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**Panel VECM Analysis of Monetary Variables and Economic
Growth in ASEAN Upper Middle Income Countries**

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Abstract: This study examines the relationship between monetary variables and economic growth in upper-middle-income ASEAN countries (Indonesia, Malaysia, Thailand) from 2000 to 2024 using a Panel VECM. Secondary data were sourced from the World Bank, IMF, and official national publications, covering economic growth, inflation, interest rates, and money supply (M2). Cointegration tests confirm a long-run relationship among variables ($p < 0.05$). Long-run VECM estimates indicate that money supply and interest rates negatively affect economic growth, whereas inflation exerts a positive effect. In the short run, money supply and interest rates maintain negative impacts, while inflation shows a positive yet fluctuating influence. Impulse Response Function analysis reveals an unstable response from inflation, while Variance Decomposition indicates that growth is driven mainly by money supply and inflation. Overall, monetary instruments play a vital role, though their effectiveness varies across variables.

Keywords: Economic Growth, Monetary Variables, Panel VECM, ASEAN Upper-Middle-Income Countries

Introduction

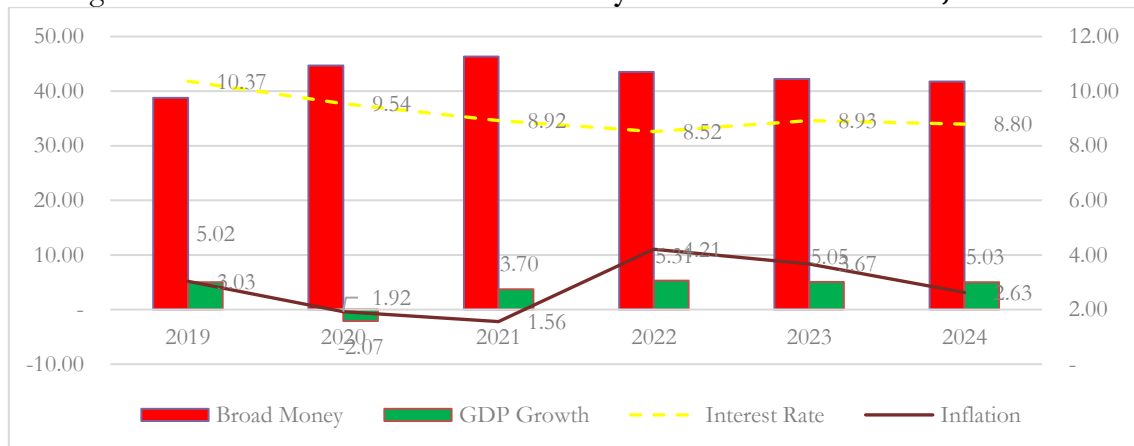
Economic growth is the primary objective of economic development in every country, as it reflects improvements in societal welfare and the nation's productive capacity. (Kravec and Jurevičienė 2022). The determinants of growth, however, are not confined to the real sector such as capital accumulation, labor, and technological progress but are also significantly shaped by monetary conditions (Gul, Mughal, and Rahim 2012). Monetary variables such as inflation, interest rates, money supply, exchange rates, and domestic credit play a crucial role in determining the direction and stability of economic growth. (Aruoba and Drechsel 2024; Bajrami et al. 2025). Therefore, analyzing the linkage between monetary variables and

economic growth becomes essential, particularly in developing countries that are vulnerable to external shocks.

In the context of global economic classification, the World Bank categorizes countries based on Gross National Income (GNI) per capita into four groups: low income, lower-middle income, upper-middle income, and high income (World Bank, 2025). For the fiscal year 2025/2026, the upper-middle-income category is defined as having a GNI per capita ranging from US\$4,516 to US\$13,935 (World Bank, 2024). Within the ASEAN region, several countries fall into this category, namely Indonesia, Malaysia, and Thailand. In 2023, Indonesia recorded a GNI per capita of approximately US\$4,870, Malaysia around US\$11,970, while Thailand has been classified as an upper-middle-income country since 2011 (World Bank, 2025). These three countries share similarities in terms of development stage, increasingly diversified economic structures, and high engagement in international trade. However, each country faces distinct challenges in managing monetary stability and economic growth (Jetin 2019).

Meanwhile, neighboring countries such as Vietnam and the Philippines remain in the lower-middle-income category, with GNI per capita of approximately US\$4,180 and US\$4,230 in 2023, respectively, although both show a consistent upward trend and have the potential to move into the upper-middle-income category in the near future. This underscores that Indonesia, Malaysia, and Thailand hold a strategic position as relatively more advanced countries compared to most other ASEAN nations, yet they still face structural challenges in maintaining monetary stability and accelerating economic growth toward high-income status (Jetin 2019).

