

Economic Growth under Threat: The Effects of Natural Disasters and Terrorism in Six ASEAN Countries

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ABSTRACT

This study examines the effects of natural disasters and terrorism on economic growth in six ASEAN countries—Indonesia, Malaysia, Thailand, Vietnam, the Philippines, and Cambodia—during 2010–2024. Using balanced panel data and the Fixed Effect Model, the study analyzes whether environmental and security shocks influence subsequent economic performance. Natural disasters and terrorism are measured with a one-period lag to capture their delayed economic effects. The results indicate negative relationships between both natural disasters and terrorism and economic growth. The estimated coefficients are -0.0138664 for natural disasters and -0.0787206 for terrorism, suggesting that both shocks constrain economic performance, with terrorism showing a relatively stronger negative association. The findings highlight the importance of disaster resilience and regional security policies for sustaining economic growth in ASEAN.

INTRODUCTION

Economic growth has long been regarded as one of the primary indicators of national development and economic prosperity. Sustained economic growth enables countries to increase income levels, reduce poverty, expand employment opportunities, and improve public welfare. According to endogenous growth theory, long-term economic growth is driven not only by capital accumulation but also by human capital, technological progress, institutional quality, and macroeconomic stability (Romer, 1990; Barro & Sala-i-Martin, 2004). Consequently, maintaining stable economic growth has become a major policy objective for both developed and developing countries because it provides the financial capacity necessary to support social development, infrastructure investment, and improvements in living standards (World Bank, 2024).

ASEAN has become one of the fastest-growing economic regions in the world over the past two decades. Rapid industrialization, increasing foreign direct investment, expanding regional trade, and demographic advantages have enabled several ASEAN economies to achieve relatively high and stable economic growth. Nevertheless, considerable differences remain across member countries. While Singapore, Vietnam, and Indonesia have experienced sustained economic expansion, other ASEAN countries continue to face structural constraints that hinder long-term growth. Moreover, the region remains highly vulnerable to external shocks arising from environmental disasters and security instability, both of which threaten economic resilience and sustainable development (Asian Development Bank, 2024; World Bank, 2024).

Natural disasters represent one of the most significant threats to economic growth in ASEAN. Located within the Pacific Ring of Fire and highly exposed to climate-related hazards, ASEAN countries frequently experience earthquakes, volcanic eruptions, floods, typhoons, droughts, and landslides. These disasters destroy physical infrastructure, disrupt production activities, reduce agricultural output, interrupt supply chains, and impose substantial fiscal burdens on governments through reconstruction spending (UNDRR, 2023). Consequently, natural disasters reduce productivity and investment while slowing both short-term and long-term economic growth.

Security instability also poses a serious challenge to economic performance. Terrorism remains a persistent concern in several ASEAN countries, including Indonesia, the Philippines, Myanmar, and Thailand. Terrorist incidents reduce investor confidence, discourage tourism, disrupt business activities, increase security expenditures, and weaken domestic consumption. In addition, prolonged insecurity discourages both domestic and foreign investment, thereby reducing capital accumulation and slowing economic growth (Institute for Economics & Peace, 2024).

Although numerous empirical studies have separately examined the effects of natural disasters or terrorism on economic growth, relatively few studies investigate their simultaneous effects within the ASEAN region. Most previous studies focus on either environmental shocks or security risks independently, making it difficult to understand their combined influence on regional economic performance. Furthermore, evidence covering multiple

ASEAN countries using recent panel data remains limited. This study addresses these gaps by simultaneously examining the effects of natural disasters and terrorism on economic growth in six ASEAN countries.

Therefore, this study aims to analyze the simultaneous and partial effects of natural disasters and terrorism on economic growth in six ASEAN countries. The findings are expected to enrich the literature on economic resilience by providing empirical evidence on how environmental and security risks shape economic performance in one of the world's most dynamic yet disaster-prone regions. The results also offer policy implications for strengthening disaster risk reduction, enhancing regional security, and promoting sustainable economic growth in ASEAN.

THEORETICAL REVIEW

Economic growth has long been explained through the **Neoclassical Growth Theory**, which emphasizes that long-run economic performance is primarily determined by capital accumulation, labor force expansion, and technological progress (Solow, 1956). According to this theory, sustained economic growth enables countries to increase production capacity, improve income levels, and enhance living standards. However, growth can be disrupted by external shocks that reduce productive capacity, destroy physical capital, and lower labor productivity. In particular, environmental disasters and security instability may impede economic activities by reducing investment, interrupting production processes, and increasing uncertainty. Therefore, while economic growth depends on the accumulation of productive resources, its sustainability is strongly influenced by a country's resilience to external disturbances.

