# Dynamic Relationships Among Money Supply, Inflation and Exchange Rates in ASEAN: A Panel VAR Approach

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**Abstract**— This paper investigates the dynamic relationships among money supply (M2), inflation, and exchange rates in ASEAN countries using yearly panel data from 2001 to 2022. Authors use Panel Vector Autoregressive (PVAR) Model in order to empirically test the Quantity Theory of Money (QTM) and Purchasing Power Parity (PPP) theories through recent trends in money supply, inflation and exchange rates (US dollar against local currencies) in ASEAN countries. First, authors perform panel unit root test if variables are useable to proceed the proposed model. Second, authors perform panel cointegration test before PVAR modeling. The findings of the results in this study are moderately consistent with theories and some present existing empirical studies related. The limitations and suggestions for future studies are discussed. This paper adds to the existing empirical literature by using microdata of ASEAN region as a focus.

**Keywords**: PVAR, Money Supply, Inflation, Exchange Rates, ASEAN.

## I. INTRODUCTION

Ensuring stability of inflation and exchange rates is a primary goal of monetary policy worldwide. Central banks employ various monetary policy tools to achieve this stability. Injecting too much money into the economy can create inflationary pressures and cause depreciation of the local currency. Therefore, effective management of the money supply, including within depository corporations, is essential to lessen inflation risks and maintain stable exchange rates against other currencies.

Each country within ASEAN presents unique economic challenges and opportunities. Understanding the dynamic relationships between money supply, inflation, and exchange rates is vital for effective policy formulation within the ASEAN countries – Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malysia, Myanmar, Philippines, Singapore, Thailand and Vietnam. These nations, while geographically close and sharing certain economic traits, face different macroeconomic environments shaped by their individual histories, political sceneries, and developmental stages.

This research article builds on the Quantity Theory of Money (QTM) and Purchasing Power Parity (PPP) theories to explore their relevance in ASEAN countries as a group. QTM suggests a direct relationship between money supply and price levels, influencing consumer behavior and price stability. PPP, on the other hand, theorizes that exchange rates adjust to equalize the purchasing power of different currencies, maintaining stable currency values despite inflation disparities between countries. Authors shall analyze how shocks in money supply, consumer price index and exchange rates affect one another within ASEAN countries in order to validate the applicability of QTM and PPP theories.

The paper is organized as follows: Section II reviews some of existing empirical studies, Section III describes the data and methodology used, Section IV presents empirical findings from panel cointegration and PVAR results, and Section V concludes with a summary of key findings.

## II. EMPIRICAL STUDIES

A large body of existing have explored the dynamic relationships among money supply (M2), consumer price index (inflation) and exchange rates using different regions as their focuses. These studies used different methodologies and datasets to examine the interdependencies and causal links between key macroeconomic variables (money growth, consumer price index and exchange rates).

In 2012, Akinbobola explored the relationships among three variables same as present study for the case of Nigeria. His results showed that causality relationships among money supply, inflation and exchange rate. He used VECM with quarterly data from 01:1986 to 04:2008. The link between money supply and inflation for the case of Kenya was studied so as to validate Monetarist Theory by using VECM [Kignada, 2014]. He concluded that money supply in the long term significantly cause inflation in Kenya, aligning with monetarist theory. Similarly, another study by Chiaraah and Nkegbe [2014] carried out to investigate dynamic relationships among GDP growth, money supply, inflation and exchange rate in Ghana. Their findings of the results

were in line with theories proving long term equilibrium associations among these variables included. In 2015, Kamali and HasanNejadNeysi examined dynamic influence among the same variables as present study for the case of Iran. The VAR model revealed that money supply affects inflation the most in Iran. Another study was carried out to answer if money supply growth causes inflation within the west African monetary zone countries [Ozekhome, 2017]. His results statistically confirmed that exchange rate depreciation, lagged inflation and monetary expansion cause inflation in the region studied.

