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THE EFFECTIVENESS OF MACROECONOMIC POLICIES ON ECONOMIC GROWTH IN THE ASEAN: A PANEL VECTOR AUTOREGRESSIVE ANALYSIS

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ABSTRACT

The ASEAN region has seen rapid GDP growth with many national governments prioritizing economic development. Discerning dynamic macroeconomic effects of policy decisions provides actionable insights into how to best achieve development goals. In this study, a Panel Vector Autoregressive (PVAR) model is used to estimate inter-relationships between the following variables: real GDP growth, inflation, exchange rate, money supply, government expenditure, and the balance of trade. Empirical relationships between these factors are highlighted by the results which indicate that real GDP growth has a positive impact on its own lag and government spending, but a negative effect on the inflation rate, exchange rate, and money supply. Moving beyond theoretical correlations, a panel VAR-Granger causality test shows that the variables have causal relationship. Additionally, this study deploys Forecast Error Variance Decomposition (FEVD) and Impulse Response Function (IRF) analyses to reveal the relative importance of each variable as well as their dynamic impacts on growth. This study adds to the current paucity of research capable of capturing dynamic effects of these inter-related factors as prior research has largely relied on static modelling techniques that isolate inter-related causal effects of macroeconomic policy decisions.

KEYWORDS: Economic Growth, PVAR, Granger Causality Test, FEVD, IRF.

1. INTRODUCTION

The economic trajectory of emerging economies is significantly influenced by the interdependent role of macroeconomic policies, specifically fiscal and monetary policies. These policies are carefully crafted to have an impact on a nation's economic activity, with the ultimate goal of promoting long-term growth and stability. Fiscal policy, in particular, serves as a strategic tool for governments to manage their budgets with the intention of influencing economic conditions through taxation and public spending. It stands as a critical instrument for economic stabilization, working to mitigate business cycle fluctuations such as booms or recessions. The primary aim of fiscal policy is to establish a sustainable economic environment by appropriately adjusting government revenue and expenditure to either stimulate or temper the economy as necessary (Pasichnyi, 2020; Fitriaini, 2020).

Conversely, monetary policy concerns the mechanisms employed by a country's monetary authority to govern the supply of money, often with the objective of targeting an inflation rate or interest rate to ensure price stability and engender trust in the currency (Immanuel & Yayamo, 2020). Typical objectives of monetary policy may include promoting maximum employment, stabilizing prices, and moderating long-term interest rates, though these goals may vary depending on the specific economic aims of the country (Burke, 2021). Coordinating fiscal and monetary policy is of prime importance in promoting public welfare and fostering long run macroeconomic stability. This coordination requires favorable monetary conditions for budgetary borrowings while maintaining long run sustainable government finances to create an objective basis for effective monetary regulation (Chugunov et al., 2021).

The Association of Southeast Asian Nations (ASEAN) is a regional intergovernmental organization, which was established in 1967 by Indonesia, Malaysia, the Philippines, Singapore and Thailand and plays an important role to strengthen regionalism process as well as for economic integration and socio-political cooperation among its member state in Southeast Asia (Hwang, 2019). Currently composed of 10 member states and Timor-Leste, being an observing nation with membership ambitions, its primary goal is to foster regional cooperation and stability. According to the International Monetary Fund (IMF), the ASEAN region is projected to have a population of 685.15 million and a GDP (PPP) of 11.93 trillion US dollars in 2024.[1]

The efficiency of fiscal and monetary policies in driving growth has been well documented in ASEAN states, but there is room to examine this relationship under dynamic models, which capture variations in economic activity attributed to changes in other macroeconomic fundaments. The objective of this research is to analyze the effect of monetary and fiscal policy on economic growth in ASEAN region in a dynamic model, which integrates system equations, and panel data, i.e., with Panel Vector Autoregressive (PVAR) model. This study is intended to contribute towards a better understanding of the linkage between macroeconomic policies and economic growth in ASEAN countries.

By incorporating a system of equations and panel data, this study intends to contribute further information on the relationship between macroeconomic policies and economic growth in the ASEAN economies. PVAR model namely a five macroeconomic variables: real GDP, inflation, exchange rate, money supply and government expenditure will be employed. Besides, the trade balance variable of exogenous is also considered. The sample parameters will be estimated by a variant of Generalized Method of Moments (GMM), yielding consistent estimates to cope with the data. Moreover, Forecast Error Variance Decomposition (FEVD) and the Impulse Response Functions (IRF) will be used for examining the consequences of monetary and fiscal policies over countries and periods.

2. LITERATURE REVIEW

2.1. The Impact of Fiscal and Monetary Policies on Economic Growth in ASEAN

There are numerous studies on the impact of fiscal and monetary policies on growth in the ASEAN. An investigation by Panigrahi et al. (2020) covered the ASEAN-5 countries and analyzed a long-term relationship between macroeconomic variables including interest rates, unemployment, inflation rates, and economic growth. The results revealed the significance of capturing the dynamic relationships between interest rate, inflation rate and output growth; however, the reaction by policy towards unemployment was found to be insignificant (Panigrahi et al., 2020). (Chugunov et al., 2021) drew attention to institutional factors, namely, the

[1] International Monetary Fund. World Economic Outlook (October 2023).

structure of spending and fiscal system conditions which determine the impact of public expenditure on economic growth in emerging economies.

Regarding the ASEAN-5 economies, (Abdullah et al., 2019) discovered significant effects of fiscal policy instruments on economic growth but with differences reported among countries. (Astuti & Udjianto, 2020) found that the ASEAN-4 monetary policy decisions, particularly interest rate policy, had a inverse effect on economic growth showing that an expansionary monetary policy could stimulate economic growth. This result was also confirmed in a latter study that found although monetary policy had a short-run negative effect on growth, it exhibited a positive effect in the longer term (Astuti & Udjianto, 2022).

