VECM Analysis on the Short-Term and Long-Term Relationship between Southeast Asian Military Spending and Indonesian Economic Growth

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Abstract

This study examines the relationship between military spending in Southeast Asia and Indonesia's economic growth from 1990 to 2023, addressing the impact of defense expenditures on regional economic dynamics. The primary aim is to analyze how military spending, influenced by geopolitical and modernization factors, interacts with Indonesia's economic performance, and to identify the long-term and short-term effects of this relationship. To achieve this, the study utilizes the Vector Error Correction Model (VECM), employing data from SIPRI and the World Bank, and applying statistical techniques such as stationarity tests, cointegration analysis, Granger causality, and impulse response functions. The results reveal a significant long-term equilibrium relationship where Indonesia's economic growth influences regional military spending, but not vice versa. Specifically, the analysis shows that while economic growth in Indonesia reduces ASEAN military expenditures over the long term, short-term dynamics highlight a notable impact of economic changes on defense budgets. Variance decomposition indicates that Indonesia's economic growth increasingly drives variations in Southeast Asian military spending, with limited reciprocal effects. Based on these findings, the study recommends aligning military modernization with sustainable economic objectives through sound fiscal management, strategic technological investments, and strengthened regional cooperation. The research suggests that balancing national security concerns with economic development is crucial for optimal resource allocation. Future studies should further investigate how technological advancements and non-traditional security challenges influence the relationship between military spending and economic growth in the region.

Keywords: Economic Growth, Defense Economics, Military Spending, Southeast Asia, Vector Error Correction Model (VECM)

I. INTRODUCTION

Military spending is an important component of government spending, not only to ensure national security but also has far-reaching implications for the economy. In Indonesia, the impact of military spending on the economy is a strategic issue, especially amid the geopolitical dynamics of Southeast Asia. With its strategic geographical position and rich natural resources, Indonesia needs to maintain its military budget to secure national interests while strengthening its economic competitiveness in the region. Properly designed military spending can drive economic growth through job creation and the development of related industrial sectors, including defense technology [1]. However, over-allocation to the sector can reduce room for investment in other vital sectors, such as education and health, which are crucial for long-term development. The increase in military spending is not only happening in Indonesia, but also reflects a global trend. World military spending reached a record high of more than two trillion US dollars in 2021, despite global economic pressures due to the COVID-19 pandemic. This reflects countries' prioritization of security amid global uncertainty, which ultimately affects macroeconomic stability and international competitiveness [2]. For Indonesia, regional and global security challenges demand a military spending policy that not only ensures national protection, but also supports sustainable economic growth.

In the short term, Indonesia's military spending could provide an economic boost through increased domestic consumption and investment in related sectors such as manufacturing and infrastructure. Chairil and Febrianti mention that military spending in Indonesia contributes to human capital and infrastructure development [3], while Smith and Smith add that it creates jobs and strengthens local industries [4]. However, fiscal pressures often limit these positive impacts, as noted by Ross that high levels of external debt can limit budgetary flexibility [5]. In the long term, the impact of military spending on economic growth is more varied and contextualized. Research by Hirnissa et. al. show that in Indonesia, military spending has a one-way relationship with economic growth, but this impact depends on the efficiency of its allocation [6]. Jones and Lee emphasize the importance of effective fiscal management in determining the impact of military spending on economic growth [7]. Zeng et al., add that the integration of military spending with domestic defense industry development can provide long-term benefits through technology transfer and innovation [8]. However, without careful management, excessive military spending can reduce allocations to other productive sectors that are more supportive of long-term growth, such as education and technological innovation [9] [10].

Geopolitical factors also influence the dynamics of military spending in Southeast Asia. Regional tensions and arms races force Indonesia to ensure that its military spending remains integrated with other development needs. In addition, the transformation of the digital economy is a strategic opportunity that can support economic growth. Rhee and Kim state that digitalization can improve the efficiency of resource allocation, including in the military sector [11], while Zeraibi et al emphasize the importance of sustainable energy resource management to support the balance between economic growth and environmental sustainability [12]. Considering these challenges and opportunities, Indonesia's military spending policy should be strategically designed to ensure synergy with national economic development. Indonesia's growing democracy creates opportunities to strengthen economic institutions, allowing for more effective budget management [13]. In addition, the transformation of the digital economy and the management of environmental carrying capacity are important elements in ensuring inclusive and sustainable growth [14][15]. Through this approach, military spending is not only an instrument to ensure national security but also a driver of stable economic development amid global challenges. Managing Indonesia's military spending amid geopolitical pressures and economic development demands therefore requires a measured and strategic approach. A combination of productive military spending, sound fiscal management, and integration of other economic policies can help Indonesia achieve stable economic growth in both the short and long term.

Military spending in Southeast Asia continues to rise along with geopolitical tensions, arms races and the need to deal with non-traditional security threats. This trend has a dual impact on national economic policies. On the one hand, military spending can boost short-term economic growth through job creation and defense industry development. However, on the other hand, large allocations to the sector can strain the state budget, reduce investment in strategic sectors such as education and infrastructure, and increase the fiscal deficit[16][17]. For Indonesia, strategic management of military spending is critical to ensure that defense budget allocations not only strengthen national security but also support sustainable economic development. Synergies between military modernization, strengthening the domestic defense industry, and other development priorities are key to optimizing the benefits of military spending amidst regional dynamics.