Figure 1. Economic Growth and Monetary Variables in Indonesia, 2019-2024



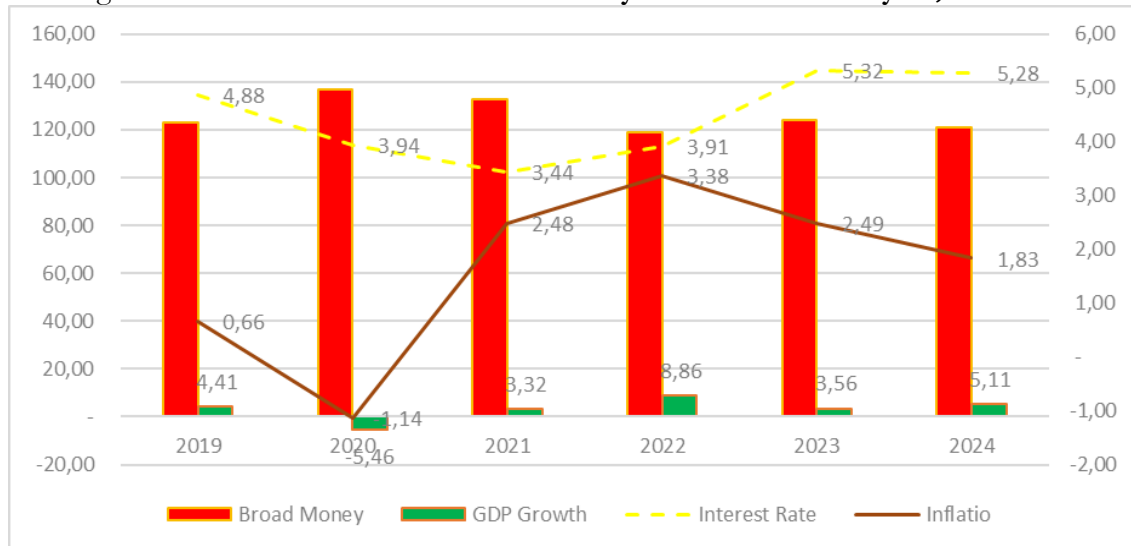
Source: World Bank, 2024

Figure 1 illustrates the development of monetary variables and economic growth in Indonesia for the period 2019–2024. Economic growth (GDP Growth) expanded by 5.02 percent in 2019 but contracted by –2.07 percent in 2020 due to the COVID-19 pandemic. Subsequently, the economy gradually recovered, reaching a range of 3–5 percent during 2021–2024. Broad Money (M2) remained relatively stable at around 35–40 percent of GDP, reflecting a sufficiently high level of liquidity in the financial market. Inflation, on the other hand, trended downward, from 3.03 percent in 2019 to 2.63 percent in 2024, thus remaining low and stable. Meanwhile, lending interest rates exhibited a declining trend from 10.37

percent in 2019 to 8.80 percent in 2024, indicating an accommodative monetary policy aimed at supporting post-pandemic recovery.

Although, in theory, an increase in money supply and a reduction in interest rates should stimulate higher economic growth (Contents 2013), in reality, Indonesia's growth only recovered to a moderate level of around 5 percent, failing to surpass pre-crisis conditions (World Bank, 2025). Moreover, the relatively low inflation contrasts with the Phillips curve theory, which suggests that low inflation is usually associated with weak growth (Jawo, Jebou, and Bayo 2023). These observations indicate a discrepancy between monetary economic theory and the empirical conditions in Indonesia.