(Mahanty et al., 2023) observed that both fiscal and monetary policies are vital for economic growth in the Asia-Pacific region, but monetary policy that had more influential effects when compared to fiscal policy. Adding further nuance, (Ismail & Sek, 2020) deployed a threshold modelling technique to investigate the effects of fiscal policy *vis-a-vis* monetary policy on economic growth in ASEAN-5 countries demonstrating that monetary policy real interest rates decreased GDP growth and broad money led to a trade-off of growth and inflation. (Phullel, 2023) revealed that fiscal policy effects gross capital formation and public debt, displaying a significant positive impact on growth, while increasing tax revenue had a negative and significant effect in South Asian countries. Furthermore, (Johadi et al., 2019) ASEAN+3 research identified economic growth, infrastructure capital expenditure, economic openness, and tax ratio rates all have significant effects on public welfare.

2.2. How Econometric Models Evaluate the Effectiveness of Fiscal and Monetary Policies

An examination utilizing a Quantile Vector Autoregressive model revealed that the effectiveness of monetary policy varies according to levels of economic uncertainty, with policy being more effective during periods of low uncertainty (Balcilar et al., 2022). (Yang et al., 2022), utilizing a Structural Vector Autoregressive (SVAR) model focusing on China, suggested that both fiscal and monetary policies could effectively regulate economic growth while exogenous shocks played a significant role in predicting the variation of the economic growth rate.

A study conducted on Turkey utilizing the Autoregressive Distributed Lag (ARDL) co-integration technique by (Arestis et al., 2021) found that both fiscal and monetary policies are effective in promoting output growth, with monetary policy having a more substantial impact. (Tadesse & Melaku, 2019) deployed an ARDL model of empirical evidence in Ethiopia demonstrating that expansionary monetary and fiscal policies have strong positive impacts, but the impact from former becomes weaker in long run than the latter. In Jordan, ARDL results indicated significant, long-run positive impacts on real GDP from both broad money supply and overall government spending, with the policy mix showing that monetary was more effective than fiscal (Yousef & Fseifes, 2021). Additionally, the ARDL co-integration method was used to examine the impact of fiscal and monetary policies on output growth in Thailand, Malaysia, and Singapore. The empirical analysis was based on quarterly time-series observations from first quarter of 1980 to first quarter of 2017. The long-run dynamics indicated that GDP was determined by interest rate and government expenditures, while the two were influenced respectively by central bank through monetary policy and Ministry of Finance via fiscal policy. Three estimation methods, including the Canonical Co-integrating Regression (CCR), Dynamic Ordinary Least Square (DOLS), and Fully Modified Least Square (FMLS) were applied to check the robustness of the sample parameters. The consistent findings from all three methods indicated that government expenditure had a positive impact on economic growth in Thailand but a negative effect in Malaysia and Singapore. Furthermore, output growth in the three countries was negatively influenced by interest rate, with fiscal policy outperforming monetary policy in Thailand and vice versa in Malaysia and Singapore (Tan et al., 2020).

Using the Two Stage Least Squares (2SLS) model and the GMM model on a sample of 49 countries across the world, (Hang & Liên, 2022) demonstrated that monetary policy, trade openness, and control of corruption were necessary attributes for per capita income growth while the rural population ratio and tax revenue were found to hinder economic growth. (Canh, 2018) researched emerging economies based on GMM estimations showing that fiscal policy had a positive effect on accelerating growth rates while being mitigated by institutional quality and external debt. (Adegoriola, 2018) employed an ECM to Nigerian data finding a long-run equilibrium relationship between monetary and fiscal policy instruments adopted to stimulate economic growth; however, both money supply and government expenditure were positively correlated with economic growth. The relationship between financial inclusion and monetary policy in ASEAN was

analyzed utilizing the VECM, which showed that financial inclusion negatively affects inflation in the long and short term, thereby increasing the effectiveness of monetary policy in selected ASEAN nations (Komala & Widodo, 2022).

(Shapor & Gevogyan, 2021) researched VAR analysis models to explain the appropriateness of using a VAR model to analyze financial indicators data and its importance for developing economic policies for states. In Indonesia, the use of the SVAR model revealed that monetary policy transmission had a weak influence on inflation while significantly stimulating economic growth (Teapon & Mustafa, 2018). (Astuti & Udjianto, 2022) analysis, specific to the ASEAN-4 countries, investigated the impact of monetary policy and international trade on growth, employing panel estimation and a VAR model to consider implications on economic expansion and inflation providing evidence that short-run effects of monetary policy is negative for economic growth while positive in the long run. Testing the effectiveness of monetary policy in relation to financial development (Abdul Karim et al., 2021) studied ASEAN-3 countries utilizing an open economy SVAR model and an ARDL model with results implying that the effect of financial development on monetary policy effectiveness did not have the same behavior across these countries.

A non-linear panel threshold regression model was used to estimate the effectiveness of macroeconomic monetary and fiscal policies to promote economic growth in times of crisis, drawing upon data from 1995-2015 in ASEAN-5 countries, finding that broad money and the real interest rate affected inflation before, as well as after crisis control, which led to positive output growth, whereas public expenditure and monetary measures were discovered to be ineffective in driving economic growth during periods of crisis (Ismail & Sek, 2020). (Teker & Teker, 2018) evaluated causal relationships between macroeconomic variables on different levels of exchange rates using a threshold VAR model, and it was illustrated that monetary aggregates can be considered as policy variables for systemic stability at the level of exchange rate.

Finally, (Ruankham & Pongpruttikul, 2023) analyzed the extent to which macroeconomic policies affect income distribution in ASEAN economies with particular focus placed on monetary policy. The analysis incorporated a recursive PVAR model to explore the dynamic effects of monetary policy on wealth inequality for the period 2000 to 2021. The study indicated that lowering the policy interest rate, rising inflation, and driving for economic growth were strongly contributing to high wealth inequality level in the short run. Most importantly, the sole emphasis on monetary policy paid little heed to potential effects from other macro-financial conditions on the dynamics of wealth distribution. To address this limitation and enhance the comprehensiveness of future studies, consideration should be given to incorporating more robust and comprehensive datasets, as well as expanding the examination to encompass additional macroeconomic variables, such as fiscal policy.