From the perspective of **Endogenous Growth Theory**, long-term economic growth is generated through continuous investment in human capital, technological innovation, knowledge accumulation, and infrastructure development rather than relying solely on physical capital accumulation (Romer, 1990). Governments play a crucial role in creating an environment that supports innovation, productive investment, and institutional stability. Consequently, economic growth is not only influenced by internal economic policies but also by external risks that affect investment decisions and productivity. Natural disasters can destroy infrastructure and productive assets, while terrorism discourages domestic and foreign investment, reduces tourism revenues, and increases transaction and security costs. These conditions weaken capital accumulation and reduce the long-term growth potential of an economy.

The relationship between **natural disasters and economic growth** is explained by the theory of **Disaster Economics**, which argues that disasters generate significant direct and indirect economic losses. Direct losses include the destruction of infrastructure, industrial facilities, agricultural land, and public assets, whereas indirect losses arise from production disruptions, declining labor productivity, interrupted supply chains, and increased government expenditure for emergency response and reconstruction (Cavallo & Noy, 2011; UNDRR, 2023). Countries with limited fiscal capacity often experience prolonged economic slowdowns because reconstruction diverts public resources away from

productive investment. Although reconstruction activities may temporarily stimulate economic output, empirical evidence generally suggests that severe and frequent disasters reduce long-term economic growth, particularly in developing countries with weaker institutional capacity.

The impact of **terrorism on economic growth** can be understood through theories of **Political Instability and Investment Risk**. Terrorist activities create uncertainty that discourages private investment, foreign direct investment, tourism, and international trade while increasing security expenditures and business operating costs (Abadie & Gardeazabal, 2003). Persistent security threats reduce investor confidence, weaken consumer spending, and disrupt business operations, thereby slowing economic expansion. In addition, governments may be forced to reallocate public expenditure from productive sectors such as infrastructure, education, and innovation toward military and security operations, reducing the resources available to support long-term economic growth (Institute for Economics & Peace, 2024). Therefore, terrorism represents an important non-economic factor capable of undermining macroeconomic performance through multiple transmission channels.

These theoretical perspectives collectively suggest that economic growth is determined not only by the accumulation of capital and technological progress but also by a country's ability to manage environmental and security risks. Natural disasters reduce productive capacity by destroying physical and human capital, whereas terrorism weakens investment, trade, tourism, and economic confidence. Consequently, both factors are expected to exert negative effects on economic growth. Integrating natural disasters and terrorism into a unified analytical framework provides a comprehensive theoretical foundation for examining the determinants of economic growth in six ASEAN countries, where rapid economic development coexists with high exposure to environmental hazards and security challenges.

From the theory discussed previously, the following model was determined

$$\text{Ln_ECG}_{it} = \beta_0 + \beta_1 \text{Ln_BAL}_{it-1} + \beta_2 \text{Ln_TER}_{it-1} + \varepsilon \dots$$

ECG= Economic Growth

BAL= Natural Disaster

TER=Terorism

The hypothesis of this research is as follows:

- H1:** Natural disasters, terrorism are hypothesized to have a significant simultaneous effect on the Economic Growth in six ASEAN countries.
- H2:** Natural disasters are hypothesized to have a negative and significant effect on the Economic Growth in six ASEAN countries.
- H3:** Terrorism is hypothesized to have a negative and significant effect on the Economic Growth in six ASEAN countries.

The conceptual framework is as follows

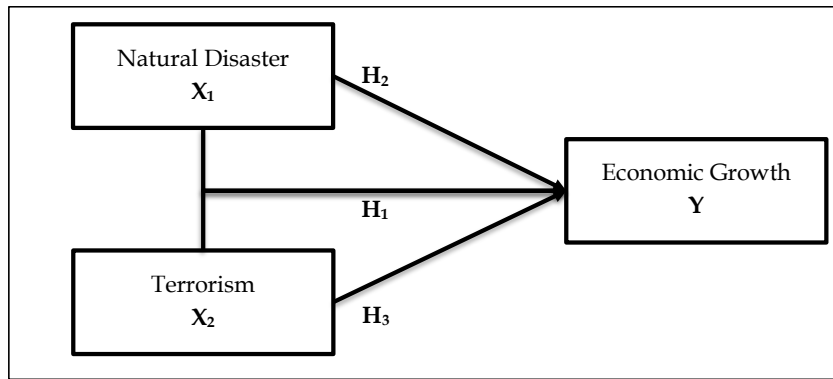


Figure 1. Conceptual Framework

METHODOLOGY

This study employs a quantitative research design to examine the effects of natural disasters and terrorism on economic growth in six ASEAN countries, namely Indonesia, Malaysia, Cambodia, the Philippines, Thailand, and Vietnam, over the period 2010–2024. The study uses balanced panel data comprising 90 country-year observations. The selection of these countries is based on the availability and consistency of annual data on economic growth, natural disasters, and terrorism, as well as their economic significance and varying exposure to environmental and security risks within the ASEAN region.