Figure 2. Economic Growth and Monetary Variables in Malaysia, 2019-2024



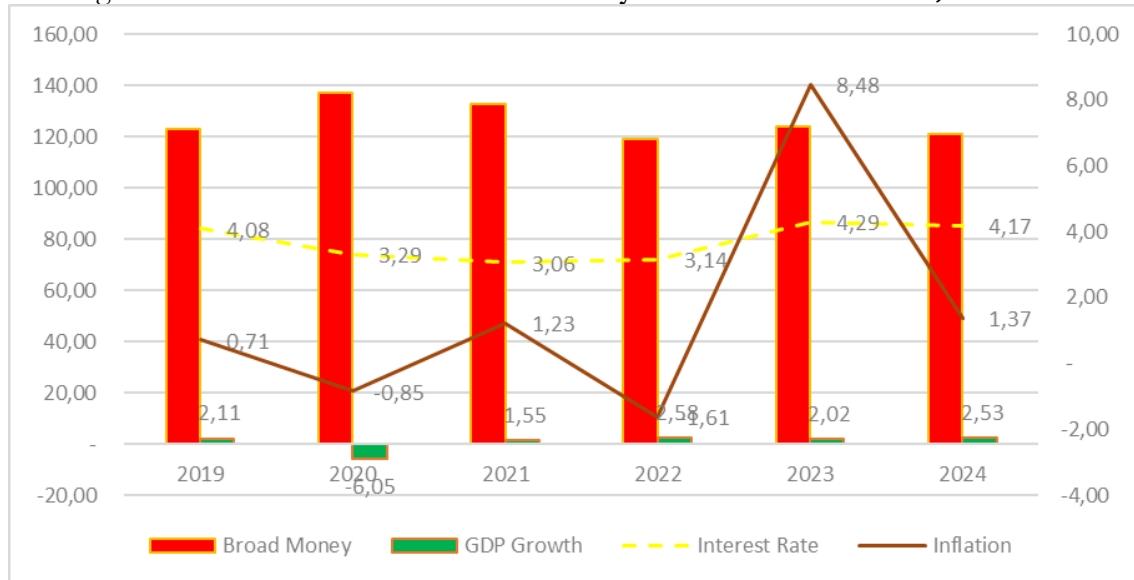
Source: World Bank, 2024

Figure 2 illustrates the economic growth (GDP Growth) of Malaysia. In 2019, growth remained relatively stable at 4.41 percent, but contracted sharply by -5.46 percent in 2020 due to the COVID-19 pandemic. The economy began to recover in 2021 with positive growth, although relatively low and fluctuating between 2.5 and 5 percent until 2024. Broad Money (M2) remained at a high level, around 120–140 percent of GDP, indicating Malaysia's relatively strong financial depth. Inflation fluctuated, falling from 0.66 percent in 2019 to -1.14 percent in 2020, then rising significantly to 3.91 percent in 2022, before declining again to 1.83 percent in 2024. Meanwhile, interest rates decreased from 4.88 percent in 2019 to 3.44 percent in 2021, before rising again to around 5.28 percent in 2024. Despite the high money supply ratio in Malaysia, economic growth remained low and even negative at times. Moreover, the reduction in interest rates during 2020–2021 did not trigger a surge in growth, but coincided with a sharp economic contraction. Inflation, which was negative in 2020, also contradicted the theory that deflation is often followed by prolonged stagnation (Kurniasih 2019; Ngah et al. 2023), as Malaysia was able to return to positive growth in the subsequent years.

Figure 3 below shows Thailand's economic growth (GDP Growth). In 2019, growth reached 2.11 percent but plunged sharply to -6.05 percent in 2020 due to the pandemic. The subsequent recovery was slow and fluctuating, even remaining negative in 2021 (-0.85 percent), before returning to low positive levels during 2022–2024. Broad Money (M2)

remained relatively high and stable, around 120–140 percent of GDP, indicating substantial financial liquidity. Inflation fluctuated sharply, from 0.71 percent in 2019 to –0.85 percent in 2020, then surged dramatically to 8.48 percent in 2023 before declining to 2.53 percent in 2024. Meanwhile, interest rates remained relatively stable at around 3–4 percent throughout the period, showing no significant fluctuations.

Figure 3. **Economic Growth and Monetary Variables in Thailand, 2019-2024**



Source: World Bank, 2024

Although a high level of Broad Money (money supply) is expected to support economic growth (Doan Van 2020), the figure shows that despite a relatively large money supply ratio, Thailand's growth remained highly volatile and was even negative in some years. Furthermore, despite relatively stable interest rates, inflation surged sharply in 2023, contradicting the theory that interest rate stability helps maintain price stability. Moreover, the sharp rebound in inflation following deflation in 2020 does not align with the observed pattern of economic growth.

Based on the data from Indonesia, Malaysia, and Thailand presented above, a pattern emerges that does not fully align with classical monetary theory. In Indonesia, despite a relatively high and stable money supply and declining interest rates, economic growth recovered only moderately, failing to surpass pre-crisis levels, while inflation remained low even with positive growth. In Malaysia, a high Broad Money ratio was not accompanied by strong economic growth and even experienced contraction, while the reduction in interest rates during 2020–2021 did not succeed in accelerating recovery. In Thailand, although money supply liquidity was substantial and interest rates remained stable, economic growth remained volatile and inflation surged sharply in 2023 following deflation. These three cases indicate that monetary instruments whether money supply, interest rates, or inflation do not always operate according to theoretical predictions in influencing economic growth. This underscores the need for a more in-depth and comparative analysis of upper-middle-income ASEAN countries to better understand the actual patterns of these relationships.

Several previous studies have primarily focused on the relationship between monetary variables and economic growth in the context of single countries, such as the impact of

interest rates on growth in Indonesia (Susanto 2018), or the influence of inflation and interest rates on growth in Malaysia (Nghah et al. 2023). Although these studies are valuable, their single-country focus provides only a partial understanding of the effectiveness of monetary instruments.

Cross-country studies in the ASEAN region have indeed begun to emerge (Bui and Doan (2024); Fitriani, Astina, and Safarida (2025); Purnomo and Wibowo (2024)), yet most are still limited to conventional methods or static analyses, and therefore do not fully capture short- and long-term dynamics simultaneously. In the context of upper-middle-income countries such as Indonesia, Malaysia, and Thailand, employing a more comprehensive approach, such as Panel VAR/VECM, is crucial to examine the linkage between monetary variables and economic growth within a dynamic framework. Hence, this research is designed to investigate the short- and long-run relationships between monetary determinants and macroeconomic stability, proxied by real economic growth.

Therefore, the novelty and specific contribution of this study are focusing explicitly on the group of Upper-Middle-Income ASEAN countries (Indonesia, Malaysia, and Thailand) to control for structural heterogeneity in financial deepening and monetary transmission efficiency, applying a Panel VECM framework to address existing literature gaps, thereby providing deeper insights into how money supply, interest rates, and inflation interact with economic growth in both the short and long run across Upper-Middle-Income ASEAN economies, and utilizing Impulse Response Functions (IRF) and Forecast Error Variance Decomposition (FEVD) to map the duration of output responses and quantify the relative contribution of monetary shocks to real GDP fluctuations.

Literature Review

Keynesian Monetary Theory and Monetarism

The hypothesis development in this study is anchored in the theoretical synthesis of two major paradigms in monetary macroeconomics: Keynesian Monetary Theory and the Modern Quantity Theory of Money (Monetarism). These theoretical frameworks provide a fundamental basis for explaining the transmission channels through which monetary instruments such as Money Supply (M2), Interest Rates, Exchange Rates, and Inflation interact with aggregate output or real Gross Domestic Product (GDP).

Keynesian Monetary Theory asserts the principle of short-run money non-neutrality. This principle posits that shifts in monetary variables exert a direct impact not only on the general price level but also on real economic variables and economic growth. Keynesian economics correlates monetary instruments with aggregate output through relative price adjustments and the cost of capital mechanism.