The existing literature on the effects of fiscal and monetary policies on economic growth in ASEAN is quite limited. Most research focuses on either fiscal or monetary policy alone, or relatively little attention has been paid to a holistic assessment of the effectiveness of both policies. Moreover, permeating the previous literature is the use of static models that do not incorporate how variations in economic activity are measured as a result of other macroeconomic variables in the system. The goal of the current study is to take on these research lacunae using a PVAR model, a dynamic panel data model which uses a system-of-equations. With this method, the paper intends to measure how monetary and fiscal policies have affected growth in a more precise manner when applied to the ASEAN region.

3. METHODOLOGY

The traditional VAR approach is a commonly used system of equations that incorporates a vector of time series variables. In this approach, excepting a control variable, all variables are treated as endogenous. However, to expand on the interconnectedness between variables within a system, a panel-data technique known as the PVAR model was developed by Love and Zicchino (2006). The PVAR model is widely regarded as a powerful tool for macroeconomic research, capable of capturing intricate interconnectedness and dynamic effects of policy changes. It has been successfully utilized to examine the effects of fiscal and monetary policies on economic indicators like private expenditure (Kaharudin & Ab-Rahman, 2022), export flows (Aslan & Acikgoz, 2023), credit growth (Chadwick, 2018), and non-performing loans (Vuslat, 2020). The model's capacity to handle diversity and changing relationships makes it highly valuable for examining the effectiveness of macroeconomic policies in both advanced and developing economies.

This research utilizes the PVAR model to examine the effectiveness of fiscal and monetary policies on real economic growth in the ASEAN region. The general model of the PVAR is presented as follows:

$$\boldsymbol{y_{it}} = \boldsymbol{\Pi_0} + \boldsymbol{\Pi_1 y_{it-1}} + \boldsymbol{\theta tb_{it}} + \boldsymbol{f_i} + \boldsymbol{d_{c,t}} + \boldsymbol{\varepsilon_{it}} \quad (1)$$

$i \in \{1,2,\dots,N\}$ and $t \in \{1,2,\dots,T_i\}$

In this equation, the variable $\boldsymbol{y_{it}}$ is a vector of $(1 \times k)$ consisting of five endogenous variables: the growth rate of real gross domestic product (*gdp*), the inflation rate (*inf*), the foreign exchange rate (*fx*), the money supply (*m*), and government expenditure (*g*). The trade balance (*tb*) is an exogenous variable represented by a vector of $(1 \times k)$, and its corresponding vector of coefficients $\boldsymbol{\theta}$ of $(1 \times k)$ serves as the control variable.

Furthermore, $\boldsymbol{\Pi_0}$ and $\boldsymbol{\Pi_1}$, represent a vector of intercept parameters and a matrix of coefficients, respectively, which capture the lagged effect of the endogenous variable. A vector of $(1 \times k)$ of the idiosyncratic errors is denoted as $\boldsymbol{\varepsilon_{it}}$, which assumed that $\boldsymbol{E(\varepsilon_{it})} = 0, \boldsymbol{E(\varepsilon'_{it}\varepsilon_{it})} = \boldsymbol{\Omega}$, and $\boldsymbol{E(\varepsilon'_{it}\varepsilon_{is})} = \boldsymbol{0}$ for all $t > s$.

The ASEAN region comprises ten member countries and is denoted by *N*, while different time periods are denoted by *T*. The model incorporates individual heterogeneity denoted by $\boldsymbol{f_i}$, which represents the cross-sectional data. To address the correlation between the individual heterogeneity $\boldsymbol{f_i}$ and the regressors that arise from the lags of the regress and, the Helmert procedure or forward mean-differencing method is employed.

The estimation technique employed in this study is the GMM, which shares numerical similarities with the equation-by-equation 2SLS estimation methodology (Arellano & Bover, 1995). To accommodate for country-specific effects, time dummies in the form of $\boldsymbol{d_{c,t}}$ are included in the model.

This study employs panel data which is a combination between time series (*t*) and cross-sectional (*i*) data. The period of the study covers 2005 to 2022, accounting for 18 years of data. Therefore, the total number of observations is 10 times 18, yielding 180 observations, denoted as $(N \times T)$. The macroeconomic data utilized for each country is obtained from the Asian Development Bank's Key Indicators Data Library.

The optimal lag order for the PVAR model and determination of moment conditions are established using Hansen's (1982) *J* statistic, which assesses the validity of over-identifying restrictions. Following the establishment of the VAR model, the PVAR-Granger causality Wald test and stability test are conducted. Moreover, the FEVD and IRF are derived from the estimated GMM parameters. A Monte Carlo Simulation is employed to provide confidence intervals for the standard error of the IRF.

4. EMPIRICAL RESULTS

4.1. Panel Unit Root Testing and PVAR Model Specification

At the very first step, since this research applies panel data, to analyze the interrelationship among all endogenous variables in the PVAR system, it is necessary to conduct panel unit root test. This research employs the Augmented Dickey-Fuller tests, based on a Fisher-type unit-root methodology in order to conduct panel unit root test. The data consists of 180 observations, encompassing ten cross-sectional countries over a span of eighteen years. The null hypothesis posits that all panels contain unit roots, whereas the alternative hypothesis suggests that at least one panel is stationary.

Table 1: Summary Statistics.

Variable	Observation	Mean	Standard deviation	Minimum	Maximum
gdp (%)	180	4.8872	3.6726	-9.5183	14.5198
inf (%)	180	4.1067	4.3124	-1.2605	22.9700
fx	180	4,588	6,722	1.2496	23,271
m	180	807,450	2,239,022	1,203	14,200,000
g	180	90,246	208,973	834	1,101,338
tb	180	9,166	19,728	-43,533	60,747

Source: Authors' Calculations.

The unit root regression results yield four distinct test statistics: inverse Chi-square, inverse normal, inverse logit, and modified inverse Chi-square. Each test statistic provides both a statistical value and a corresponding p-value. Table 1 presents the summary statistics of all variables in this study.