There was also an empirical study that used vector error correction model (VECM) with micro-data of Turkey as focus to examine dynamic links between CPI, Money Supply (M3) and Exchange Rate [Sunal, 2018]. His findings showed a long run significant relationship plus changes in M3 and exchange rate cause inflation. It also revealed that a 100 billion TL increase in M3 is associated to a 19-point rise in CPI, and a 1 TL depreciation of the local currency results an 82.9-point increase in CPI. Another study specifically examined movements of money supply, inflation, and exchange rate in Cambodia using Bayesian VAR model with one lag [Sean et al, 2019]. Their findings revealed that money supply causes the depreciation of Khmer Riel currency against US dollar that resulted inflationary. Their empirical results were consistent not only with theories but also some empirical studies related. One study also conducted for the case of Indonesia and Libya examining the dynamic effects of money supply, exchange rate and interest rates on inflation [Amhimmid et al, 2021]. Their results revealed the significant effect of money supply and insignificant influence of exchange rates on inflation rates in Indonesia and Libya.

Another study was carried out for the case of Egypt using VEC model [Dekkiche, 2022]. His findings showed that money supply is a long-run predictor of inflation for Egypt case. Recently, one study was carried out in Papua New Guinea, examining dynamic relationships among real GDP, money supply, inflation and exchange rate using annual data covering the years from 1977 to 2020 [Paul et al, 2023]. Their findings revealed that money supply positively causes inflation and exchange rate depreciation. In recent year, one study was conducted the dynamic links between economic growth, money supply, exchange rate and inflation in Gambia [Jawo et al, 2023]. Autoregressive Distributed Lags (ARDL) modeling results showed that money supply, exchange rate, economic growth and exchange rate cause inflation negatively in short term and positively in long run.

One study was conducted very recently in developing ASEAN region regarding money policy and macro factors on current account using panel VEC model for periods between 2007 and 2001 [Andini et al, 2024]. Their results indicated that interest rates, inflation and economic growth (GDP) have significant and negative long run effect while exchange rate and foreign direct investment have a significant and positive effect in both short-/long term. On the other hand, they found trade openness has significant negative impact in the long run but positive effect in the short-run in developing ASEAN countries excluding Lao PDR and Cambodia.

These existing literature leaves an empirical gap to fill for ASEAN countries as a group. Hence, this study proceeds to fill this gap by employing panel vector autoregressive (PVAR) model in order to validate both theorical assumptions and existing studies.

## III. DATA AND METHODOLOGY

This study collected the publicly available secondary data covering from 2001 to 2022 from Asia Development Bank (ADB) and the Central Statistical Organization of Myanmar (CSO). The data includes money supply (M2) or broad money liabilities, annual rate of inflation (consumer price index), and official exchange rates at the end of period (US dollar against local currencies). Table 1 shows the notation and source of variables used for the findings of the results.

**Table 1.** Notation and Source of Data and Variables

| Country | Notation | Description | Source |
|---|---|---|---|
| Brunei Darussalam | MS | Money Supply (M2), BND Million | ADB |
| Brunei Darussalam | CPI | Annual Rate of Inflation (Consumer Price Index, %) | ADB |
| Brunei Darussalam | EXR | Exchange Rate (US$ against BND) | ADB |
| Cambodia | MS | Money Supply (M2), Riel Billion | ADB |
| Cambodia | CPI | Annual Rate of Inflation (Consumer Price Index, %) | ADB |
| Cambodia | EXR | Exchange Rate (US$ against Riel) | ADB |
| Indonesia | MS | Money Supply (M2), IDR Trillion | ADB |
| Indonesia | CPI | Annual Rate of Inflation (Consumer Price Index, %) | ADB |
| Indonesia | EXR | Exchange Rate (US$ against IDR) | ADB |
| Lao PDR | MS | Money Supply (M2), LAK Billion | ADB |