Conversely, the Monetarist school, pioneered by Milton Friedman, places a fundamental emphasis on the Quantity Theory of Money ($MV = PQ$). Monetarism contends that although money supply expansion may temporarily stimulate output in the short run, long-run growth in money supply (M2) that exceeds the growth rate of real output will ultimately result strictly in inflationary pressures (money neutrality in the long run). Consequently, Monetarism underscores the necessity of maintaining measured and stable monetary liquidity to ensure

price predictability (controlled inflation) as an indispensable condition for sustained economic growth.(Mishkin 1995, 2019)

Monetary Transmission Mechanism

According to Keynesian Monetary Theory, monetary variables are non-neutral in the short run (money non-neutrality). Changes in monetary instruments such as Money Supply (M2), Interest Rates, and Exchange Rates influence the real sector through shifts in interest rate levels and relative prices. These shifts, in turn, stimulate investment, consumption, and net exports as primary components of Gross Domestic Product (GDP) formation (Mishkin 1995).

In the context of Upper-Middle-Income ASEAN countries, this dynamic operates through three main transmission channels:1) Interest Rate Channel: Changes in policy rates directly affect money market and credit interest rates, thereby influencing aggregate investment and consumption decisions. Then 2) Exchange Rate Channel: Exchange rate volatility affects the price competitiveness of exports and imports (terms of trade) as well as foreign capital flows, directly impacting the trade balance and economic growth. And 3) Money Supply Channel (Monetarism): In the long run, domestic liquidity (M2) must grow in proportion to real output growth to prevent inflationary distortions while providing adequate working capital for the productive sector.

The Relationship Between Monetary Variables and Economic Growth

In studies examining the impact of monetary variables on economic growth in upper-middle-income ASEAN countries, the relationship between monetary instruments and real output has become increasingly important. For instance, research in the ASEAN region using a Panel VAR model shows that increases in money supply have a positive and significant effect on GDP a key measure of economic growth. Other monetary variables, such as inflation, interest rates, and exchange rates, also contribute to growth fluctuations, although to a lesser extent (Song and Lim 2024)

Meanwhile, studies in Malaysia have shown a more consistent pattern. Akalpler and Duhok (2018), using OLS estimation, found that inflation, interest rates, and money supply all have a positive relationship with economic growth, although the contribution of money supply is relatively small (Akalpler and Duhok 2018). This finding is reinforced by research conducted by (Paramita and Noviarisanti 2021)which concluded that money supply significantly affects Malaysia's GDP, highlighting the importance of monetary instruments in influencing macroeconomic well-being.

Research in the ASEAN-4 countries (Indonesia, Malaysia, the Philippines, and Thailand) using a panel data approach and Vector Autoregression (VAR) found that monetary policy through interest rates exerts a negative effect on economic growth in the short run, but its impact turns positive in the long run(Purnomo and Wibowo 2024). This finding is particularly interesting as it diverges from the classical assumption that inflation always harms growth, suggesting the existence of threshold conditions or differences in economic structures across countries. Other studies have expanded the scope of monetary variables by including multiple indicators simultaneously from money supply, interest rates, and inflation to exchange rates using panel data spanning four decades across several ASEAN countries.

The results indicate that variables such as M2, interest rates, and exchange rates, both individually and collectively, have a significant effect on economic growth (Arifin, Ratnasih, and Sidik 2022).

In line with this, a study conducted by Ningsih et al. (2025) highlights that the monetary sector, through financial inclusion, plays a crucial role in promoting more qualitative and inclusive growth in Indonesia. Their findings indicate that financial inclusion has a positive and significant relationship with inclusive growth, both in expanding employment opportunities and reducing income inequality (Ningsih et al. 2025; Ningsih and Aimon 2021). This suggests that, in addition to traditional channels such as money supply, interest rates, inflation, and exchange rates, modern financial channels in the form of financial inclusion cannot be overlooked in the framework of economic growth analysis in upper-middle-income ASEAN countries.

Another empirical study examining the relationship between macroeconomic variables, stock market development, and economic growth found that real interest rates and inflation are negatively correlated with economic growth, whereas stock market indicators, such as market capitalization, exert a positive effect on growth in the ASEAN region (Setiawan, Purnamasari, and Ulum 2020). These findings underscore that the financial sector and capital markets are not merely complementary tools but play a significant role in monetary policy, influencing both aggregate demand and investment. A more technical analysis using a Panel ARDL approach further shows that interest rates and inflation have both short- and long-term effects on GDP in Southeast Asia, and this model captures the heterogeneous responses among ASEAN countries, making it highly relevant for application to the upper-middle-income (UMI) ASEAN group (Nguyen 2025)

Regarding the complex transmission mechanisms, a study using pre- and post-pandemic data from seven ASEAN countries revealed that GDP exerts a dominant influence on inflation and exchange rates, while money supply (M2) and interest rates also make significant contributions to macroeconomic fluctuations, both in the short and long run. (Hou, Lie, and Tony 2024).

Theoretically, global literature indicates that the effectiveness of monetary policy in developing countries is strongly influenced by financial market depth, the availability of policy instruments, and resilience to external shocks. Several studies have found that the role of central banks, their independence, and the economic structure within the transmission mechanism critically determine the effects of policy on growth, with some studies showing significant impacts while others report limited effects (Daoui 2023).