As shown in Table 2, the unit root tests yield the following results: all panels containing the variables of gross domestic product (gdp), inflation rate (inf), foreign exchange (fx), and trade balance (tb) exhibit at least one stationary panel, given that the p-values for these variables are all less than 0.05. For the money supply variable (m), the null hypothesis of unit root test is rejected at a 5% significance level according to the inverse chi-square (p-value = 0.0352) and modified inverse Chi-square (p-value = 0.0212) statistics.

Table 2: Panel Unit Root Test.

Variable	**Test Statistics**			
	Inverse Chi-squared(20)	Inverse normal	Inverse logit t(54)	Modified inv. Chi-squared
gdp	32.0562**	-2.0464**	-1.9836**	1.9062**
inf	45.189***	-3.8817***	-3.7451***	3.9827***
fx	63.7496***	-4.1992***	-4.8443***	6.9174***
m	32.8319**	-1.5841*	-1.6386*	2.0289**
g	32.142**	-0.7121*	-0.9496*	2.357***
tb	36.6942**	-2.7428***	-2.6608***	2.6396***

Source: Authors' calculations.

Note: The statistical significance levels at 1%, 5%, and 10% are denoted by asterisks (,**,*).***

However, based on the inverse normal and inverse logit test statistics, the null hypothesis is rejected at a 10% significance level. Regarding the government expenditure variable (g), the unit root test indicates rejection of the null hypothesis under both inverse Chi-square and modified inverse chi-square statistics at 5% and 1% significance levels, respectively. However, the inverse normal and inverse logit test statistics yield insignificant results, with p-values greater than 0.05. In conclusion, it can be inferred that each panel data contains at least one stationary panel.

The subsequent stage involves the selection process of the PVAR model. The determination of the optimal lag order is crucial in both the specification and moment condition of the PVAR model. To establish the optimal lag length, various information criteria are employed, namely the Akaike information criterion (AIC), Bayesian information criterion (BIC), and Hannan–Quinn information criterion (HQIC) (Akaike 1969, Schwarz 1978; Rissanen 1978; Akaike 1977, Hannan & Quinn 1979). These criteria are adapted for the GMM using Adrew and Lu's (2001) technique known as the maximum likelihood-based model-selection criteria, which is derived from the J statistic of over-identifying restrictions developed by Hansen (1982). The information pertaining to the coefficient of determination (CD), J statistic and its corresponding p-value, as well as the information criteria including modified Bayesian information criterion (MBIC), modified Akaike information criterion (MAIC), and modified Hannan–Quinn information criterion (MQIC), are presented in Table 3. The maximum lag for the PVAR model is three, and the instrumental variables range from the first to the third lag of the endogenous variables. It is noteworthy that lower values of the information criteria indicate better quality of the model. As per the selection order criteria presented in Table 3, the PVAR specification with a lag of one yields the lowest values for MBIC, MAIC, and MQIC.

Table 3: Selection Order Criteria.

lag	CD	*J*	*J* p-value	MBIC	MAIC	MQIC
1	0.9999994	53.87791	0.3283383	-180.6895	-46.12209	-100.6941
2	0.9999997	22.44466	0.6099567	-94.83904	-27.55534	-54.84134
3	0.9807382	6.15E+20	0.000000	6.15E+20	6.15E+20	6.15E+20

Source: Authors' calculations.

4.2. Pvar Analysis of Macroeconomic Interrelationships

The estimation of the PVAR model is illustrated in Table 4. However, it is a precondition for the interpretation of estimated results that the over-identifying restrictions are not rejected at Hansen's J Chi-square test. The Hansen's J Chi2(50) statistic is 58.703946 and its associated p-value is 0.187. The null hypothesis of the test is not rejected because its p-value is larger than 0.05, which implies that the over-identifying restrictions are valid.

The PVAR system being studied consists of five endogenous (dependent) variables with five regression equations. The first equation explains the dynamics of the observed association between real GDP, its lag and lags of other endogenous variables in the system: inflation rate, exchange rate, money supply, government expenditure and exogenous variable trade balance.

Table 4: Panel Var Model Regression Results.

Variable	**Coefficient**					
	gdp(t-1)	*inf(t-1)*	*fx(t-1)*	*m(t-1)*	*g(t-1)*	*tb*
gdp(t)	0.1670 (3.61)***	-0.0836 (-2.25)**	-0.0006 (-3.25)***	-0.00000163 (-3.37)***	0.0000243 (4.34)***	-0.0000539 (-3.94)***
inf(t)	-0.3545 (-3.98)***	-0.4175 (-11.13)***	0.0014 (3.70)***	0.000006 (7.69)***	-0.000086 (-11.07)***	-0.000175 (-4.66)***
fx(t)	-77.7027 (-7.08)***	-52.5959 (-6.94)***	1.1705 (23.7)***	0.0006 (6.87)***	-0.0079 (-8.45)***	-0.0258 (-5.21)***
m(t)	59119.30 (6.80)***	4638.40 (1.22)*	-179.56 (-4.78)***	0.8089 (12.68)***	4.0006 (5.60)***	17.9133 (4.44)***
g(t)	1579.89 (7.12)***	1995.00 (7.76)***	-2.0603 (-2.07)**	-0.0072 (-1.86)*	1.0621 (33.30)***	0.4227 (3.96)***

Source: Authors' calculations.

Note: The statistical significance levels at 1%, 5%, and 10% are denoted by asterisks (***,**,*). The z-statistics are presented in parentheses. The instrumental variables employed in the analysis are l(1/3).(gdp inf fx m g) tb, where l(1/3) signifies the use of the first three lags of endogenous variables as instrumental variables.

The growth rate of real GDP in the current period is influenced significantly from the positive expansion realized during the previous period, at a significance level of 1%. On the other hand, if the inflation rate increases, it reduces economic grow statistically but insignificantly at 5% level. The negative relationship of exchange rate, growth rate of money supply, and growth rate of real GDP is significant at the 1% level. Specifically, this means that a depreciation of the exchange rate or an expansion of monetary policy by the central bank will repress the growth rate of domestic output. In contrast, those implementation of fiscal expansionary policy cause economic growth further more as it can be told from the positive and highly significant coefficient estimate of government expenditure at 1%. Moreover, the estimation results of GDP

equation suggest an inverse relationship between trade balance (an exogenous variable) and growth of GDP.

