
| $\boldsymbol{LnER_{t-2}}$ | -0.129 | 0.440 | -0.249 |
| | (1.44) | (3.52)** | (1.29) |
| $\boldsymbol{LnPD_{t-1}}$ | -0.134 | 0.618 | 0.994 |
| | (1.04) | (3.44)** | (3.58)** |
| $\boldsymbol{LnPD_{t-2}}$ | 0.176 | 0.396 | -0.838 |
| | (1.30) | (2.10)* | (2.88)** |
| $\boldsymbol{LnTR_{t-1}}$ | -0.088 | -0.075 | 0.699 |
| | (1.05) | (0.65) | (3.89)** |
| $\boldsymbol{LnTR_{t-2}}$ | -0.007 | -0.071 | -0.255 |
| | (0.08) | (0.61) | (1.41) |
| $\boldsymbol{Cons}$ | 0.842 | 5.237 | -7.079 |
| | (0.74) | (3.32)** | (2.90)** |
| $\boldsymbol{P > Chi2}$ | 0.0000 | 0.0000 | 0.0000 |
| $\boldsymbol{R^2}$ | 0.7981 | 0.9863 | 0.7558 |
| Log likelihood | 86.88701 | | |
| Sigma | 7.45e-08 | | |
| AIC | -5.989728 | | |
| HQIC | -5.744394 | | |
| SBIC | -4.948278 | | |
| Number of Obs. | 22 | | |

Note: *, **Statistically significance at level of 0.05 and 0.01 respectively.

The values in "()" is z-statistics

The empirical analysis of the above table shows that we have 3 models, namely:

For model 1, demonstrates a positive relationship between the exchange rate of kip to dollar and its current value, with a 1% increase or decrease in the past year causing a 0.997% increase or decrease. The independent variables, public debt and trade balance, do not significantly influence the exchange rate, The $R^2$ indicates that the independent variables can explain 98.68% of the dependent variable.

The model 2 reveals that the exchange rate of the kip to the dollar and the public debt in the previous period significantly influence the current public debt. However, the exchange rate from two years ago has a similar effect on public debt, contradicting the hypothesis. The exchange rate in the past year has the opposite effect, with a statistical significance level of 0.01. If other factors remain constant, a 1 increase in the exchange rate leads to a 1.022% decrease in public debt. Conversely, a 1% decrease in the exchange rate results in a 1.022 increase in public debt. The level of public debt in the last year and two years also affects the current level of public debt in the same direction, with a statistical significance level of 0.01 and 0.05 respectively. The trade balance has no influence on the level of public debt. The $R^2$ indicates that the independent variables can explain 98.63% of the dependent variable.

In Model 3, the exchange rate and public debt have significant impacts on the trade balance in Lao PDR. An increase in the exchange rate between the kip and the dollar or a depreciation of the kip against the dollar leads to Lao PDR being able to export more, as importers feel the price of goods has fallen. The level of public debt also has a significant influence on the trade balance. A 1 increase in public debt leads to a 0.994% increase in the trade balance. The previous year's trade balance affects the current trade balance with a 0.01 significance level in the same direction. A 1 increase or decrease in the previous year's trade balance causes a 0.699 increase or decrease in the current trade balance. The$R^2$ indicates that the independent variables can explain 75.58% of the dependent variable.

**Table 5.** Granger Causality Test

| Equation | Excluded | chi2 | df | Prob > chi2 |
|---|---|---|---|---|
| LnER | LnPD | 2.9331 | 2 | 0.231 |
| | LnTR | 1.3967 | 2 | 0.497 |
| | ALL | 3.0482 | 4 | 0.55 |
| LnPD | LnER | 19.737 | 2 | 0.000** |
| | LnTR | 1.3043 | 2 | 0.521 |
| | ALL | 19.829 | 4 | 0.001** |
| LnTR | LnER | 6.514 | 2 | 0.039* |
| | LnPD | 21.555 | 2 | 0.00** |
| | ALL | 22.588 | 4 | 0.00** |

Note: *,**Statistically significance at the level of 0.05 and 0.01 respectively

The results of the Granger causality between public debt and the trade balance show the probability values for the null hypothesis that there is no causality. Here we can reject the null hypothesis at a significance level of 5%. The results show that there is a unidirectional causal relationship between the variables, i.e. the one-way causality runs via public debt to the trade balance, but not via the trade balance to public debt.