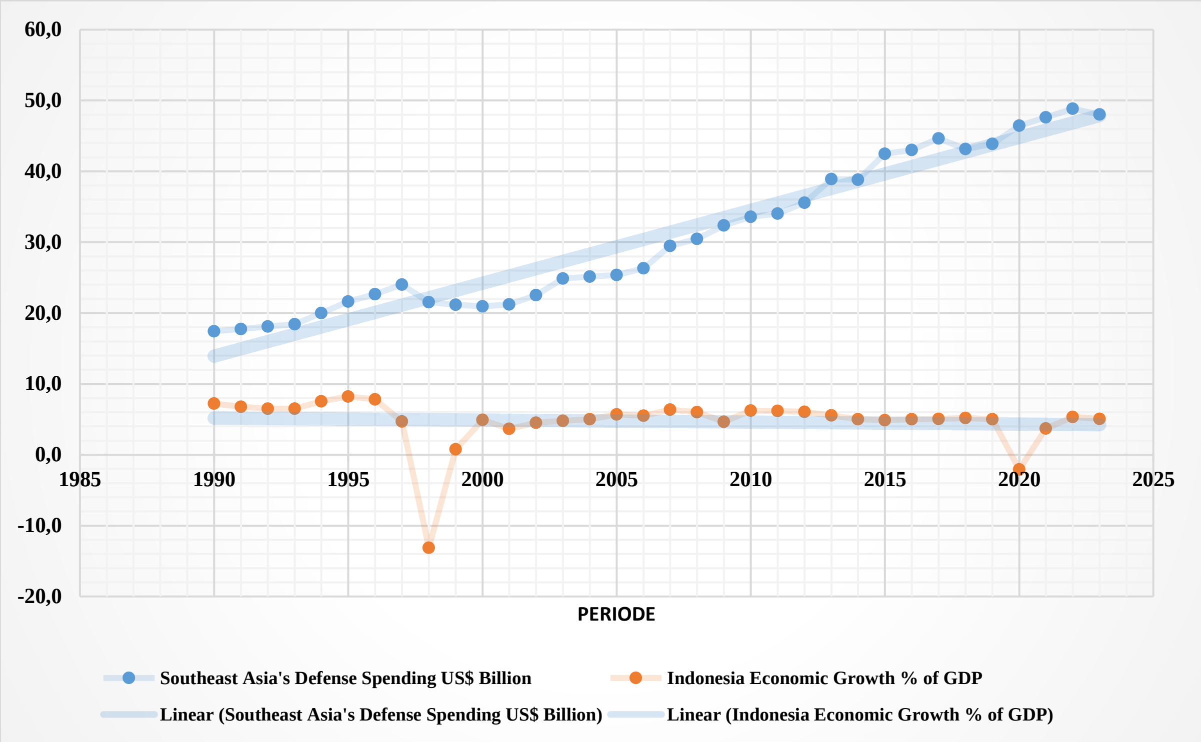

FIGURE 1. ASEAN DEFENSE SPENDING TRENDS & INDONESIA ECONOMIC GROWTH 1990 – 2023

Data from the Stockholm International Peace Research Institute (SIPRI) and the World Bank show the relationship between Southeast Asia's defense spending and Indonesia's economic growth in the period 1990-2023. Based on the graph, Southeast Asia's defense spending experienced a significant upward trend from around US$10 billion in the early 1990s to more than US$50 billion in 2023. This increase indicates the growing defense needs in the region, likely influenced by geopolitical dynamics, population growth, and military modernization. The linear trend line in defense spending reflects steady growth throughout the period. In contrast, Indonesia's economic growth, measured as a percentage of Gross Domestic Product (GDP), shows a more volatile pattern. While mostly in the 0-10% range, a sharp decline occurred in the 1998-1999 period, coinciding with the Asian economic crisis. After the crisis, economic growth stabilized, but did not show a significant increase in the long term, as evident from the flat linear trend line. Visually, there is no direct correlation pattern between the increase in Southeast Asian defense spending and Indonesia's economic growth. Despite the consistent increase in defense spending, Indonesia's economic growth has remained at a relatively stagnant level, with some major fluctuations.

Military spending is an important element in a country's fiscal policy to maintain national stability and deal with security threats. However, significant budget allocations to this sector often pose an economic dilemma, especially in developing countries. The concept of trade-offs between military spending and other sectors, such as education, health and infrastructure, poses a challenge to policymakers. This phenomenon is known as the "substitution effect," where an increase in the military budget tends to reduce investment in other productive sectors. This study aims to analyze the causal relationship between military spending in Southeast Asia and Indonesia's economic growth using the Vector Error Correction Model (VECM) approach. The analysis aims to identify the short-term and long-term relationship between the two variables, as well as the implications for Indonesia's fiscal policy in the context of regional geopolitical dynamics.

II. LITERATURE REVIEW

A. Military Spending

Studies of defense spending and its relationship with economic or geoeconomic growth show complex interactions with varying outcomes across different countries and contexts. Previous studies have used a variety of methodologies to explore these dynamics, revealing positive, negative and, in some cases, insignificant relationships between the two variables. Research trends indicate increasing attention to this topic. A bibliometric analysis of 381 documents published between 1991 and 2021 shows significant contributions from countries such as the United States, China and Greece [18]. One of the most influential journals in this field is Defence and Peace Economics, which confirms the academic focus on the relationship between defense spending and economic development.

Kollias and Tzeremes examine the causal relationship between defense spending and economic growth using the rolling-window causality test method [19]. This study shows that the causal relationship between the two variables can change over time, depending on the dynamics of the economy and the global context that affects defense policy. The findings provide new insights that the relationship between defense spending and economic growth is not static, but influenced by temporal and contextual factors that require continuous analysis. Meanwhile, Santamaría et. al., through scientmetric analysis, explore the development of research in the field of defense spending and economic growth [20]. The study identified research trends, key academic contributions, as well as potential future research areas. The results of the analysis show that attention to this topic is on the rise, with various multidisciplinary approaches being used to understand the relationship between defense spending and economic growth dynamics. This study emphasizes the need for a holistic approach to capture the complexity of the relationship between the two variables, including economic and geopolitical impacts.

In terms of causality, research using the Granger causality test shows mixed results. For example, in China there is a two-way causality between defense spending and economic growth, while in the United States there is a one-way causality from economic growth to defense spending [21]. In addition, a cross-country study of six selected countries also showed a significant causal relationship in some countries, emphasizing that the impact of defense spending on economic growth is contextual [22]. Meanwhile, with regard to the economic burden of militarization, research results using the Global Militarization Index (GMI) for 116 countries over the period 1995-2019 found no systematic relationship between the level of militarization and GDP growth. This suggests that high defense spending does not necessarily correlate with economic growth ("Militarization, Investment and Economic Growth 1995-2019: Initial Global Findings", 2022). However, some other studies argue that defense spending can boost economic growth through job creation and technological advancement. This more nuanced view suggests that the relationship between defense spending and economic growth requires further exploration.

B. Economic Growth

The relationship between military spending and economic growth is a complex topic and has been the subject of numerous studies with mixed results. Military spending is often considered an essential element for maintaining national security, but its impact on economic growth presents various dynamics depending on the country context, level of economic development, and allocation of available resources. In general, this relationship can be understood through the perspectives of macroeconomics, growth theory and public budget allocation. In developed countries, military spending tends to have minimal economic impact. Kolinets and Dluhopolskyi show that the main drivers of economic growth in these countries are productive domestic investments, such as in technology, education and infrastructure, rather than military spending [23]. In contrast, in developing countries, the relationship between military spending and economic growth is often more ambiguous. In the Indonesian context, this result is not entirely relevant. As a developing country, Indonesia faces limited fiscal capacity, so increased military spending often comes at the expense of other strategic sectors. As such, the economic implications of military spending in Indonesia are more significant than in developed countries. Putra et al. reveal that in developing countries, no significant causal relationship between military spending and economic growth was found, showing that other factors such as institutional capacity and budget allocation determine growth more [24].