| | | | |
|---|---|---|---|
| Lao PDR | CPI | Annual Rate of Inflation (Consumer Price Index, %) | ADB |
| Lao PDR | EXR | Exchange Rate (US$ against LAK) | ADB |
| Malaysia | MS | Money Supply (M2), MYR Million | ADB |
| Malaysia | CPI | Annual Rate of Inflation (Consumer Price Index, %) | ADB |
| Malaysia | EXR | Exchange Rate (US$ against MYR) | ADB |
| Myanmar | MS | Money Supply (M2), MMK Billion | ADB & CSO |
| Myanmar | CPI | Annual Rate of Inflation (Consumer Price Index, %) | ADB & CSO |
| Myanmar | EXR | Exchange Rate (US$ against MMK) | ADB |
| Philippines | MS | Money Supply (M2), PHP Million | ADB |
| Philippines | CPI | Annual Rate of Inflation (Consumer Price Index, %) | ADB |
| Philippines | EXR | Exchange Rate (US$ against PHP) | ADB |
| Singapore | MS | Money Supply (M2), SDG Million | ADB |
| Singapore | CPI | Annual Rate of Inflation (Consumer Price Index, %) | ADB |
| Singapore | EXR | Exchange Rate (US$ against SDG) | ADB |
| Thailand | MS | Money Supply (M2), THB Billion | ADB |
| Thailand | CPI | Annual Rate of Inflation (Consumer Price Index, %) | ADB |
| Thailand | EXR | Exchange Rate (US$ against THB) | ADB |
| Vietnam | MS | Money Supply (M2), VND Billion | ADB |
| Vietnam | CPI | Annual Rate of Inflation (Consumer Price Index, %) | ADB |
| Vietnam | EXR | Exchange Rate (US$ against VND) | ADB |

Notes: ADB = Asia Development Bank, www.data.adb.org; and CSO = "Central Statistical Organization of Myanmar, www.csostat.gov.mm.

**MODEL SPECIFICATION**

In order for PVAR model to be appropriate, the variables in the panel must not be cointegrated but should be stationary either at their levels or after first differencing. If the variables are cointegrated, the appropriate model is the Panel Vector Error Correction Model (PVECM). To determine if the variables have a long-run relationship, panel cointegration tests using the Pedroni and Kao methods are conducted. If these tests show no evidence of a long-term relationship among the variables, the PVAR model is applied instead. The original $VAR_{(p)}$ model is introduced in 1980 by Christopher A. Sims [Christiano, 2012]. In this model, variables are treated as endogenous with order p. The general form of the model can be expressed as:

$$\Upsilon_{it} = c + \sum_{j=1}^{p} \alpha_j \Upsilon_{it-j} + \varepsilon_{it}, \qquad \varepsilon_t \sim \mathrm{N}(0, \Sigma) \tag{5}$$

Where $\Upsilon_{it}$ $(\Upsilon_{1t}, \Upsilon_{2t}, \ldots, \Upsilon_{it})$ = the endogenous variables at time t; k × k metrics $\alpha_{1,}\alpha_2, \ldots, \alpha_j$= the coefficients to be estimated; and $\varepsilon_{it}$, (1×k) = vector of error terms with covariance matrix Σ.

The empirical forms of PVAR(p) equations are as following:

$$DMS_{1,t} = \alpha_1 + \sum_{j=1}^{p} \theta_{1,j}\, DMS_{1,t-j} + \sum_{j=1}^{p} \beta_{1,j}\, DCPI_{1,t-j} + \sum_{j=1}^{p} \delta_{1,j}\, DEXR_{1,t-j} + \varepsilon_t \tag{6}$$

$$DCPI_{1,t} = \alpha_2 + \sum_{j=1}^{p} \theta_{2,j}\, DCPI_{1,t-j} + \sum_{j=1}^{p} \beta_{2,j}\, DEXR_{1,t-j} + \sum_{j=1}^{p} \delta_{2,j}\, DMS_{1,t-j} + \varepsilon_t \tag{7}$$

$$DEXR_{1,t} = \alpha_3 + \sum_{j=1}^{p} \theta_{3,j}\, DEXR_{1,t-j} + \sum_{j=1}^{p} \beta_{3,j}\, DCPI_{1,t-j} + \sum_{j=1}^{p} \delta_{3,j}\, DMS_{1,t-j} + \varepsilon_t \tag{8}$$