The Granger causality results also show that the exchange rate has a positive relationship with government debt and the trade balance at a statistically significant level of 1% and 5% respectively. It is evidence from the results that there is unidirectional causal relationship between the variables i.e. one-way causality runs through the exchange rate to public debt and the trade balance, but not through public debt and the trade balance to the exchange rate or public debt and the trade balance does not cause the exchange rate volatility.

**Table 6.** Lagrange-multiplier (LM) Test

| Lagrange-multiplier test | | | |
|---|---|---|---|
| **lag** | **chi2** | **df** | **Prob > chi2** |
| 1 | 10.5568 | 9 | 0.30732 |
| 2 | 6.8159 | 9 | 0.65628 |
| $H_0$: no autocorrelation at lag order | | | |

The Lagrange multiplier test with lag (2) indicates that the main hypothesis of no autocorrelation problem cannot be rejected, indicating that the expected values of random variables are not related or that expectations in one period do not affect expectations in other periods, indicating the appropriateness of the VAR model.

**Table 7.** Jarque Bera Test for Residuals

| **Equation** | **chi2** | **df** | **Prob > chi2** |
|---|---|---|---|
| LnER | 1.888 | 2 | 0.38906 |
| LnPD | 20.94 | 2 | 0.00003 |
| LnTR | 0.688 | 2 | 0.70877 |
| ALL | 23.516 | 6 | 0.00064 |

The Jarque-Bera test indicates that the main hypothesis was rejected as the prob value of all variables is less than the critical value of 0.05, indicating not normally distributed expected value. Here we continue that example by refitting that model and using the eigenvalues of the companion matrix of the corresponding VAR model.

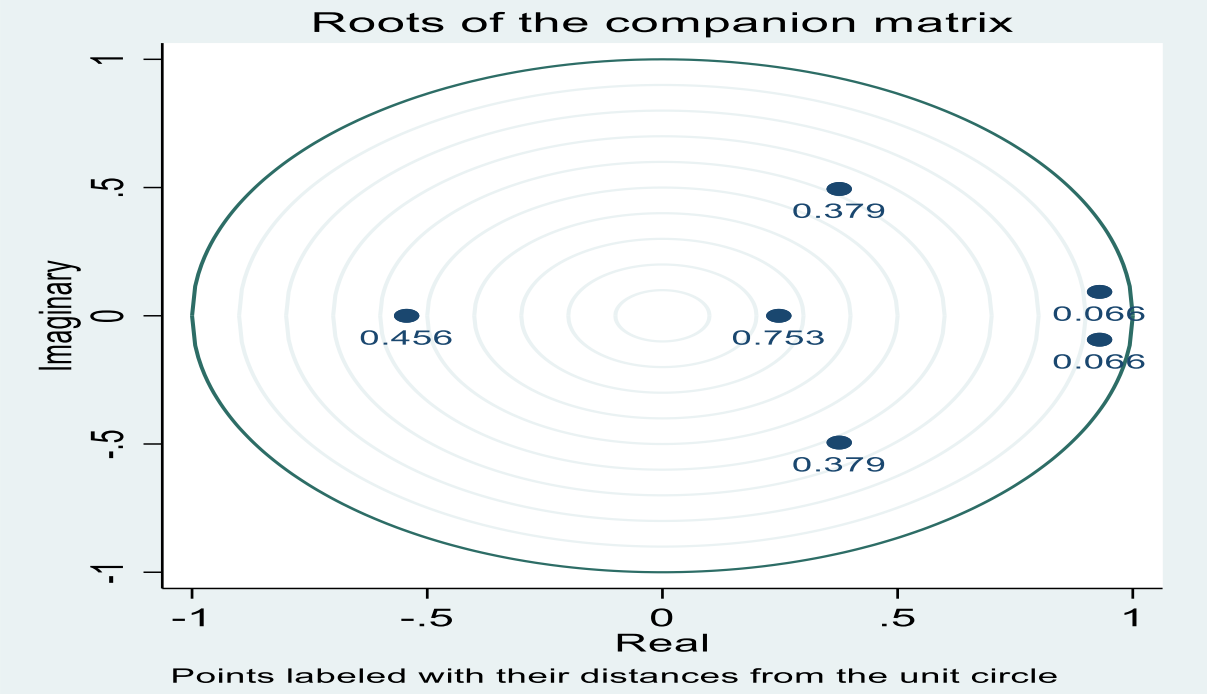


**Figure 1.** Roots of the companion matrix

The graph option displayed eigenvalues with real and complex components on the x and y axes, indicating that the eigenvalues are within the unit circle visually. The study's dynamic matrix indicates the VAR model is stable due to the modulus of eigenvalues staying within the unit circle, and no complex eigenvalues leading to the circuit. The VAR model was found to be suitable for examining the relationship between exchange rate, public debt, and trade balance.