More in-depth research in NATO countries suggests a two-way causal relationship between military spending and economic growth [25]. This means that not only does military spending affect economic growth, but economic growth also determines a country's capacity to increase military spending. However, research in South Asia shows that military spending has a negative impact on economic growth in the short term, with increased spending associated with a decrease in Gross Domestic Product [26], something similar could happen in Indonesia, as geopolitical pressures in the Southeast Asian region drive significant military spending, often at the expense of other sectors that support long-term economic growth. This reflects the budgetary pressures faced by countries in the region, where high military spending often comes at the expense of investment in other productive sectors. Saeed in his analysis of 133 countries explores that a 1% increase in military spending relative to GDP reduces economic growth by 1.10% [27]. This suggests there are significant opportunity costs associated with military spending, particularly in terms of reduced resource allocation to vital sectors such as education, health and social infrastructure. These implications underscore the importance of efficient budget management to ensure that military spending does not hamper long-term economic growth.

In theory, military spending can affect economic growth through several channels. On the one hand, military spending can boost short-term aggregate demand by encouraging domestic consumption and investment, especially in related sectors such as manufacturing and technology. However, in the long term, inefficient resource allocation can reduce economic productivity and hinder sustainable development. This effect is more pronounced in developing countries that have limited fiscal capacity and more pressing development needs. In the global context, the relationship between military spending and economic growth reflects the trade-off between security needs and economic development. While military spending can be justified to protect state sovereignty, its economic implications often require critical evaluation. The high opportunity costs of military budget allocations must be taken into account, especially to ensure that domestic investments in vital sectors are not neglected. This theory emphasizes the importance of strategic fiscal planning and public resource management to create a balance between national security and sustainable economic development. The guns vs butter theory provides an important foundation for understanding the trade-off dilemma in defense economic policy. The term refers to resource allocation decisions between military needs (guns) and civilian needs (butter). In economic theory, an increase in military spending is often associated with a decrease in budgets for other public sectors, such as education, health and infrastructure. Samuelson (1948) explains that under conditions of limited resources, governments are faced with a choice between meeting national security needs or prioritizing people's welfare through investment in the civilian sector.

III. METHOD

This study employs a quantitative approach with econometric methods to analyze the short-term and long-term relationship between Southeast Asian military spending and Indonesia's economic growth over the period 1990-2023. The model used is the Vector Error Correction Model (VECM), which is able to capture the dynamics of the relationship between the two variables. The research data were obtained from two main sources, namely the Stockholm International Peace Research Institute (SIPRI) for Southeast Asian countries' military spending data, and the World Bank for Indonesia's economic growth data measured as a percentage of Gross Domestic Product (GDP). The data used is annual to maintain consistency and quality of analysis. The main variables in this study consist of the dependent variable, namely Indonesia's economic growth, and the independent variable, namely Southeast Asian countries' military spending expressed in billion US dollars. The object of this study includes Southeast Asian countries, Indonesia being the main subject for economic growth, given its role as the largest economy in the region. The Southeast Asian region was chosen due to its high dynamism in geopolitical and strategic terms, which drives a significant increase in military spending. By analyzing the period 1990-2023, this study aims to capture long-term trends and provide a comprehensive understanding of military-economic relations in the region. VECM was selected in this study because this method is able to capture short-term and long-term relationships between variables that have dynamic linkages. The advantage of VECM is its ability to identify error correction mechanisms towards long-term equilibrium following external disturbances. This is relevant for this study, given Indonesia's dependence on regional economic and geopolitical dynamics that may affect military budget allocation and economic growth.

The statistical approach in this study involves the use of Eviews 13 software. Statistical analysis was conducted to explore the dynamic relationship between Southeast Asian military spending and Indonesia's economic growth, both in the short and long term. The following is a description of the statistical analysis used:

A. Stationarity Test (Unit Root Test)

Before proceeding to the VECM model analysis, the first step is to test the stationarity of the data. The Augmented Dickey-Fuller (ADF) test is used to check whether the data has unit roots (non-stationarity). Stationarity is important to ensure that the data used in the VECM model does not contain unidentified trends or seasonal variations. If the data is found to be non-stationary, then transformations such as differentiation may be required[28].

$$\Delta Y_t = \beta_1 + ZY_{t-1} + \alpha_i + \varepsilon_t \text{ (Constant Only)} \quad (1)$$
$$\Delta Y_t = \beta_1 + \beta_2 t + ZY_{t-1} + \alpha_i + \varepsilon_t \text{ (Trend and Constant)} \quad (2)$$
$$\Delta Y_t = ZY_{t-1} + \alpha_i + \varepsilon_t \text{ (No Trend, No Constant)} \quad (3)$$

The hypothses to be tested are:
Ho: the variable has unit root
H1: the variable doesn't has unit root
Decision If t statistics value is > ADF critical value we fail to reject Ho and otherwise

B. Cointegration Test

After ensuring the stationarity of the data, the next step is to test whether there is a long-term relationship between Southeast Asian military spending and Indonesian economic growth. A cointegration test using the Johansen method is conducted to identify whether there is a cointegrating relationship between the two variables. If the variables are cointegrated, then they have a stable long-term relationship even though they may be non-stationary at the origin level[29]. The test starts with a VAR representation of the variables as:

$$A_k(L) X_t = \mu_0 + \varphi \Delta_t + \varepsilon_t \quad (4)$$

We assume that the system is integrated of order one, I(1). If there are indications of I(2) variables, they must be transformed into I(1) before setting up the VAR model. The VAR model can be converted into a VECM by applying the differencing operator.

$$\Delta X_t = \Gamma \Delta X_{t-1} + \ldots \Gamma_{-1} \Delta X_{t--1} \Pi X_{t-1} + \varphi \Delta_t + \varepsilon_t \quad (5)$$

Where Γ and Π are matrices of variables, with the lag length denoted as k for each variable. The VECM can be expressed in a more detailed component form as follows:

$$\Delta X_t = \sum_{i=1}^{k-1} \Gamma_1 \Delta X_{t-i} + \Pi X_{t-1} + \mu_0 + \varphi \Delta_t + \varepsilon_t \quad (6)$$

The number of cointegrating variables is directly proportional to the number of stationary relationships within the Π-matrix. If no cointegration exists, all rows in the Π-matrix will be zero. Conversely, if stationary combinations are present, some rows will have non-zero values. The rank of the Π-matrix determines both the number of independent variables and the number of cointegrating relationships. This rank is based on the significant eigenvalues in the Π-matrix, where each eigenvalue represents a meaningful stationary relationship. If the matrix has a reduced rank, it indicates the existence of a cointegrating relationship among the X' variables. If rank(Π) = 0, it implies a non-stationary relationship among the X' variables, and it is recommended to difference the data before modeling. However, if rank(Π) = p, meaning the matrix has full rank, then all variables are cointegrated. This method was employed in the study to determine the order or number of cointegrating equations among the variables.