These can also be written in a matrix form:

$$\begin{bmatrix} DMS_{1,t} \\ DCPI_{1,t} \\ DEXR_{1,t} \end{bmatrix} = \begin{bmatrix} \alpha_1 \\ \alpha_2 \\ \alpha_3 \end{bmatrix} + \begin{bmatrix} \theta_{1,t} & \beta_{1,t} & \delta_{1,t} \\ \theta_{2,t} & \beta_{2,t} & \delta_{2,t} \\ \theta_{3,t} & \beta_{3,t} & \delta_{3,t} \end{bmatrix} \begin{bmatrix} DMS_{t-j} & DCPI_{t-j} & DEXR_{t-j} \\ DCPI_{t-j} & DEXR_{t-j} & DMS_{t-j} \\ DEXR_{t-j} & DCPI_{t-j} & DMS_{t-j} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1,t} \\ \varepsilon_{2,t} \\ \varepsilon_{3,t} \end{bmatrix} \quad (9)$$

The steps for estimating a Panel Vector Autoregressive (PVAR) model are as follows:

***Step 1***: Panel Unit Root Test to check if the variables are stationary at their levels or if they need to be first differenced to run PVAR model.

***Step 2***: Panel Cointegration Test to verify if the variables are cointegrated at the same order.

***Step 3***: Lag Length Selection Test to determine the optimal number of lags order for the model.

***Step 4***: AR Roots Test to ensure the model with selected lag order is stable so that it produces reliable results in Impulse Responses Function (IRF).

***Step 5***: Estimate the PVAR model using the optimal lag length.

***Step 6***: Granger Causality Test if the variables can cause one another in the short run.

***Step 7***: Impulse Response Function (IRFs) Test to analyze how shocks to one variable affect its own future values and those of other variables.

***Step 8***: Variance Decomposition Test to examine the share of different shocks to the variation in the variables given in variance decomposition.

## IV. RESULTS

As previously introduced, authors first perforemd panel unit root test to check if the variables are stationary or else first differenced when estimating PVAR(p) model. Table 2 below shows the results from panel unit root tests of variables at I(0) and I(1). Based on the results computed, all variables are stationary at first difference I(1) with significant level. So, it requires to perform panel cointegartion test whether panel vector error correction model (PVECM) is appropriate. The results of panel cointegration test are provided in Table 3. Panel cointegaration verified the variables are not cointegrated at significant level at the same order so that the proposed PVAR model is more appropriate.

**Table 2.** Panel Unit Root Test with constant and trend

| **Methods/Variables** | **MS** | **D(MS)** | **CPI** | **D(CPI)** | **EXR** | **D(EXR)** |
|---|---|---|---|---|---|---|
| | T-value (P-value) | T-value (P-value) | T-value (P-value) | T-value (P-value) | T-value (P-value) | T-value (P-value) |
| Levin, Lin & Chu t* | 1.44495 | -5.10027 | -2.99364 | -2.91026 | 0.98385 | -5.67287 |
| | (0.9258) | (0.0090) | (0.0014) | (0.0018) | (0.8374) | (0.0000) |
| Breitung t-stat | 6.33029 | -1.21455 | -0.72238 | 0.14819 | 1.59016 | -1.63569 |
| | (1.0000) | (0.1123) | (0.2350) | (0.5589) | (0.9441) | (0.0510) |
| Lm, Pesaran and Shin W stat | 3.23183 | -4.23425 | -2.38824 | -8.29320 | 2.15664 | -4.14092 |
| | (0.9994) | (0.0000) | (0.0085) | (0.0000) | (0.9845) | (0.0000) |
| ADF-Fisher chi-square | 16.2661 | 59.3888 | 48.5621 | 104.022 | 13.1574 | 72.0960 |
| | (0.7000) | (0.0000) | (0.0004) | (0.0000) | (0.8705) | (0.0000) |
| ADF-Choi Z-stat | 3.51560 | -3.78234 | -1.94463 | -6.90740 | 1.97603 | -4.08492 |
| | (0.9998) | (0.0001) | (0.0259) | (0.0000) | (0.9759) | (0.0000) |
| PP-Fisher chi-square | 13.3201 | 47.7189 | 63.9898 | 572.374 | 11.8215 | 82.0572 |
| | (0.8632) | (0.0005) | (0.0000) | (0.0000) | (0.9221) | (0.0000) |
| PP- Choi Z-stat | 4.20179 | -1.63631 | -4.19255 | -18.8434 | 2.44324 | -5.50636 |
| | (1.0000) | (0.0509) | (0.0000) | (0.0000) | (0.9927) | (0.0000) |

Notes: levin, lin and Chu t* are assumed to be common unit root method; and the rest are based on individual unit root methods.