## 5. Conclusion and discussion

The empirical by VAR model, reveals that exchange rate and public debt have a significant impact on the trade balance with a statistical level of 1% and 5% respectively. The previous of the exchange rate has a positive effect and align with the setting hypothesis. As the results, 1% increase in the exchange rate volatility leads the trade balance increased by 0.863%. This result consistent with the research of Tunc et al. (2018) that a significant positive impact of external exchange rate risk on exports to a specific destination, particularly in advanced countries, countries with low bilateral exchange rate volatility, and countries with a concentrated export market. However, it against the study of Raddatz (2017) that exchange rate volatility has a minimal negative impact on aggregate trade flows. Senadza & Diaba (2017) argue that exchange rate volatility doesn't significantly impact imports, but it has a negative short-term impact on exports, but a positive long-term impact on exports.

For the relationship between public debt and trade, they have a positive relationship, meaning that public debt in previous year also has a positive significant impact on trade balance with a statistically significant level of 5%, which 1% increase in previous public debt leads to trade balance increased by 0.994. This result contradicts with the research of Burhan & Hamdya (2023) that domestic debt and the net trade balance has negative relationship.

Furthermore, the study reveals that the exchange rate volatility for the previous year has a negative significant with public debt, meaning that if the previous exchange rate volatility increasing by 1% will cause public debt decreased by 1.22%. This result consistent with the research of Wahyuni et al. (2019) that foreign exchange reserves have no significant long-term impact on foreign debt, while the exchange rate positively influences foreign debt and Kouladoum (2019) reveals that external debt significantly impacts the real exchange rate, while debt servicing also has a negative and significant impact.

However, the study reveals that public debt and trade balance does not impact on the exchange rate which in line with previous studies, such as Safet Kurtović's (2017) and Mesagan, Alimi & Vo's (2022) findings. Otherwise, Lotfalipour & Bazargan (2014) found no significant effect on the trade balance, suggesting that the fluctuation of the actual exchange rate cannot be used to address the trade balance problem. They also found that the trade balance is more affected by imports than exports, suggesting that the government should focus on producing goods to replace imports and Razak & Masih (2018) found that public debt significantly impacts the exchange rate.

The results of the Granger causality between public debt and the trade balance there is a unidirectional causal relationship between the variables meaning that there is a one-way causality runs through public debt to the trade balance, but the trade balance does not cause public debt. Otherwise, the exchange rate has a positive relationship with public debt and the trade balance at a statistically significant level of 1% and 5% respectively. It is evidence from the results that there is unidirectional causal relationship between the variables i.e. one-way causality runs through the exchange rate to public debt and the trade balance, but not through public debt and the trade balance to the exchange rate or public debt and the trade balance does not cause the exchange rate volatility. The findings contradict the research conducted by Ivascu et al. (2024) that a weak, non-significant positive relationship between gross loan debt and foreign exchange rates. The burden of gross debt loan can be influenced by exchange rates' appreciation or depreciation, and the level of gross debt loan can also affect exchange rates.

According to the discussion above, the causality between exchange rate, public debt, and trade balance in Lao PDR, compared to previous studies, lacks consensus, indicating that further research is necessary to conduct.

### 5.1 Suggestions for use in this research

The exchange rate affects trade balance, so parties must maintain kip stability and export production. Failure to do so could lead to kip depreciation, affecting the trade balance if export production remains low and substandard, highlighting the importance of maintaining stability in the kip.

The depreciation of the kip could increase government debt due to a lack of reserves to address economic issues, potentially leading to increased borrowing. To address this issue, agencies should create legislation under the foreign exchange management act and prioritize urgent public debt projects, ensuring that the most important projects are implemented.

### 5.2 Further researchers

This paper uses the VAR model, which may not accurately compare analysis results. It recommends combining it with other models like SVAR, ARDL, SUR, and quantile for future studies. On the basis of the literature evaluation and criticism, it is established that different methods lead to different results. In addition, it is necessary to increase the sample size in the analysis as well as to find a way to control the variables, since the data used in this analysis covers the period of the economic crisis and the spread of Covid-19 disease.

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