C. Granger Causality Test

The Granger causality test is used to identify the direction of the causal relationship between Southeast Asian military spending and Indonesian economic growth. This test helps determine whether one variable can predict the other in the future, both in the short and long term. It can also show whether there is a one-way or two-way causal relationship between the two variables[30]. This evaluates causality by regressing each variable on its own lagged values as well as the lagged values of other variables:

$$Y_t = \beta_0 + \sum_{=1} \beta Y_t + \sum_{=1} X_{t-} + \mu_t \quad (7)$$

This method also enables the identification of causal relationships in the opposite direction.

$$X_t = \alpha_0 + \sum_{=1} \alpha X_{t-} + \sum_{=1} \phi Y_{t-} + v_t \quad (8)$$

The model must be fully specified to avoid spurious regression. In the specified model, X_t and Y_t represent the variables, μ_t and v_t are uncorrelated error terms, t denotes the time period, and k indicates the number of lags. The hypotheses to be tested are:

H_o: $\alpha_i = 0$ against H_1: $\alpha_i \neq 0$

If $\neq 0$ but $\alpha_i = 0$ then X cause Y_t and if $\alpha_i \neq 0$ but $= 0$ then Y_t cause X_t if both $\neq 0$ and $\alpha_i \neq 0$ the causality is bidirectional. This approach is applied to two variables (ASEAN military spending and Indonesia's economic growth) to analyze the causal relationships and their directions among these variables.

D. Vector Error Correction Model (VECM)

After finding cointegration, a Vector Error Correction Model (VECM) was used to capture the short-term and long-term relationship between Southeast Asian military spending and Indonesian economic growth. The VECM model allows to identify how these variables interact with each other in the short-term, as well as how they return to long-term equilibrium after external disturbances. VECM is a suitable modeling approach when variables are cointegrated. It is particularly effective for long-term forecasting, as VAR does not explicitly account for long-term relationships.

According to Pfaff (2007) a bivariate I(1) vector $(Y_{1t}, Y_{2t})' = Y_t$ with cointegtrating vector $\beta = (1, -\beta)$ where $\beta' Y_t = (1, -\beta)\ (Y_{1t}, Y_{2t})' = Y_{1t} - \beta_2 Y_{2t} \rightarrow$ I(0) An ECM exist in the form.

$$\Delta Y_{1t} = \alpha_1 + \gamma_1 (Y_{1t-1} - \beta_2 Y_{2t-1}) + \sum_{i=1}^{k} \varphi_{1i} \Delta Y_{1t-i} + \sum_{i=1}^{l} \varphi_{2i} \Delta Y_{2t-i} + \varepsilon_{1t} \quad (9)$$

$$\Delta Y_{2t} = \alpha_2 + \gamma_2 (Y_{1t-1} - \beta_2 Y_{2t-1}) \sum_{i=1}^{k} \varphi_{1i} \Delta Y_{1t-i} + \sum_{i=1}^{l} \varphi_{2i} \Delta Y_{2t-i} + \varepsilon_{1t} \quad (10)$$

We can then estimate ECM; but we can actual estimate $Y_{1t-1} - \beta_2 Y_{2t-1}$, Where $0 < _1 < 1$ and $0 < _2 < 1$ The VECM discussed above was estimated for the cointegrated variables.

IV. RESULT & DISCUSSIONS

Based on the results of the stationarity test using Augmented Dickey-Fuller (ADF) at the level and first difference, it can be concluded that the two variables, namely the logarithm of military spending in Southeast Asia (Log(X)) and the logarithm of Indonesia's economic growth (Log(Y)), show different characteristics at the stationarity level. At the level level, the test results show that the T-Statistic value for Log(X) is -0.489621 with a probability of 0.8809, while for Log(Y) the T-Statistic value is -0.733798 with a probability of 0.8243. Both probabilities are greater than the 5% significance level (0.05), so the null hypothesis (H0), which states that there are unit roots (non-stationarity), cannot be rejected. Thus, both variables are non-stationary at the level level.

However, at the first difference level, the T-Statistic value for Log(X) is -4.852271 with a probability of 0.0004, and for Log(Y) is -5.830049 with a probability of 0.0000. Both probabilities are smaller than the 5% (0.05) significance level, so the null hypothesis (H0) can be rejected. This indicates that both variables become stationary after being reduced to the first difference. Overall, these results indicate that both variables are integrated of order one (I(1)), which means that the data is not stationary at level but becomes stationary after the first differencing. Therefore, further analysis, such as VECM (Vector Error Correction Model) or cointegration analysis, can be conducted to identify the long-term relationship between the variables.

The results of the Vector Autoregressive (VAR) model stability test show that all roots of the characteristic polynomial have modulus values smaller than 1, which are 0.425029 and 0.258514, with some roots in the form of conjugate complexes. The absence of roots outside the unit circle indicates that the model meets the stability requirement. Theoretically, model stability indicates that the parameter estimates in the VAR model do not result in divergent variable values, so the system can respond to an external disturbance (shock) in a controlled manner. In other words, after a disturbance, the system will gradually return to equilibrium without causing unpredictable fluctuation patterns. This condition is an important requirement so that further analysis, such as impulse response function (IRF) and variance decomposition, can be conducted validly to describe the causal relationship and contribution of each variable in the model. In the context of a study analyzing the relationship between military spending in Southeast Asia (D(LOGX)) and Indonesia's economic growth (D(LOGY)), the stability of the model provides a solid foundation for exploring the short- and long-term interactions between the two variables. This stability ensures that the interpretation of the model results is not affected by parameter instability that may cause bias. Thus, the analytical results generated from this model can be trusted to explain the pattern of the relationship between military spending and economic growth. In addition, a stable model also strengthens the validity of policy recommendations, particularly in assessing the implications of military spending on economic development. The reliability of this model allows researchers to provide more evidence-based recommendations to policymakers, so that resource allocation strategies for the defense and development sectors can be carried out more efficiently and sustainably.

TABLE I. STATIONARITY TEST (UNIT ROOT TEST)

ADF STAT	LEVEL		FIRST DIFFERENCE	
	T-Stat	Prob.	T-Stat	Prob.
Southeast Asian Military Spending Log(X)	-0.489621	0.8809	-4.852271	0.0004
Indonesian Economic Log(Y)	-0.733798	0.8243	-5.830049	0.0000

TABLE II. VAR STABILITY

Root	Modulus
0.180541 - 0.384779i	0.425029
0.180541 + 0.384779i	0.425029
-0.233920 - 0.110050i	0.258514
-0.233920 + 0.110050i	0.258514

TABLE III. JOHANSEN COINTEGRATION TEST

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized		Trace	0.05	Prob.**
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Critical Value
None *	0.528016	32.11750	15.49471	0.0001
At most 1 *	0.273687	9.593207	3.841465	0.0020
Trace test indicates 2 cointegrating equation(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				
Unrestricted Cointegration Rank Test (Max-eigenvalue)				
Hypothesized		Max-Eigen	0.05	Prob.**
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Critical Value
None *	0.528016	22.52430	14.26460	0.0020
At most 1 *	0.273687	9.593207	3.841465	0.0020
Max-eigenvalue test indicates 2 cointegrating equation(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				

TABLE IV. GRANGER CAUSALITY TESTS

Null Hypothesis:	Obs	F-Statistic	Prob.
LOGY does not Granger Cause LOGX	32	4.73344	0.0173
LOGX does not Granger Cause LOGY		0.41315	0.6657