Nevertheless, the majority of existing research has focused on single-country cases, such as Indonesia or Malaysia, resulting in only partial insights. Although cross-country studies in ASEAN exist, they primarily concentrate on general macroeconomic linkages, such as international trade or financial markets, rather than specifically on core monetary variables. Furthermore, the methods employed are often relatively simple, such as panel regressions with fixed or random effects, which do not fully capture the dynamic nature of short- and long-term relationships.

The novelty of this study lies in two main aspects. First, it specifically focuses on the group of ASEAN upper-middle-income countries (Indonesia, Malaysia, and Thailand), which share

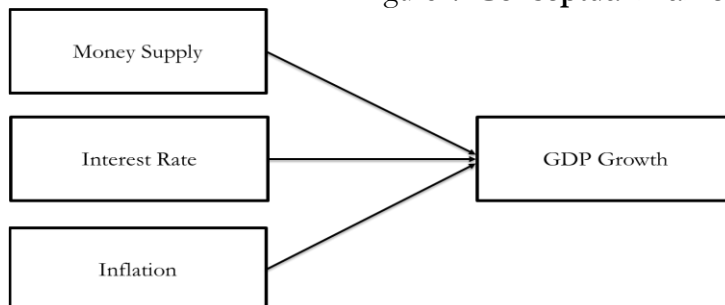
similar development levels but differ in economic structures and monetary policies. This focus is important to uncover the extent to which the effects of monetary policy on economic growth are similar or divergent across these countries. Second, the study employs a dynamic panel approach (VAR/VECM) capable of explaining bidirectional causality, short-term effects, and long-term cointegration among variables. Consequently, the findings are expected to provide a more comprehensive understanding compared to previous research, which tends to be partial.

Moreover, the novelty of this research also lies in its attempt to assess the consistency of monetary instruments in promoting economic growth in upper-middle-income ASEAN countries facing similar challenges, such as regional financial integration, trade openness, and global risks like commodity price shocks and international financial crises. Therefore, this study is expected to enrich the literature on the effectiveness of monetary policy in developing countries transitioning toward high-income status.

Conceptual Framework

The econometric model utilized in this research is directly operationalized from the conceptual framework developed to capture the interrelationships among the studied variables. The structural configuration of these variable relationships is illustrated in Figure 4.

Figure 4. **Conceptual Framework**



Based on the theoretical and empirical review, this research model illustrates the hypothesized relationships among monetary variables specifically Money Supply, Interest Rate, and Inflation and economic growth (GDP Growth) in Upper Middle Income ASEAN countries. It operationalizes the conceptual framework into measurable constructs tested using Panel VECM.

Methods

This study employs a quantitative approach using dynamic panel data analysis, specifically the Vector Autoregressive (VAR) or Vector Error Correction Model (VECM), depending on the results of the cointegration tests among the variables. This method is chosen as it aligns with the study's conceptual framework, in which monetary variables and economic growth influence each other simultaneously and dynamically, both in the short and long run.

The data used are secondary annual data for the period 2000–2024, in accordance with the availability and consistency across upper-middle-income ASEAN countries (Indonesia,

Malaysia, and Thailand). The primary data source is the World Bank (World Development Indicators).

The dependent variable in this study is economic growth, proxied by real Gross Domestic Product (GDP) growth. The independent variables representing monetary factors include inflation (CPI, annual %), policy/benchmark interest rate (lending interest rate), and money supply (M2, % of GDP). These variables are selected because they are key instruments and indicators commonly used in monetary policy and significantly influence macroeconomic dynamics

Table 1. Indicators of Research Variables

Variables	Indicator and measurement
Economics Growth	Real GDP growth (annual %) – represents the country's economic performance
Money Supply	Broad Money % of gdp, indicates total liquidity in the economy
Interest rate	Lending interest rate %, reflects the cost of borrowing and monetary stance in percent.
Inflation	Inflation, consumer prices (annual %), measures the general change in price level 100.

The analysis begins with a stationarity test using Unit Root Tests (Levin-Lin-Chu, Im-Pesaran-Shin, and Fisher ADF). If the data are non-stationary at level but stationary at the first difference, the Johansen-Fisher cointegration test is conducted to confirm the existence of long-term relationships among the variables. If the variables are found to be cointegrated, a Panel VECM model is applied; otherwise, a Panel VAR model is used.

The VAR/VECM model is then estimated to obtain the dynamic relationships among the variables. Subsequently, an Impulse Response Function (IRF) analysis is performed to illustrate the response of economic growth to shocks from each monetary variable, while Variance Decomposition (VDC) is conducted to examine the relative contribution of each monetary variable to the variation in economic growth over the short and long term.