Each individual variable in the inflation rate equation exerts a highly significant influence on the rate of inflation. Real GDP growth, government expenditure, and trade balance all negatively affect inflation. A higher economic growth rate, expansionary fiscal policy, and higher trade balance contribute to a reduction in the inflation rate. Conversely, inflation is influenced by exchange rate depreciation and an increase in money supply. Moreover, the inflation rate in the current state is reduced by a higher inflation rate in the previous state, as evidenced by the lag inflation rate's negative coefficient (-0.4175).

All independent variables in the foreign exchange equation exhibit a statistically significant impact on the dependent variable. An increase in the growth rate of real GDP or inflation rate leads to exchange rate appreciation. The estimated parameters for money supply and government expenditure show positive and negative values, respectively, and are highly significant at a 1% level. An increase in money supply leads to exchange rate depreciation, whereas an increase in government expenditure leads to appreciation. The trade balance negatively affects foreign exchange at a significant level of 1%.

The coefficient of real GDP growth is found to be positive and statistically very significant at 1%. In addition, the government-spending variable is expected to be positive and statistically significant on money supply (due to the money supply equation). These results are consistent with the theory that the inflation is induced by a government intervention, in which money supply growth follows economic growth and government spending. The economic results of the money supply system are that, foreign exchange has significantly negative impact on money supply at a 1% significance level, which implies being depreciation in exchange rate reduces in money supply. On the other hand, increase in trade balance will mean more money supply. The impact of the rate of inflation on money supply, however, is regarded as being negligible.

Within the context of the government equation regression, the growth rate of real GDP, inflation rate, and trade balance all significantly determine government expenditure at a 1% level. On the other hand, foreign exchange and money supply exert a negative and significant influence on government expenditure at 5% and 10% levels, respectively.

On the information provided from the PVAR estimation, there are several interpretations about the performance of macroeconomic policies that have been conducted by the developing countries in ASEAN. First, the positive relationship between real GDP growth and its lag implies that current performance is influenced by past achievement in economic output. To ensure economic development in ASEAN countries, it is crucial to keep the growth path stable. Second, the negative relationship between inflation rate and growth means that inflation is bad for growth. This underscores the importance of executing sound monetary policies to tame inflation and spur growth. Third, the inverse relationship between international reserves and RGDP growth indicates that exchange rate depreciation or a loose monetary policy may undermine output growth, domestically. Therefore, the exchange rate must be stabilized and proper monetary policy pursued to stimulate economic growth. The significant positive relationship between public expenditure and economic development highlights the contribution of fiscal activities to spur economic growth. It implies that loosening of fiscal policy can lead to higher economic growth in the ASEAN countries. In addition, the negative relationship between the trade balance and GDP growth indicates that a higher value of the trade balance leads to lower economic growth. This indicates that pro-export policies should be part of the country's development strategy.

In relation to the inflation rate equation, the strong effect of several variables reveals that growth rate of GDP and government expenditure can have a negative impact on inflation as well as trade balance. Both an exchange rate devaluation and monetary expansion are also linked with greater inflation. These results suggest that a holistic policy and coordinated policy framework is necessary to control inflation in the context of ASEAN.

The sensitivity of Panel B to different levels foreign exchange in Equation (5) implies that economic growth and inflation will lead the rate of exchange to appreciate. Furthermore, money supply and spending by the government also affect exchange rates. The results imply a hybrid approach of monetary and fiscal policy is necessary to stabilize the foreign exchange rates in the ASEAN with mixed regime.

The money supply equation also underscores the positive relationship between economic growth and money supply, as well as the negative effect of foreign exchange on money supply. In addition, higher trade balance causes money supply to increase. These results stress the importance of adopting policies that promote growth in business

and maintain a stable money stock for securing a healthful monetary setting among ASEAN countries.

Finally, the regression of the government equation shows that government expenditure largely depends on real GDP growth, inflation rate and trade balance. On the contrary, exchange and money affect government expenditure negatively. Such results imply that the policies, which relating to stimulating economic growth and restraining inflation would be necessary to govern government expenditure within the ASEAN countries.

The substantially influencing power of different variables in the equation of inflation could be brought out that economic growth, government expenditure and trade balance have important roles in reducing inflation. Furthermore, depreciation of the exchange rate and expansion of money supply are accompanied by increased inflation. These results suggest that a multi-dimensional policy has to be implemented for the successful control of inflation across the ASEAN region.

Ever since in the equation of foreign exchange a majority of determinants exercised considerable impact, it is acceptable to expect that economic expansion and rates of inflation have their effect on real upward movement of the rate of exchange. In addition, monetary aggregate and government expenditure do affect the foreign exchange rate. The results indicate that a mixed approach, involving both monetary and fiscal policies, is essential for the stabilization of foreign exchange rates in the ASEAN countries.

The equation for money supply highlights the positive correlation between economic growth and money supply, as well as the negative impact of foreign exchange on money supply. Furthermore, an increase in trade balance leads to a boost in money supply. These findings emphasize the need for policies that support economic growth and facilitate a stable money supply to ensure a healthy financial environment within the ASEAN region.

Third, the government equation's regression analysis reveals real GDP growth, inflation rate and trade balance are the major factors influencing government expenditure. Conversely, exchange rate and money supply have a negative impact on government spending. These results indicate that the monetary policy to support economic expansion and inflation under control must be carried out to efficiently deal with government spending problems in ASEAN.

4.3. Panel Var-Granger Causality Analysis

Following the analysis and interpretation of the regression outcomes from the PVAR model, the next step involves conducting the Panel VAR-Granger causality Wald test. The test's null hypothesis posits that the excluded variable does not Granger-cause the equation variable. The rejection of the null hypothesis implies that the excluded variable Granger-causes the equation variable. The findings of the test are presented in Table 5, illustrating that real GDP growth is significantly influenced by inflation rate, foreign exchange, money supply, and government expenditure. All of these variables Granger-cause real GDP growth at the 1%, except for inflation rate which remains significant at the 5% level. Furthermore, all the variables are observed to Granger-cause real GDP growth at 1% significant level.