Based on the results of the Johansen cointegration test (Table III), both using the Trace Test and the Max-Eigenvalue Test, there is evidence of a cointegration relationship among the variables tested. In the Trace Test, the null hypothesis (H0) stating the absence of cointegration (None) is rejected, because the trace statistic value of 32.11750 exceeds the critical value at the 5% significance level of 15.49471, with a probability of 0.0001. In addition, the null hypothesis for "At most 1" cointegration is also rejected, as the trace statistic value of 9.593207 is greater than the critical value of 3.841465, with a probability of 0.0020. These results indicate the existence of two cointegrating equations at the 5% significance level. In the Max-Eigenvalue Test, the null hypothesis (H0) stating the absence of cointegration (None) is again rejected, because the max-eigen statistic value of 22.52430 is greater than the critical value of 14.26460, with a probability of 0.0020. The hypothesis of "At most 1" cointegration is also rejected because the max-eigen value of 9.593207 exceeds the critical value of 3.841465, with a probability of 0.0020. This supports the conclusion that there are two cointegrating equations at 5% significance level. The results of this test indicate that the variables in the model have a cointegrating relationship, which indicates the existence of a stable long-term relationship between the variables. Thus, the Vector Error Correction Model (VECM) approach is an appropriate method for analyzing short-term and long-term relationships between variables.

The Granger causality test results in the Table IV show the causality relationship between the logarithmic ASEAN military expenditure (LOGX) and logarithmic Indonesia economic growth (LOGY) variables. Based on the test results, the null hypothesis stating that LOGY does not cause (Granger Cause) LOGX is rejected at the 5% significance level, with an F-Statistic value of 4.73344 and a probability of 0.0173. This indicates that Indonesia's economic growth variable (LOGY) has a causal influence on ASEAN military expenditure (LOGX) in the time frame tested. In contrast, the null hypothesis that LOGX does not Granger Cause LOGY cannot be rejected, as the probability value of 0.6657 is greater than the 5% significance level. This means that ASEAN military spending (LOGX) does not show a causal relationship with Indonesia's economic growth (LOGY). Overall, these results suggest a one-way causality relationship, where Indonesia's economic growth affects ASEAN military spending, but not vice versa. This could be an indication that changes in the Indonesian economy could have an impact on the allocation of military expenditure in the ASEAN region.

Based on the Vector Error Correction Model (VECM) estimation results, the analysis of the relationship between ASEAN military spending (LOGX) and Indonesia's economic growth (LOGY) shows significant dynamics in the long and short term. The coefficient of the cointegration equation indicates a significant long-term relationship between the two variables. The coefficient D(LOGY(-1)) of -0.217600 with a t-statistic of -4.75137, which is greater than the critical value (i.e. 1.96 at 5% significance level), indicates that LOGY significantly affects LOGX in the long term. The relationship is negative, meaning that an increase in Indonesia's economic growth (LOGY) tends to be followed by a decrease in ASEAN's military spending (LOGX), or vice versa. This may reflect the trade-off between resource allocation for economic growth needs and military spending. The constant of -0.016142 indicates an adjustment mechanism towards the long-term equilibrium, although the small value of the constant indicates that the effect is not dominant.

In the short term, an analysis of the Error Correction Term (ECT) shows that only LOGX adjusts significantly to the long-term equilibrium. The ECT coefficient on D(LOGX,2) of -1.540697 with a t-statistic of -4.55005 indicates that about 154% of LOGX's deviation from the long-term equilibrium is corrected each period. In contrast, in D(LOGY,2), the ECT coefficient of -0.606154 with a t-statistic of -0.31129 is insignificant, indicating that LOGY does not experience any meaningful adjustment to the long-term equilibrium. In addition, the lag variable of the change in LOGX is insignificant against itself in the short term, while the change in

LOGY at the first lag has a significant and negative impact on LOGX. This indicates that changes in Indonesia's economic growth in the previous period affect ASEAN military spending in the short-term, but ASEAN military spending does not have a knock-on effect on Indonesia's economic growth.

The overall performance of the model can be measured by the R-squared value and F-statistic. In the D(LOGX,2) equation, the R-squared of 59.68% indicates that most of the variation in LOGX changes can be explained by the model. This equation is also statistically significant with an F-statistic value of 7.1066. Meanwhile, in the D(LOGY,2) equation, an R-squared of 41.83% indicates a lower ability to explain variations in LOGY changes, although the model remains significant with an F-statistic of 3.4522. The results suggest a significant long-term relationship between ASEAN military expenditure and Indonesia's economic growth, with ASEAN military expenditure dominating the adjustment dynamics. In the short term, changes in Indonesia's economic growth have a significant impact on ASEAN military spending, but not vice versa. This relationship may reflect higher economic prioritization of growth over military spending, or the influence of certain structural policies in the ASEAN region. The implications of these results are important for policy-making, as they highlight the need to balance resource allocation between the needs of economic growth and military spending.

TABLE V. VECTOR EROR CORRECTION ESTIMATE

Cointegrating Eq:	CointEq1	
D(LOGX(-1))	1.000000	
D(LOGY(-1))	-0.217600 (0.04580) [-4.75137]	
C	-0.016142	
Error Correction:	**D(LOGX,2)**	**D(LOGY,2)**
COINTEQ1	-1.540697 (0.33861) [-4.55005]	-0.606154 (1.94721) [-0.31129]
D(LOGX(-1),2)	0.316514 (0.25593) [1.23672]	-0.537332 (1.47174) [-0.36510]
D(LOGX(-2),2)	0.272653 (0.18254) [1.49362]	-0.495184 (1.04974) [-0.47172]
D(LOGY(-1),2)	-0.216359 (0.06528) [-3.31423]	-0.726466 (0.37541) [-1.93514]
D(LOGY(-2),2)	-0.135759 (0.04533) [-2.99459]	-0.442009 (0.26070) [-1.69547]
C	-0.001004 (0.00771) [-0.13014]	-0.004980 (0.04435) [-0.11229]

R-squared	0.596862	0.418339
Adj. R-squared	0.512875	0.297159
S.E. equation	0.042238	0.242895
F-statistic	7.106600	3.452223
Log likelihood	55.71178	3.232757
Akaike AIC	-3.314119	0.184483
Schwarz SC	-3.033879	0.464722
Mean dependent	-0.001099	-0.005722
S.D. dependent	0.060518	0.289728
Determinant resid covariance (dof adj.)		7.57E-05
Determinant resid covariance		4.84E-05
Log likelihood		63.89842
Akaike information criterion		-3.326561
Schwarz criterion		-2.672669
Number of coefficients		14