Through this methodology, the study aims to comprehensively capture the simultaneous and dynamic interactions between monetary policy and economic growth in upper-middle-income ASEAN countries. Consequently, the findings are expected to provide an empirical basis for the formulation of effective and sustainable monetary policies in the region. Long-Run Cointegration Equation:

$$GDP_{it} = \beta_0 + \beta_1 UBit + \beta_2 SBit + \beta_3 INFit + \epsilon_{it} \dots\dots\dots(1)$$

Where:

GDP_{it} = Real GDP growth (annual %) for country i in period t

$UBit$ = Broad Money % of gdp for country i in period t

$SBit$ = Lending interest rate %, for country i in period t

$INFit$ = Inflation, consumer prices (annual %) for country i in period t

ϵ_{it} = Error term

Vector Error Correction Model:

$$\Delta GDP_t = \alpha_0 + \sum_{i=1}^p \alpha_{1i} \Delta GDP_{t-i} + \sum_{i=1}^{q_1} \alpha_{2i} \Delta LUB_{t-i} + \sum_{i=1}^{q_2} \alpha_{3i} \Delta SB_{t-i} + \sum_{i=1}^{q_3} \alpha_{4i} \Delta INF_{t-i} + \epsilon_t \dots\dots\dots (2)$$

When:

- Δ = First-difference operator (indicating short-term dynamics)
- α_0 = Short-run intercept term
- $\alpha_1, \alpha_2, \dots, \alpha_4$ = Short-run dynamics coefficients
- p = Optimal lag length for the dependent variable
- q_1, q_2, q_3 = Optimal lags for individual independent variables

Findings

In this study, stationarity tests were conducted using Unit Root Tests with the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) approaches. The results indicate that most variables are non-stationary at levels but become stationary at the first difference with a significance probability below 5%. This condition suggests that the data meet the requirements for further analysis using the VAR/VECM models.

Next, the determination of the optimal lag length for the model is conducted. Lag selection is a crucial step because a lag that is too short may result in the loss of dynamic information between variables, while a lag that is too long may cause multicollinearity issues and reduce the degrees of freedom in the model. Therefore, the optimal lag is chosen based on several information criteria, including the Akaike Information Criterion (AIC), Schwarz Criterion (SC), and Hannan-Quinn Criterion (HQ).

Table 2. **Optimal Lag Test**

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-397.0209	NA	4796126.	26.73473	26.92155	26.79450
1	-356.3018	67.86521	934562.9	25.08679	26.02092*	25.38562
2	-339.0945	24.09025	918913.7	25.00630	26.68774	25.54421
3	-327.1582	13.52774	1426862.	25.27722	27.70596	26.05419
4	-283.1152	38.17064*	316042.2*	23.40768*	26.58373	24.42372*

*indicates lag order selected by the criterion

Based on the estimation for determining the optimal lag length, Table 2 above shows the values for various information criteria, with the lowest (best) values indicated by the highest number of asterisks observed at lag 4. Therefore, the model used in this study should employ lag 4, as the information criteria indicate the minimum values at this lag. Selecting lag 4 allows the VAR/VECM model to better capture the dynamic relationships among monetary variables and economic growth without compromising model efficiency.

The next step is to conduct the Johansen cointegration test to determine whether a long-term relationship exists among the variables used, namely Gross Domestic Product (GDP), inflation (INF), interest rate (SB), and money supply (UB). If the test indicates the presence of cointegration, the Vector Error Correction Model (VECM) is applied. Conversely, if no cointegration is found, the analysis proceeds using the Vector Autoregression (VAR) model in differenced form.

Table 3. Cointegration Test

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.966706	160.1703	47.85613	0.0000
At most 1 *	0.811122	68.30640	29.79707	0.0000
At most 2 *	0.563767	23.30668	15.49471	0.0027
At most 3	0.033073	0.908078	3.841466	0.3406
Trace test indicates 3 cointegrating eqn(s) at the 0.05 level Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.966706	91.86391	27.58434	0.0000
At most 1 *	0.811122	44.99972	21.13162	0.0000
At most 2 *	0.563767	22.39860	14.26460	0.0021
At most 3	0.033073	0.908078	3.841466	0.3406
Max-eigenvalue test indicates 3 cointegrating eqn(s) at the 0.05 level				

Table 3 presents the cointegration test using the Johansen approach. The Trace Statistic test indicates the presence of three cointegrating relationships at the 5% significance level. This is evidenced by the Trace Statistic values exceeding the critical values for the hypotheses "None," "At most 1," and "At most 2," with corresponding p-values below 0.05. Similarly, the Max-Eigenvalue test also identifies three cointegrating relationships at the 5% level. The Max-Eigen Statistic values exceed the critical values for the first three hypotheses, and the p-values confirm their significance. Thus, both tests provide consistent results, indicating the existence of three cointegrating relationships among the variables. This suggests that the data are cointegrated, and the model captures a long-term equilibrium relationship among the analyzed variables. Theoretically, this cointegrating relationship aligns with the Monetarist view, which asserts that monetary variables and real output adhere to a stable equilibrium path in the long run. The existence of this long-run relationship reinforces the long-run money neutrality hypothesis, wherein monetary expansion is ultimately anchored by the structural equilibrium conditions of the economy. At the same time, the statistical significance of the Error Correction Term (ECT) validates the Keynesian synthesis, demonstrating that short-run adjustments following monetary shocks do not occur instantaneously, but rather require a gradual correction mechanism to restore the economy toward its long-run equilibrium trajectory (Mishkin 1995). These empirical findings are consistent with (Khieu 2021), who found that money supply (M2), interest rates, and inflation establish a stable long-run cointegrating relationship with real GDP.

Table 4. VECM Long-Run Estimation

Cointegrating Eq	CointEq1
D(GDP(-1))	1.000000
D(UB(-1))	-0.001118 (0.00034) [-3.27919]
D(SB(-1))	-0.477290 (0.20905) [-2.28313]
D(INF(-1))	0.296740 (0.08730) [3.39912]
C	-0.145826

The VECM estimation results presented in Table 4 indicate a significant long-run relationship among the variables in the model. The coefficient of economic growth (GDP) is normalized to 1 as the reference variable.