All variables and all entries of the PVAR system Granger-cause inflation at 1% level. A similar pattern applies to foreign exchange, whereby both single and all factors significantly Granger caused the exchange rate at 1% very high significant level. All elements of the system, real GDP, foreign exchange reserves, government expenditure and money supply are seen to Granger cause the money supply at a 1% level of significance. However, no Granger-causal relationship is observed between the inflation rate and money supply.

Table 5: Panel VAR-Granger Causality Wald Test.

Equation\ Excluded	**Chi-square**					**df**				
	inf	*fx*	*m*	*g*	ALL	*inf*	*fx*	*m*	*g*	ALL
gdp	5.061**	10.547***	11.381***	18.877***	43.307***	1	1	1	1	3
inf	15.856***	13.673***	59.088***	122.653***	138.978***	1	1	1	1	3
fx	50.136***	48.158***	47.152***	71.47***	152.759***	1	1	1	1	3
m	46.268***	1.499*	22.855***	31.364***	72.685***	1	1	1	1	4
g	50.639***	60.173***	4.283**	3.457*	155.449***	1	1	1	1	3

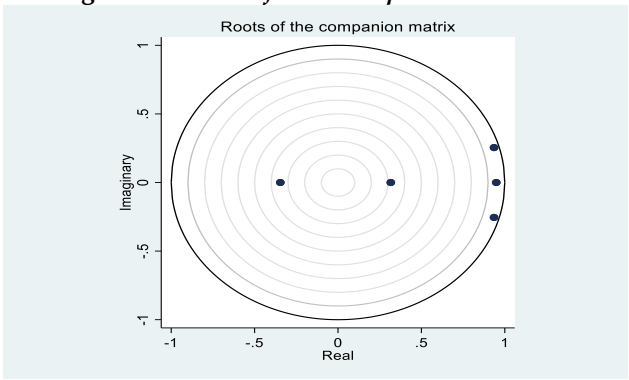
Source: Authors' calculations.

Note: The statistical significance levels at 1%, 5%, and 10% are denoted by asterisks (,**,*).***

It is worth noting that real GDP, inflation rate, and all variables in the PVAR system significantly influence government expenditure at a 1% level. Moreover, the null hypothesis stating that foreign exchange does not Granger-cause government expenditure is rejected at a 5% level of significance. Furthermore, while money supply does exhibit Granger-causality on government expenditure, its significance is weak. It may be inferred based on the results of panel VAR-Granger causality Wald test,

that macroeconomic policies have been successful in affecting the major macroeconomic indicators of real GDP growth, inflation rate, exchange rates, money supply and government expenditure. Results of Granger causality tests show that all these variables have trend leading effect on real GDP growth at different degrees of significance. This means that the changes in inflation, exchange rate, money aggregate and government spending cause variations in real GDP growth. As a whole, these results present strong evidence that macroeconomic policies are effective in promoting economic growth across the ASEAN member states. Moreover, the study also reveals existence of significant interrelations between and among variables operating in the macroeconomic system. All the explanatory variables (both individually and jointly) exhibit Granger causality on inflation rate and exchange rate at extremely significant levels. This demonstrates that inflation and exchange rate deviations are endogenous in nature, which indicates a large dependence among these macroeconomic variables. Moreover, the real GDP growth, inflation rate and all explanatory variables together have positive relationship with government expenditure. This implies that government spending is responsive to variations in economic activity and inflation, which emphasizes the effectiveness of macroeconomic policy of fiscal discipline. It means that public expenditure reacts to the fluctuations of economic activities and prices and is evidence for effectiveness in macroeconomic policy over fiscal behavior. However, it is important to note that Granger causality of money supply on government expenditure does not completely explain the dynamics of government spending. This suggests that monetary policy will be ineffective in influencing government through its expenditures within the ASEAN countries.

Figure 1: Roots Of The Companion Matrix.



Source: Authors' Calculations.

4.4. Panel Var Forecast Error Variance Decomposition Analysis

Prior to analyzing the forecast error variance decomposition and impulse response function of PVAR model, it is necessary to conduct a stability test of proposed PVAR model. The roots of the companion matrix are shown in Figure 1, from which it can be seen that PVAR model is stable since all the eigenvalues of the system are inside unit circle.

According to the analysis of variance decomposition of forecast errors in Table 6, around these different horizons, it is found that the extent and pattern of impact of ASEAN macroeconomic policies on real GDP growth change over time. The findings show the determination of changes in real GDP, during the early period is dominated by own variation, which suggests a strong degree of endogenous properties driving economic growth. In contrast, government spending is the most important determinant of changes in real GDP from period 2 to period 3. This indicates that the fiscal policy of the other ASEAN members appeared to have been successful in promoting growth during this period.

Moreover, the rank ordering of drivers remains same from fourth to sixth period as rate of inflation, government consumption and money supply and exchange rate are dominating the real GDP growth. It should be noted, however, that these two factors diverge during this phase, which show much greater uncertainty and volatility of the economy. Especially in period 7, the influence of exchange rate volatility on real GDP is almost two times more important than that in period 6 as a factor for economic growth. This raises concerns of how the rest of the world, including global trade and exchange rate volatility, is influencing ASEAN's economy.

Table 6: Forecast Error Variance Decomposition.