**Table 3.** Panel Cointegration Test

| ***Kao Residual Cointegration Test*** | | | | |
|---|---|---|---|---|
| **Method** | **Statistic** | **Prob.** | **Weighted Statistic** | **Prob.** |
| ADF | 0.554367 | 0.2897 | - | - |
| ***Pedroni Residual Cointegration Test*** | | | | |
| Panel v-Statistic | -0.044781 | 0.5179 | -2.040417 | 0.9793 |
| Panel rho-Statistic | 2.908007 | 0.9982 | 2.785415 | 0.9973 |
| Panel PP-Statistic | 4.51536 | 1.0000 | 3.897008 | 1.0000 |
| Panel ADF-Statistic | -1.270832 | 0.1019 | 4.041973 | 1.0000 |

The optimal lag length selection is selected by minimum value of several criterion including Final Prediction Error (FPE), Akaike Information Criterion (AIC), Schwarz Information Criterion (SIC), and Hannan-Quinn Information Criterion (HQIC) which is essential for VAR(p) model. Based on Table 4, lag 3 is chosen. Despite the fact that the optimal lag length is determined, it still requires the stability of PVAR. Figure 1 indicates the stability of PVAR while the roots exist located in the unit circle. The stability of inverse roots of AR characteristic polynomial confirms the reliable results in impulse responses functions (IRFs).

After confirming the stability and the optimal lag order for the PVAR model, three empirical equations with a lag of 3 were estimated. The first equation shows that the money supply at time t is mainly influenced by its own value at time t-3, with a coefficient of 0.545546, a t-value of 4.74723, and a p-value of 0.0000. Given 1 US dollar against local currencies of each ASEAN country, authors found that the inflation rate at time t-3 has a negative but not statistically significant effect on the money supply at time t, and exchange rates have a positive but not statistically significant effect. In summary, these results indicate that in some ASEAN countries, the money supply is mainly influenced by its own past values rather than by past inflation rates or exchange rates. This reveals that changes in the money supply within these ASEAN countries are largely driven by their own historical trends, reflecting a certain degree of stability in monetary policies within ASEAN region.

The second equation examines the relationship among inflation rates, exchange rates, and the money supply at time $t$, indicating negative associations despite their lack of statistical significance. In the third equation, exchange rates at time $t$-3 show a negative relationship with the money supply and a positive relationship with inflation at time $t$, yet these effects are not statistically significant.

These statistical findings conclude that while inflation rates and exchange rates theoretically highly correlated with the money supply, their practical impact within the specified lag period is not statistically obvious in the ASEAN countries under investigation using Panel VAR modeling. Further research is needed to explore additional factors that could explain monetary policy decisions within these economies or individuals. The bidirectional Granger causality tests examine the influence among variables within the Panel VAR (PVAR) model for ASEAN countries. The results are reported in Table 6.

**Table 4.** Lag Length Selection Test

| **Lag** | **LR** | **FPE** | **AIC** | **SIC** | **HQIC** |
|---|---|---|---|---|---|
| 0 | NA | 4.64E+17 | 49.19158 | 49.24692 | 49.21404 |
| 1 | 493.9 | 2.63E+16 | 46.32218 | **46.54353*** | 46.41200 |
| 2 | 35.85 | 2.35E+16 | 46.20813 | 46.59549 | 46.36532 |
| **3** | **31.44*** | **2.14e+16*** | **46.11753*** | 46.6709 | **46.34208*** |
| 4 | 12.93 | 2.20E+16 | 46.14104 | 46.86043 | 46.43296 |