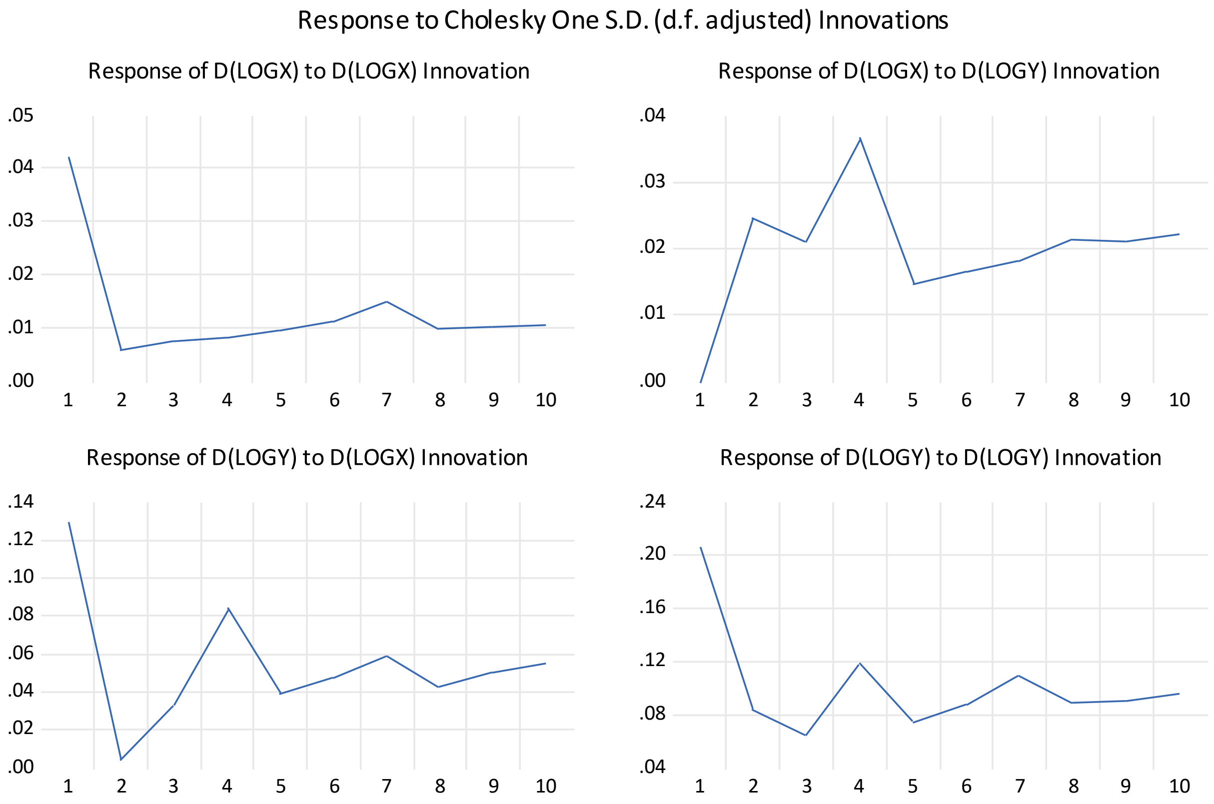

FIGURE 2. IMPULSE RESPONSE FUNCTION

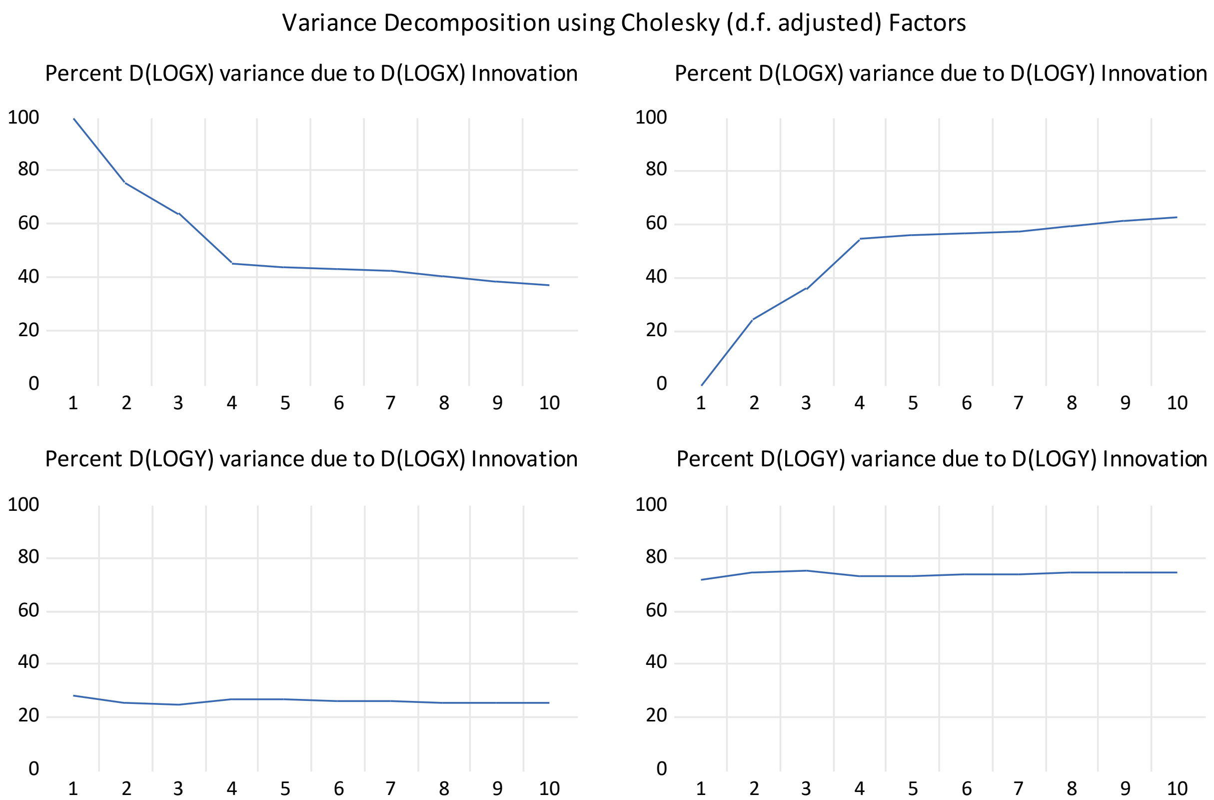

FIGURE 3. VARIANCE DECOMPOSITION

The Impulse Response Function (IRF) provides an overview of how the endogenous variables in the model system respond to a shock of one standard deviation to other variables or themselves within a certain period of time. The IRF results for 10 periods displayed in the graph above show the dynamics of the relationship between D(LOGX) and D(LOGY). First, the response of D(LOGX) to shocks to itself shows a positive pattern with a significant initial impact in the first period. However, this impact declines rapidly after the second period and tends to stabilize in subsequent periods. This suggests that the effect of shocks to D(LOGX) on itself is temporary and quickly stabilizes. Meanwhile, the response of D(LOGX) to shocks to D(LOGY) shows a relatively small positive impact at the beginning but increases to a peak in the third period. After that, the impact gradually decreases and stabilizes, although it still shows slight fluctuations.