Response	**Forecast**	**Impulse variable**				
variable	**horizon**	*gdp*	*inf*	*fx*	*m*	*g*
gdp						

	1	1.00000	0.00000	0.00000	0.00000	0.00000
	2	0.97751	0.00735	0.00162	0.00316	0.01035
	3	0.92788	0.02799	0.00230	0.01100	0.03082
	4	0.89815	0.04185	0.00234	0.01715	0.04052
	5	0.87453	0.05738	0.00468	0.02098	0.04243
	6	0.85902	0.06643	0.01133	0.02233	0.04088
	7	0.84467	0.07036	0.02237	0.02204	0.04056
	8	0.82827	0.06998	0.03631	0.02115	0.04429
	9	0.80845	0.06748	0.05079	0.02061	0.05266
	10	0.78596	0.06492	0.06360	0.02106	0.06446
inf						
	1	0.00385	0.99615	0.00000	0.00000	0.00000
	2	0.05337	0.85459	0.00104	0.02103	0.06997
	3	0.07202	0.80613	0.00201	0.03120	0.08865
	4	0.08770	0.77640	0.00850	0.03689	0.09052
	5	0.12037	0.73463	0.02409	0.03724	0.08366
	6	0.14877	0.69024	0.04694	0.03500	0.07905
	7	0.17080	0.64166	0.07309	0.03238	0.08207
	8	0.18260	0.59547	0.09777	0.03116	0.09300
	9	0.18519	0.55611	0.11742	0.03218	0.10910
	10	0.18118	0.52650	0.13036	0.03547	0.12649
fx						
	1	0.04636	0.35331	0.60033	0.00000	0.00000
	2	0.24666	0.16091	0.56128	0.00791	0.02323
	3	0.26677	0.10587	0.55231	0.02152	0.05353
	4	0.25234	0.08096	0.53350	0.04234	0.09086
	5	0.22123	0.07926	0.50918	0.06720	0.12313
	6	0.19036	0.09556	0.47616	0.09341	0.14451
	7	0.16926	0.12240	0.43813	0.11784	0.15238
	8	0.16297	0.15281	0.39895	0.13727	0.14800
	9	0.17230	0.17918	0.36327	0.14897	0.13628
	10	0.19345	0.19549	0.33495	0.15160	0.12451
m						
	1	0.02869	0.50514	0.17258	0.29359	0.00000
	2	0.27582	0.35688	0.18423	0.17001	0.01307
	3	0.36170	0.26862	0.21422	0.10702	0.04844
	4	0.38638	0.19747	0.24489	0.07085	0.10040
	5	0.37711	0.14627	0.26779	0.05051	0.15832
	6	0.35146	0.11265	0.28062	0.04073	0.21454
	7	0.31944	0.09423	0.28409	0.03814	0.26409
	8	0.28742	0.08812	0.28004	0.04018	0.30424
	9	0.25945	0.09130	0.27069	0.04489	0.33367
	10	0.23811	0.10078	0.25841	0.05066	0.35204
g						
	1	0.00559	0.09788	0.05464	0.02572	0.81617
	2	0.06665	0.06436	0.05244	0.01645	0.80010
	3	0.06750	0.04566	0.05329	0.01493	0.81861
	4	0.07026	0.03835	0.05295	0.01339	0.82504
	5	0.06968	0.03387	0.05234	0.01240	0.83171
	6	0.06857	0.03156	0.05136	0.01165	0.83686
	7	0.06700	0.03018	0.05019	0.01112	0.84152
	8	0.06536	0.02940	0.04889	0.01077	0.84558
	9	0.06380	0.02890	0.04758	0.01057	0.84914
	10	0.06242	0.02854	0.04631	0.01052	0.85221

Source: Authors' calculations.

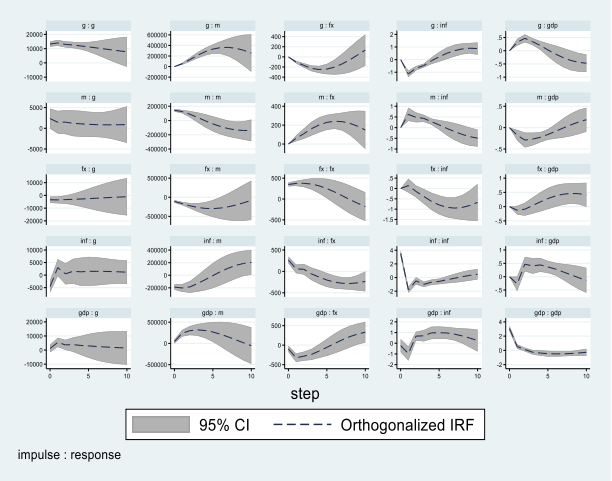
From period 7 to period 10, order of factor drivers of the variation in real GDP changes with rate of inflation; government expenditure; foreign exchange reserve and money supply declining in importance. It is an indication that the weight of macroeconomic drivers of growth may differ over time. Last, but not least, the rising long-run role of foreign exchange as a source of real GDP variation, its contribution has increased from 2.24% in period 6 to 6.36% in period 7, underscores the importance of keeping an eye on

and stabilizing exchange rates in order to sustain economic growth over time for ASEAN members.

4.5. Impulse Response Function Analysis Of Macroeconomic Shocks

The dynamic effects of the shocks on the economic growth rate are analyzed using impulse response functions over a ten-period forecasting period. Figure 2 shows impulse response functions that describe how a one-standard-deviation shock to each variable affects the level of real output growth rate over time. The first row of Figure 2 offers evidence that a government spending (g) shock indeed induces an increase in its own variable. Nevertheless, money supply and exchange rate are negatively impacted by shocks in the government expenditure.

Figure 2: Impulse Response Function.



Source: Authors' Calculations.

In contrast, positive shocks in GDP and inflation cause the government spending to rise. The positive relationship between growth and government expenditure shocks indicate that the certain increases in public expenditure can increase economic activity. Thus, policy makers need to make focused investments in infrastructure, education and health in order to drive GDP.

Second row of Figure 2 indicates a shock to money supply (m) leads to the immediate positive response of m. In contrast, all the other variables such as GDP, government expenditure, foreign exchange rate and inflation have a negative influence on money supply. The positive short–run response of money supply to its own shock means that accommodative monetary policy, as represented by decrease in interest rate or quantitative easing, can have a beneficial impact on the growth process. However, policy makers also need to be on the lookout for inflation pressures.