**Fig. 1.** Model Stability Check

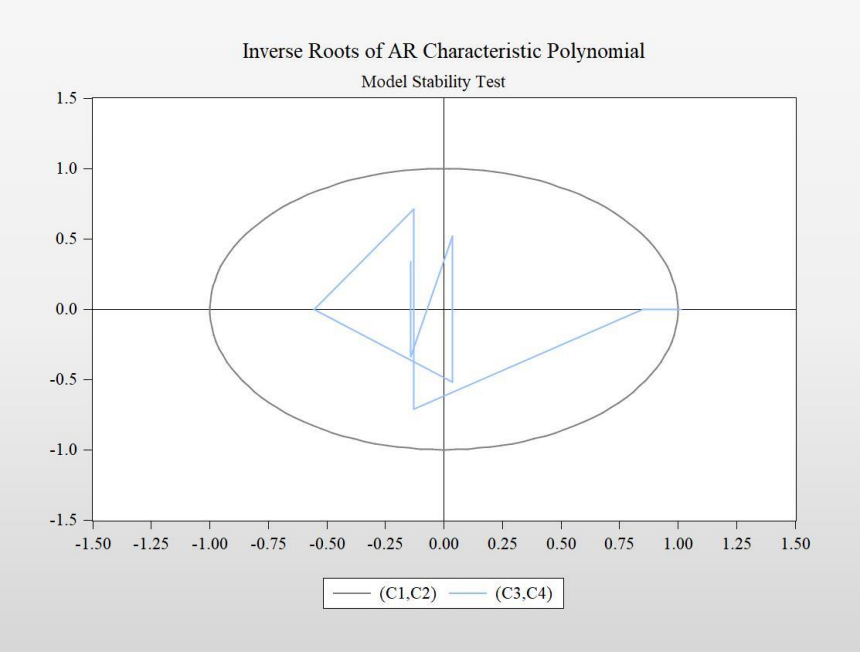


**Table 5.** Coefficient (t-statistic) [Prob.]

| Variables | DMS | DCPI | DEXR |
|---|---|---|---|
| DMS | 0.545546 (4.74723) | -6.48E-06 (-0.97057) | -0.001354 (-1.42713) |
| | [0.0000] | [0.3322] | [0.1542] |
| DCPI | -838.5821 (-0.799027) | -0.165729 (-2.71692) | 2.846929 (0.32856) |
| | [0.4246] | [0.0068] | [0.7426] |
| DEXR | 10.18878 (0.800539) | -0.000760 (-1.02793) | 0.073083 (0.69551) |
| | [0.4238] | [0.3045] | [0.4871] |
| Constant | 3137.323 (0.584090) | -0.083571 (-0.267693) | 67.4336 (1.520639) |
| | [0.5594] | [0.7890] | [0.1290] |
| | ***Model Statistics*** | | |
| R-squared | 0.937451 | 0.277624 | 0.158860 |
| F-Statistic | 283.0954 | 7.259396 | 3.567407 |
| Durbin-Watson Stat | 1.790130 | 2.176697 | 1.660266 |
| Normality Test | -1.392032 [0.0000] | 0.204726 [0.2621] | 2.763500 [0.0000] |

**Table 6.** PVAR Granger Causality Test

| Null Hypothesis: No Granger Causality | Chi squared ($Chi^2$) | P-Value | Conclusion |
|---|---|---|---|
| Dependent Variable: DMS | | | |
| DCPI | 2.509859 | 0.4735 | Strongly Supported |
| DEXR | 7.176246 | 0.0665 | Weakly Supported |
| ALL | 9.001957 | 0.1735 | Strongly Supported |
| Dependent Variable: DCPI | | | |
| DMS | 7.443952 | 0.0590 | Weakly Supported |
| DEXR | 8.518869 | 0.0364 | Strongly Unsupported |
| ALL | 14.07774 | 0.0288 | Strongly Unsupported |
| Dependent Variable: DEXR | | | |
| DMS | 2.868166 | 0.4124 | Strongly Supported |
| DCPI | 3.929401 | 0.2692 | Strongly Supported |
| ALL | 5.744475 | 0.4524 | Strongly Supported |

The impulse response functions (IRFs) represent how each endogenous variable responds to shocks in itself and other variables over time. In this study, authors estimate impulse responses of variables over a ten-year horizon. Based on Figure 2, it can be

seen that the shock from money supply on its own and two other variables (inflation and exchange rates) shows an increasing trend.