In contrast, the response of D(LOGY) to shocks to D(LOGX) shows a different pattern. The initial shock produces a significant negative impact in the first period, but this response reverses to positive in the second period and peaks in the third to fourth period. After that, the response fluctuates before slowly stabilizing. This indicates that D(LOGY) tends to be more sensitive to external shocks than D(LOGX), with a more volatile response pattern. In addition, D(LOGY)'s response to shocks to itself starts with a negative impact in the first period, but turns positive in the second period. This response pattern continues to fluctuate between positive and negative until the 10th period, reflecting that the impact of shocks on D(LOGY) is more persistent than that of D(LOGX).

The IRF results indicate a dynamic relationship between D(LOGX) and D(LOGY). D(LOGX) tends to show faster stabilization to shocks from both itself and D(LOGY). In contrast, D(LOGY) has a more volatile response to shocks, especially from D(LOGX), with more significant impacts and takes longer to stabilize. The economic implication is that policies affecting these variables need to consider their different sensitivities to shocks. D(LOGY), as a more sensitive and volatile variable, requires a more cautious approach to reduce uncertainty, while D(LOGX) can more quickly adapt to shocks in the system.

Based on the Variance Decomposition results for 10 periods, the analysis shows how the innovation contributions from D(LOGX) and D(LOGY) affect the variability of each variable in the system. The graphs provide important insights into the dominant sources of variability in each variable over time. In the first graph, which depicts the percentage of variance in D(LOGX) explained by innovations in D(LOGX) itself, it can be seen that in the initial period (period 1), almost 100% of the variance in D(LOGX) is due to its own innovations. However, this contribution decreases gradually over time until it reaches around 60% in the 10th period. This shows that while D(LOGX) remains the dominant factor in explaining its own variability, the influence of other variables, in this case D(LOGY), increases gradually over time. In contrast, in the second graph, which plots the percentage of variance in D(LOGX) explained by innovations in D(LOGY), the contribution of D(LOGY) to the variability of D(LOGX) is almost zero in the initial period, but increases significantly from period 2 to period 10. By the 10th period, the innovation of D(LOGY) explains about 40% of the variability of D(LOGX). This confirms that in the long term, D(LOGY) plays an important role in influencing changes in D(LOGX).

The third graph shows that the variance of D(LOGY) is largely explained by the innovation of D(LOGX). In the first period, the contribution of D(LOGX) innovation is relatively low, but it increases gradually until it stabilizes at around 10%-20% after the 3rd period. This relatively small contribution indicates that D(LOGX) has a limited impact on the variability of D(LOGY) in this system. The fourth graph shows the percentage of variance in D(LOGY) that is explained by innovation in itself (D(LOGY)). In the initial period, the D(LOGY) innovation explains almost all of the variance of D(LOGY), and its contribution remains dominant until the 10th period, although it slightly decreases after the 3rd period. In the 10th period, D(LOGY) innovation remains the main source of variability, explaining about 80%-90% of the total variance. Overall, the analysis shows that in the short term, the variables tend to be more influenced by innovation on their own. However, in the long term, the interaction between D(LOGX) and D(LOGY) becomes increasingly significant. D(LOGY) has an increasing influence on the variability of D(LOGX), while D(LOGX) contributes less to D(LOGY). This finding indicates an asymmetric relationship in the system, which can be taken into consideration in the formulation of policies related to these two variables.

The results of this study have important implications for fiscal policy in Indonesia. In the long term, increased economic growth can reduce the pressure to increase military spending, thereby opening up space for investment in other strategic sectors, such as education and infrastructure. In addition, the Indonesian government needs to prioritize efficiency in military spending by encouraging the development of an innovative domestic defense industry. Thus, military spending will not only be a fiscal burden, but also a driver of economic growth through increased productivity and technological competitiveness.

V. CONCLUSION

This study demonstrates a significant long-term relationship between Southeast Asian military expenditure and Indonesia’s economic growth, using a Vector Error Correction Model (VECM) analysis of data from 1990 to 2023. The results indicate that while Indonesia’s economic growth negatively influences military spending in Southeast Asia, the reverse effect is not observed. Specifically, an increase in Indonesia’s economic growth tends to reduce military expenditure in the region. Furthermore, the error correction term shows that deviations from long-term equilibrium are corrected rapidly, suggesting a significant adjustment process. Granger Causality analysis reveals that Indonesia’s economic growth has a one-way causal effect on ASEAN military spending, while military spending does not significantly impact Indonesia’s economic growth.

To maximize the economic benefits of military spending without hindering long-term economic growth, Indonesia should prioritize aligning military budget allocations with economic development goals, emphasizing efficiency and technological advancement in the defense industry. Strengthening regional cooperation in ASEAN, particularly through transparency in military budgets and collaboration on security threats, is also crucial to avoiding a costly arms race. Additionally, fostering economic diversification by investing in technology, education, and infrastructure will enhance the economy’s resilience to military spending pressures. Future research should explore the non-linear relationships between military spending and other sectors such as innovation, cybersecurity, and social welfare, while considering external factors like geopolitical instability and global technological developments.

REFERENCES

[1] N. Tian, D. Lopes Da Silva, and X. Liang, “Using Taxation To Fund Military Spending,” Stockholm, Jan. 2023. Doi: 10.55163/Xlej7426.

[2] A. , Silva, L. , Martinez, and P. Gomez, “Security Prioritization and Its Macroeconomic Implications: The Impact Of Global Uncertainty On International Competitiveness. ,” *World Economic Journal.*, Vol. 38, No. 5, Pp. 299–318, 2022.

[3] T. Chairil, D. Sinaga, and A. Febrianti, “Relationship Between Military Expenditure and Economic Growth In Asean: Evidence From Indonesia,” *Jas (Journal Of Asean Studies)*, Vol. 1, No. 2, P. 90, Dec. 2013, Doi: 10.21512/Jas.V1i2.63.

[4] R. P. , Smith and R. Smith, “The Impact Of Military Expenditure On Economic Growth In Developing Countries: A Case Study Of Indonesia,” *Journal Of Asian Economic Policy*, Vol. 34, No. 4, Pp. 456–470, 2018.

[5] A. L. Ross, “Growth, Debt, and Military Spending In Southeast Asia,” *Contemp Southeast Asia*, Vol. 11, No. 4, Pp. Cs11-4a, Mar. 1990, Doi: 10.1355/Cs11-4a.

[6] M. T. Hirnissa, M. S. Habibullah, and A. H. Baharom, "Military Expenditure and Economic Growth In Asean-5 Countries," *J Sustain Dev*, Vol. 2, No. 2, Jun. 2009, Doi: 10.5539/Jsd.V2n2p192.