The third row of Figure 2 shows that the response is negative when there is an exchange rate (fx) adverse shock. Shocks to government spending and inflation negatively affect the exchange rate. Nevertheless, if there is positive shock in GDP and money supply then appreciates the exchange rate. This negative reaction of the exchange rate to its shock underscores the critical role of maintaining stability in the exchange rate. Therefore, central banks need to act when there is a risk of overshooting.

Moreover, going down the fourth row of Figure 2, a shock to inflation triggers an expansion (contraction) in its section. GDP and government spending shocks have a positive effect on inflation, while money supply and the exchange rate influence negatively on inflation. The inflation targeting framework recommends a positive response of inflation to its own shock. In this respect, policymakers should set moderate inflation rates for promoting economic growth and avoiding hyperinflation.

Finally, the fifth row of Figure 2 highlights that whenever there is a shock on GDP itself, the short-term reaction of the growth rate of output is no negative but asymptotically approaches zero in future periods. This observation suggests the increasing GDP will play a positive role in promoting economic growth and reducing GDP will be negative effect. Moreover, shocks (arising from other variables) namely government spending, money supply, foreign exchange rate and inflation affect GDP. More precisely, a positive government spending shock increases GDP, and so does a positive inflation shock. On the contrary, money supply and exchange rate shocks significantly lower GDP. The positive impact of both government spending shocks and inflation shocks on GDP emphasizes the importance of structural reform. Better governance, less red tape and an improved business environment can help to improve sectoral economic performance.

5. CONCLUSION

The empirical results of this study offer useful implications for the performance of macroeconomic policies in ASEAN. A panel VAR approach is adopted to analyze the inter-dynamics among certain key variables such as real GDP growth, inflation rate, exchange rate, money supply, government expenditure and trade balance.

The results of the unit root tests indicate that some stationary panels are found in at least one unit or panel dataset, supporting the stationarity of those variables included in the analysis. According to a variety of information criteria the best fit for the

PVAR model is realized at lag order one.

The findings obtained from PVAR analysis demonstrate interplay among the variables studied. In particular, the study shows that real GDP growth is positively associated with its own lag as well as negatively associated with the inflation rate, exchange rate and money supply. On the other hand, government expenditure has a positive and statistically significant effect on the growth rate of real GDP. While the inflation rate of a country is negatively affected by many factors with real GDP growth, government expenditure and trade balance as significant determinants. The exchange rate is also discovered to be determined by real GDP growth, inflation rate, money supply and government spending. Moreover, money supply also has an impact on real GDP growth in the form of exchange rate and trade balance. Real GDP growth, inflation rate, trade balance, exchange rate and money supply also contribute to government spending. These results underscore the importance of achieving a stable and continuous increase in GDP growth, maintaining low inflation rates, managing exchange rates, selecting suitable fiscal and monetary policies by dint of trade balance as the main elements for promoting economic development in ASEAN countries.

The Panel VAR-Granger causality test results reveal the presence of causal relationships among the variables. Concurrently, real GDP growth is also positively and significantly influenced by inflation rate, exchange rate, money supply and government expenditure. Likewise, all regressors are found by the Granger test to cause real GDP growth. All variables significantly affect the inflation rate, while the foreign exchange rate both influences it directly and is influenced by it, in addition to causing significant impacts on money supply and government expenditure. Furthermore, real GDP growth, inflation rate and trade balance have significant impacts on government expenditure whereas money supply has a strong impact on government expenditure. These findings also provide evidence on the potency of ASEAN macroeconomic policies in determining macroeconomic variables and stimulating economic growth in the region.

The FEVD shows the contribution of each variable in explaining real GDP growth over time. The results imply that, in the short term, government spending is the most significant factor of divergences in real GDP growth, followed by inflation rate, exchange rate and money supply. In terms of changes in real exports, to reflect an exchange rate impact; however, it gets rather large from the formulas with variations being much higher in the later periods. The empirical findings of this study not only indicate the influence of ASEAN macroeconomic policy on real GDP growth is effective, but also indicate the different weight attached to each factor by each era. This provides a clear rationale for policymakers to pursue policies that are adaptive and flexible to changing economic environments.

Analysis of the impulse response function also visually displays the dynamic effects of shocks to the variables on economic growth. There are immediate effects of shocks to government spending, money supply and inflation rate on their corresponding variables whereas the shocks on real GDP growth and foreign exchange rate have lagged effects. The reactions of the variables to shocks are indicative of the interrelations and feedback between system components. Since the results are region-specific, policymakers need to work together on regional projects. Complementary trade, investment, and financial stability policies can positively impact growth. Policymakers should also be aware of potential negative externalities. For example, money supply and exchange rate shocks could be harmful for other variables. Therefore, wise risk management is necessary for prevention of potential adverse effects. These findings can provide guidance to ASEAN policymakers, yet the effectiveness of coordination could be hampered by the structure of the ASEAN-ECO Framework of Cooperation. When compared to a more centralized institution, such as the European Central Bank, the alignment of national central banks in the ASEAN could prove to be more difficult given the relatively lower level of integration found in the bloc. Additional domestic fiscal and budgetary rules could also prevent ASEAN member states from coordinating government spending to address an exogenous shock leading to potential beggar thy neighbor effects.

Despite the important information revealed in the present study, some limitations should be acknowledged. First, it uses data which is panel in nature from member states of ASEAN and hence the findings may not be extrapolated to other regions or economies. Secondly, the study deals with a nuanced subset of variables and ignores overlaid complexity from macroeconomic dynamics. Third, there can be other factors and parameters beyond what is considered here that may affect the effectiveness of macroeconomic policies. Finally, the analysis presumes a linearity and stability of associations between the variables through time that could possibly not operate as intended in real-life settings.

Subsequent research in this area may overcome

these limitations and consider other aspects of macroeconomic policy. It would be interesting if more variables were added and experimentally checked with results for policy options concerning specific economic sectors examined. Moreover, comparisons across different regions or countries would offer a wider view of the effectiveness of macroeconomic policies using advanced econometric methods to address endogeneity and heterogeneity in the most rigorous way.

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