The shock from inflation rate increases money supply in second and third years followed by a decreasing trend. But, the response to itself shows a downward trend while it tends to depreciate the local currencies starting from second year. In addition, the shock from exchange rates given US dollar against local currencies of each ASEAN countries to itself, money supply, and inflation shows a continuous increasing trend.

**Fig. 2**. Impulse Responses Function

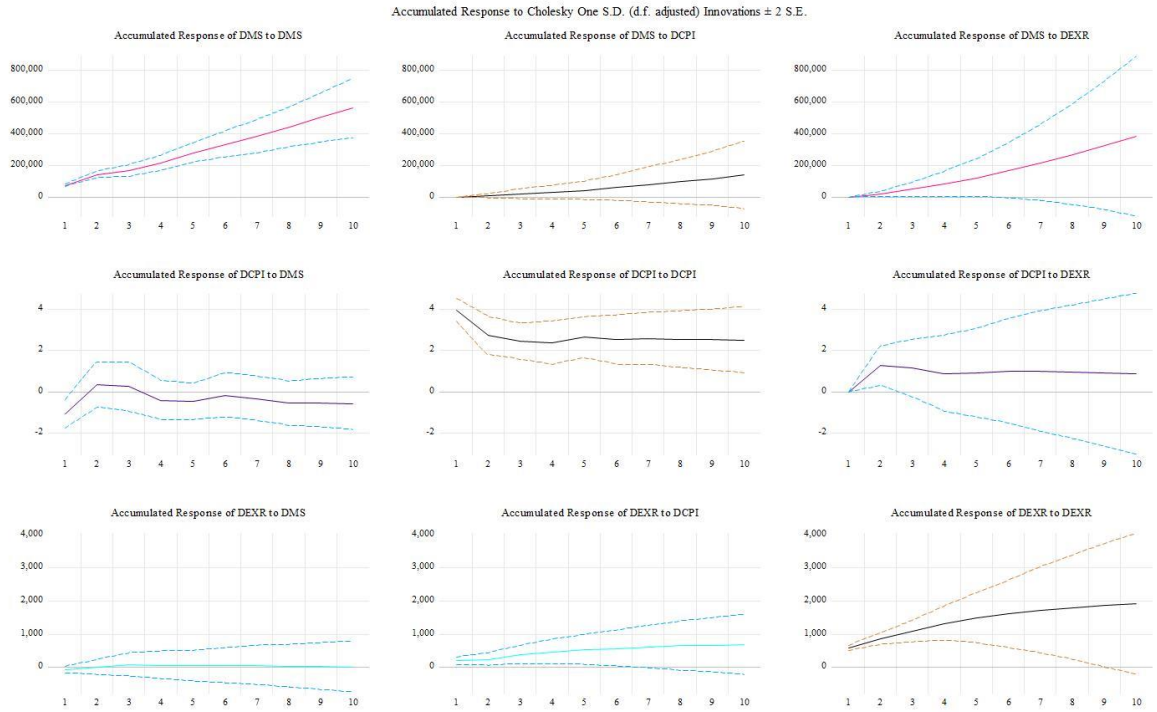


**Table 7.** Variance Decomposition

| Variable/Period | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| ***Variance Decomposition of DMS*** | | | | | | | | | | |
| DMS | 100 | 94.61 | 87.29 | 83.00 | 79.86 | 74.81 | 70.15 | 67.12 | 64.43 | 61.67 |
| DCPI | 0.00 | 0.66 | 1.90 | 2.02 | 2.17 | 2.97 | 3.57 | 3.80 | 4.10 | 4.48 |
| DEXR | 0.00 | 4.73 | 10.81 | 14.98 | 17.96 | 22.22 | 26.28 | 29.08 | 31.46 | 33.85 |
| ***Variance Decomposition of DCPI*** | | | | | | | | | | |
| DMS | 6.73 | 14.27 | 14.24 | 15.87 | 15.84 | 16.20 | 16.29 | 16.49 | 16.48 | 16.48 |
| DCPI | 93.27 | 78.33 | 78.32 | 76.56 | 76.61 | 76.26 | 76.18 | 76.00 | 75.99 | 75.98 |
| DEXR | 0.00 | 7.40 | 7.44 | 7.57 | 7.55 | 7.54 | 7.53 | 7.52 | 7.53 | 7.54 |
| ***Variance Decomposition of DEXR*** | | | | | | | | | | |
| DMS | 1.08 | 1.88 | 2.67 | 2.39 | 2.35 | 2.34 | 2.30 | 2.36 | 2.38 | 2.40 |
| DCPI | 10.50 | 9.08 | 11.57 | 11.57 | 11.53 | 11.44 | 11.53 | 11.55 | 11.55 | 11.54 |
| DEXR | 88.42 | 89.04 | 85.77 | 86.04 | 86.13 | 86.22 | 86.17 | 86.09 | 86.07 | 86.05 |

The variance decomposition is a method used to determine the proportion of the variance of a given variable that can be attributed to its own shocks and the shocks to other variables over time periods ranging from 1 to 10. Based on the variance decomposition analysis, money supply largely affects its own shocks. However, over 10 periods, its own shocks account for a decreasing proportion (from 100% to 61.67%), while shocks from "inflation" and "exchange rates" become more influential, explaining 4.48% and 33.85% respectively by the tenth period. Initially, inflation is primarily driven by its own historical trends or also called shocks that explains over 93% of its fluctuations. Over 10 periods, its own shocks account for a reduced share (from 93.27% to 75.98%), while shocks from "money supply" and "exchange rates" increase in significance, explaining 16.48% and 7.54% respectively by the tenth period. Likewise, exchange rates are heavily influenced by their own past values which accounts

for about 89% of their devaluation. Across 10 periods, its own shocks continue to dominate (86.05%), but contributions from "money supply" and "inflation" also grow, explaining 2.40% and 11.54% respectively.