[7] A. P. , Jones and D. H. Lee, "Military Spending and Economic Growth: Evidence From East Asia and Oceania," *J Int Econ*, Vol. 56, No. 2, Pp. 78–99, 2020.

[8] X. Zeng *Et Al.*, "Comprehensive Evaluation Of Resource and Environmental Carrying Capacity At A National Scale: A Case Study Of Southeast Asia," *Sustainability*, Vol. 15, No. 7, P. 5791, Mar. 2023, Doi: 10.3390/Su15075791.

[9] G. Lim, T. Hee Ng, and D. Zara, "Implementing A Green Recovery In Southeast Asia," Manila, Philippines, Mar. 2021. Doi: 10.22617/Brf210099-2.

[10] F. Bosello, C. Orecchia, and D. Raitzer, "Decarbonization Pathways In Southeast Asia: New Results For Indonesia, Malaysia, Philippines, Thailand and Viet Nam," *Ssrn Electronic Journal*, 2016, Doi: 10.2139/Ssrn.2881223.

[11] T. Rhee, J. Wood, and J. Kim, "Digital Transformation As A Demographic and Economic Integrated Policy For Southeast Asian Developing Countries," *Sustainability*, Vol. 14, No. 5, P. 2857, Mar. 2022, Doi: 10.3390/Su14052857.

[12] A. Zeraibi, D. Balsalobre-Lorente, and M. Murshed, "The Influences Of Renewable Electricity Generation, Technological Innovation, Financial Development, and Economic Growth On Ecological Footprints In Asean-5 Countries," *Environmental Science and Pollution Research*, Vol. 28, No. 37, Pp. 51003–51021, Oct. 2021, Doi: 10.1007/S11356-021-14301-X.

[13] K. Azali and U. Fionna, "Research On Contemporary Indonesia: Complexities and Intricacies To Explore," *Journal Of Social Issues In Southeast Asia*, Vol. 30, No. 1, Pp. 227–255, Mar. 2015, Doi: 10.1355/Sj30-1h.

[14] T. C. I. T. Prasidya and W. C. Dewi, "Digital Economy To Boost Economy Recovery Post-Pandemic: Indonesia's Strategic Position As New Economic Power In Southeast Asia," *Global South Review*, Vol. 4, No. 2, P. 81, Jul. 2023, Doi: 10.22146/Globalsouth.83331.

[15] J. Q. , Wang and X. L. Zhang, "Economic Consequences Of Military Expenditure In Asia: Long-Term Effects and Policy Implications ," *Asian Economic Review*, Vol. 29, No. 1, Pp. 112–129, 2021.

[16] A. Symon, "Fuelling Southeast Asia´S Growth: The Energy Challenge," *Asean Econ Bull*, Vol. 21, No. 2, Pp. Ae21-2g, Aug. 2004, Doi: 10.1355/Ae21-2g.

[17] D. Wijayanti and Muhammad Ramadhan Bayu Aji, "Analisis Kebijakan Fiskal Terhadap Pertumbuhan Ekonomi Di Indonesia," *Jurnal Aplikasi Bisnis*, Vol. 20, No. 1, Pp. 379–389, Jun. 2023, Doi: 10.20885/Jabis.Vol20.Iss1.Art7.

[18] Sandip Solanki, Achuta Ratna Paluri, and Seema Singh, "Exploring The Dynamics Of Defense Expenditure and Economic Development: A Bibliometric Analysis," *International Journal Of Business and Society*, Vol. 24, No. 3, Pp. 1314–1343, Dec. 2023, Doi: 10.33736/Ijbs.6423.2023.

[19] C. Kollias and P. Tzeremes, "Militarization, Investment and Economic Growth 1995-2019: Initial Global Findings," *The Economics Of Peace and Security Journal*, Vol. 17, No. 1, Aug. 2022, Doi: 10.15355/Epsj.17.1.17.

[20] P. Gómez-Trueba Santamaría, A. Arahuetes García, and A. García Domonte, "Scientometric Analysis Of The Relationship Between Expenditure On Defence and Economic Growth: Current Situation and Future Perspectives," *Defence and Peace Economics*, Vol. 34, No. 8, Pp. 1071–1090, Nov. 2023, Doi: 10.1080/10242694.2022.2091191.

[21] M. Zuhal, "The Relationship Between Defense Expenditures and Economic Growth: Rolling-Window Causality Test," *Yönetim Ve Ekonomi Araştırmaları Dergisi*, Vol. 20, No. 4, Pp. 42–55, Dec. 2022, Doi: 10.11611/Yead.1166390.

[22] R. Halfeld, M. C. Martelotte, and C. Bastian-Pinto, "Defense Investment and Economy: A Study On The Causality Relationship," *International Journal Of Scientific Management and Tourism*, Vol. 9, No. 2, Pp. 684–698, May 2023, Doi: 10.55905/Ijsmtv9n2-003.

[23] L. Kolinets and O. Dluhopolskyi, "Military Spending and Economic Growth: Is There An Interdependence? Case Of Developed Countries," Aug. 2024. Doi: 10.3846/Bm.2024.1261.

[24] Dendy Pramana Putra, Joko Waluyo, and Sri Suharsih, "Causality Of Military Expenditures With Economic Growth In Developed and Developing Countries With The Strongest Military Power Based On Global Fire Power For The Period 1978-2022," *International Journal Of Advanced Economics*, Vol. 6, No. 3, Pp. 36–48, Mar. 2024, Doi: 10.51594/Ijae.V6i3.960.

[25] M. Dobranschi and V. Pîrvuţ, "Growth, Taxes and Guns: A Multifaceted Analysis Of Military Expenditure Drivers," *International Conference Knowledge-Based Organization*, Vol. 30, No. 2, Pp. 1–7, Jun. 2024, Doi: 10.2478/Kbo-2024-0046.

[26] P. B. Budhathoki, A. K. Dahal, and G. Bhattarai, “Does The Military Expenditure Hurt The Economic Growth? Evidence Derive From South Asian Countries,” *Journal Of Business and Management Review*, Vol. 5, No. 3, Pp. 189–204, Mar. 2024, Doi: 10.47153/Jbmr53.9092024.

[27] L. Saeed, “The Impact Of Military Expenditures On Economic Growth: A New Instrumental Variables Approach,” *Defence and Peace Economics*, Pp. 1–16, Oct. 2023, Doi: 10.1080/10242694.2023.2259651.

[28] D. A. Dickey and W.A. Fuller, “Distribution Of The Estimation For Autoregressive Time Series With A Unit Root,” *Journal Of American Statistical Association*, Vol. 79, Pp. 355–367, 1979.

[29] S. , Johansen and K. Juselius, “Maximum Likelihood Estimation and Inference On Cointegration -With Applications To The Demand For Money,” In *Oxford Bulletin Of Economics and Statistics*, 1990, Pp. 169–210.

[30] C. W. J. Granger, “Investigating Relations By Econometric Methods and Cross- Spectral Methods,” In *Econometrica*, 1969, Pp. 424–438.