The money supply (UB) variable has a negative coefficient of -0.001118 with a t-statistic of -3.27919, which is significant, indicating that an increase in money supply negatively affects economic growth in the long run. This finding is consistent with (Purnomo and Wibowo 2024). The interest rate (SB) also has a negative coefficient of -0.477290 with a t-statistic of -2.28313, indicating that higher interest rates tend to suppress long-term economic growth. This result is supported by (Arifin et al. 2022). In contrast, inflation (INF) has a positive coefficient of 0.296740 with a t-statistic of 3.39912, which is significant, suggesting that inflation contributes positively to economic growth in the long run. This is in line with previous studies (Akalpler and Duhok 2018; Song and Lim 2024). The constant term in the equation is -0.145826.

Overall, these results indicate that economic growth, money supply, interest rates, and inflation have a strong long-term equilibrium relationship, supporting the existence of a correction mechanism to maintain macroeconomic stability.

Table 5. VECM Short-Run Estimation

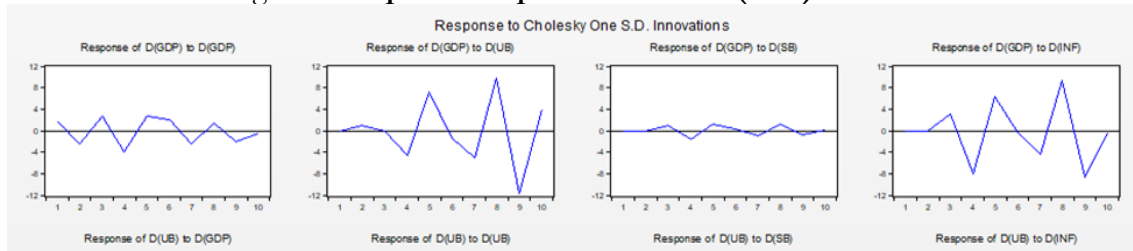
Variable	Coefficient	T Statistic
CointEq1	-4.741542	-4.09477
D(GDP(-1))	3.357367	3.16553
D(GDP(-2))	1.729755	1.80834
D(GDP(-3))	0.679604	1.05344
D(GDP(-4))	-0.106369	-0.37583
D(UB(-1))	-0.002214	-1.72340
D(UB(-2))	-0.006645	-5.02071
D(UB(-3))	-0.007673	-4.78830
D(UB(-4))	0.001345	0.71918
D(SB(-1))	-4.449270	-2.665498
D(SB(-2))	0.359403	0.24228
D(SB(-3))	-4.200206	-2.86499
D(SB(-4))	4.851731	3.816901
D(INF(-1))	1.322765	3.84612
D(INF(-1))	2.600697	5.40507
D(INF(-1))	0.901603	1.51784
D(INF(-1))	0.585655	1.551784
C	-1.792597	
R Squared	0.85283	

The short-run VECM estimation results presented in Table 5 illustrate the short-term dynamics among the variables, showing how changes in monetary variables affect economic growth (GDP) over a brief period.

For instance, at the first lag, money supply ($\Delta UB(-1)$) has a negative coefficient of -0.002214 with a t-statistic of -1.72340, indicating that a one-unit increase in money supply in the previous period reduces current economic growth by 0.002214 units, which is statistically significant. Similarly, at the second lag, money supply ($\Delta UB(-2)$) has a negative coefficient of -0.00645 with a t-statistic of -5.02071, demonstrating a comparable negative effect. These findings are consistent with (Šulíková, Siničáková, and Štiblárová 2019).

Furthermore, the interest rate at the first lag ($\Delta SB(-1)$) also exhibits a significant negative effect on economic growth, with a coefficient of -0.449270 and a t-statistic of -2.66498. This indicates that a one-unit increase in the interest rate reduces economic growth by 0.449270 units, in line with (Alhayria and Azaluddin 2023) In contrast, inflation at the first lag ($\Delta INF(-1)$) shows a significant positive effect, with a coefficient of 1.322765 and a t-statistic of 3.84612, suggesting that a one-unit increase in inflation boosts economic growth by 1.322765 units in the short run. This result is supported by the study of (Razia and Omarya 2022).

Figure 5. Impulse Response Function (IRF) Results



Based on the Impulse Response Function (IRF) analysis presented in Figure 4, the response of GDP to shocks in itself exhibits a relatively stable pattern with slight positive fluctuations from the first period up to around the fourth period. This indicates that shocks to economic growth generate a short-term response that persists, although not very strongly.

Regarding the response of GDP to shocks in money supply (UB), the IRF shows an initial increase in response up to the fourth period, followed by a sharp decline until the ninth period. This suggests that shocks to money supply have a positive effect in the early periods, but the effect is unstable and tends to turn negative in subsequent periods.

Meanwhile, the response of GDP to interest rate (SB) shocks appears largely neutral and does not exhibit a significant pattern, as indicated by the IRF line remaining close to the horizontal axis without sharp fluctuations. This implies that short-term changes in interest rates do not directly affect economic growth.

The response of GDP to inflation (INF) shocks shows a fluctuating and unstable pattern, with increases and decreases from period to period. This indicates that inflation has an inconsistent impact on economic growth, likely due to its dual nature moderate inflation can be beneficial, whereas high inflation may be detrimental depending on the prevailing economic context.