# V. CONCLUSION

In this paper, the dynamic relationships among money supply, inflation and exchange rates in ASEAN region by using Vector Autoregressive (VAR) model with panel annual time series data covering from 2001 to 2022. Initially, the study verified that all variables – money supply (M), inflation (P), and exchange rates (E) – are stationary at first difference (I(1)), confirming the appropriateness of a Panel Vector Autoregressive (PVAR) modeling approach over a Vector Error Correction Model (VECM).
The bidirectional granger causality tests reveal that there is some evidence to support the presence of a causal relationship between changes in money supply (DMS) and inflation (DCPI) within the ASEAN countries studied. The test results show a chi-squared value of 7.443952 with a corresponding p-value of 0.0590. This indicates that while the evidence is not awesomely strong, there is a tendency towards a causal link from money supply to inflation. Plus, there is strong evidence to support the hypothesis that movements in exchange rates (DEXR) cause changes in inflation rates (DCPI) within the ASEAN countries studied. The chi-squared value for this relationship is 8.518869, with a low p-value of 0.0364. But the results do not provide empirical evidence for inflation causing changes in money supply or exchange rates within ASEAN region. These findings are moderately consistent with the theoretical frameworks of Quantity Theory of Money (QTM) and Purchasing Power Parity (PP). That could be due to a certain degree of stability in money policies within ASEAN region.
Although this study contributes to understanding real-world economic phenomena and relevance of theorical frameworks of monetary approach, there are some limitations to address for future research. First, the findings of the results in this study relied on yearly time series data which may overlook short-term dynamics that affect those relationships studied. Secondly, this study used ASEAN countries as a group which may produce heterogeneity across individual economies. Thirdly, there are some macroeconomic variables that definitely have high influence on the movements of money supply, inflation and exchange rates in ASEAN region. Therefore, future study should consider to use monthly or quarterly data while investigating specific country or region with additional macro variables.

## CONFLICTS OF INTEREST

Authors declare no potential completing conflict of interests regarding authorship and publication of this work.

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