Table 6. Variance Decomposition

Variance Decomposition of D(GDP)					
Period	S.E.	D(GDP)	D(UB)	D(SB)	D(INF)
1	1.657882	100.0000	0.000000	0.000000	0.000000
2	3.028610	90.58533	8.541469	0.467647	0.405552
3	5.182942	57.63953	2.941741	3.868015	35.55071
4	11.33914	24.32746	16.43364	2.886300	56.35260
5	15.02062	16.92042	31.59556	2.249593	49.23442
6	15.24014	18.38874	31.53109	2.209725	47.87044
7	16.85172	17.09973	34.46824	2.164376	46.26766
8	21.72732	10.66555	41.19606	1.610456	46.52793
9	26.27783	7.929905	47.92130	1.204915	42.94388
10	26.59370	7.782200	49.08512	1.177693	41.95498

Variance Decomposition (VDC) is used to determine the proportion of variation in economic growth (GDP) that is attributable to shocks from other variables in the system, such as money supply (UB), interest rates (SB), and inflation (INF), over future periods. This analysis helps to understand the relative role of each variable in influencing GDP in both the short and long run.

In the first period, almost all of the variation in GDP (100%) comes from itself, indicating that other variables have not yet exerted any influence. However, this proportion decreases significantly over time. For instance, by the fourth period, GDP's contribution to itself falls to only 24.32%, while the impact of inflation rises to 56.35%, and money supply begins to contribute 16.43%. By the tenth period, GDP's contribution to its own variation drops further to 7.78%, whereas money supply becomes the most dominant contributor at 49.08%, followed by inflation at 41.95%. Meanwhile, the contribution of interest rates remains small and relatively insignificant, around 1.17%.

These results suggest that, in the long run, economic growth is largely influenced by money supply and inflation, whereas the effect of interest rates is relatively minor.

Conclusion

Based on the results of this study using the Panel VECM model, it can be concluded that there is a long-run relationship between monetary variables, namely money supply (M2), interest rates, and inflation, and economic growth in Indonesia, Malaysia, and Thailand. In the long run, money supply and interest rates have a negative effect on economic growth, while inflation shows a positive effect, confirming that overly expansionary monetary policy or high interest rates can potentially suppress growth, whereas moderate inflation can stimulate economic activity. In the short run, the dynamics of money supply and interest rates continue to show negative effects, while inflation exerts a positive effect, although not always consistent. The Impulse Response Function (IRF) analysis shows that shocks to money supply initially produce a positive response in economic growth, but turn negative in the following periods, while interest rate shocks tend to be neutral, and inflation shocks generate a fluctuating response. Variance Decomposition results reveal that in the long run, economic growth is mainly influenced by money supply and inflation, while the contribution of interest rates is relatively small. Overall, these findings emphasize that monetary instruments play an important role in promoting economic growth, but their effectiveness varies across variables, with moderate inflation supporting growth and excessive increases in money supply or high interest rates potentially suppressing economic performance.

This study has several limitations that should be noted. First, the monetary variables used are limited to inflation, interest rates, and money supply, and therefore do not include other instruments such as exchange rates or domestic credit, which may also influence economic growth. Second, the use of annual data limits the model's ability to capture short-term fluctuations in more detail compared to quarterly or monthly data. Lastly, the analysis focuses only on three ASEAN upper-middle income countries, so the results may not necessarily apply to all ASEAN countries or other income groups.

Based on the empirical findings and conclusions of this study, several targeted policy recommendations are proposed to foster stable economic growth across upper-middle-income ASEAN economies. First, maintaining a balanced monetary policy framework is

essential, wherein central banks carefully calibrate the trade-off between price stability and economic growth. Rather than aggressively suppressing inflation, monetary authorities should maintain inflation within an optimal, moderate corridor to stimulate aggregate demand and investment, while remaining vigilant against high inflation that could impair macroeconomic stability. Second, broad money supply (M2) management requires prudent execution to mitigate inflationary pressures and the risk of asset price bubbles, which could distort long-run output trajectories. Central bank namely Bank Indonesia, Bank Negara Malaysia, and the Bank of Thailand should pivot from mere quantitative expansion of M2 toward enhancing liquidity quality. To prevent capital misallocation and latent inflationary pressures from unanchored monetary expansion, expansionary measures should be directed through targeted macroprudential liquidity incentives toward productive sectors (such as manufacturing and downstream industries) rather than non-productive consumption. Furthermore, interest rate policies must be adaptive to domestic and global economic conditions while actively safeguarding the investment climate. Given that high policy rates directly suppress real investment activity while exhibiting limited transmission efficacy, central banks should avoid sharp, abrupt rate hikes (shock tightening) in favor of a gradualist approach (gradualism). Concurrently, governments and financial regulatory authorities must enhance financial transmission channels by narrowing Net Interest Margins (NIM) in the banking sector, ensuring that policy rate reductions effectively translate into lower real borrowing costs for businesses. Synergistic policy coordination between monetary and fiscal authorities remains critical particularly through targeted real-sector stimulus, infrastructure development, and productive investment to maximize economic growth potential. In addition, given the high degree of economic openness in ASEAN, monetary management should extend beyond national borders toward regional policy coordination to buffer against external shocks, including global financial crises and commodity price volatility. Finally, deepening domestic financial markets is a strategic imperative to enhance the overall efficacy of monetary transmission, thereby securing a more stable and sustainable long-run growth trajectory.

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