The study relies exclusively on secondary data obtained from internationally recognized sources. Economic growth data are obtained from the World Bank's World Development Indicators, while information on terrorism is derived from the Institute for Economics & Peace (IEP), particularly the Global Terrorism Index and related terrorism datasets. Data on natural disasters are obtained from internationally recognized disaster databases. Additional cross-checking is conducted using ASEANstats and other international sources to ensure consistency and comparability across countries and over time.

Economic growth is specified as the dependent variable and is measured by the annual percentage growth rate of real Gross Domestic Product (GDP). This measure reflects changes in the volume of economic production and is widely employed as an indicator of macroeconomic performance. Natural disasters and terrorism constitute the two principal explanatory variables. Natural disasters are measured by the annual number of recorded disaster events, capturing the frequency of environmental shocks affecting each country. Terrorism is measured by the annual number of recorded terrorist incidents, representing the intensity of security-related disturbances affecting economic activity. Both variables are expected to have negative effects on economic growth because environmental and security shocks can disrupt production, destroy physical capital, reduce investment, increase uncertainty, and impose additional fiscal and economic costs.

Panel data estimation is conducted using the Common Effect Model (CEM), Fixed Effect Model (FEM), and Random Effect Model (REM). Model specification is determined through a sequence of standard panel-data tests. The Chow test is employed to compare the Common Effect and Fixed Effect specifications, while

the Hausman test is used to determine whether the Fixed Effect or Random Effect specification is more appropriate. The Lagrange Multiplier (LM) test is additionally considered when determining the suitability of the Random Effect Model relative to the Common Effect Model. The model selected through these specification tests is subsequently employed for the main estimation.

The empirical analysis focuses on three hypotheses. The first hypothesis examines whether natural disasters and terrorism jointly exert a significant effect on economic growth. The second hypothesis tests whether natural disasters have a significant negative effect on economic growth, while the third hypothesis examines whether terrorism has a significant negative effect on economic growth. The simultaneous effect of the explanatory variables is evaluated through a joint significance test, while their individual effects are assessed based on the statistical significance and estimated coefficients of the respective variables. Statistical significance is evaluated at the conventional 1%, 5%, and 10% levels. All empirical estimations and statistical tests are performed using Stata.

RESULTS

The six ASEAN countries examined in this study—Indonesia, Malaysia, Thailand, Vietnam, the Philippines, and Cambodia—represent economies with different levels of economic development and varying exposure to natural disasters and terrorism. During the 2010–2024 period, the six countries generally maintained positive economic growth, although the magnitude and stability of growth varied considerably across countries and over time. Indonesia remained the largest economy among the sample countries, while Vietnam recorded relatively strong and sustained economic expansion. Malaysia and Thailand demonstrated relatively stable growth supported by their diversified economic structures, whereas the Philippines and Cambodia experienced continued economic expansion associated with increasing domestic economic activity and structural transformation.

The descriptive characteristics of the study variables also indicate substantial variation across the six ASEAN countries. Economic growth fluctuated over the study period, reflecting both country-specific developments and external shocks affecting the regional economy. The COVID-19 pandemic represents a particularly significant common shock, resulting in substantial contractions in economic activity in several sample countries in 2020, followed by varying degrees of economic recovery in subsequent years. These differences in growth performance provide important variation for examining the extent to which environmental and security-related shocks influence economic activity.

Natural disaster exposure varies substantially across the sample countries. Indonesia and the Philippines are among the countries with relatively high exposure to natural hazards due to their geographical location, extensive coastlines, and vulnerability to earthquakes, volcanic eruptions, floods, landslides, and tropical storms. Vietnam and Thailand also experience recurrent floods, storms, droughts, and other climate-related hazards, while Malaysia and Cambodia face floods, storms, droughts, and other environmental shocks at

varying levels of intensity. The frequency of natural disasters observed during the study period indicates that environmental shocks represent a persistent challenge to economic stability in the region. Such events can damage infrastructure and productive assets, disrupt supply chains, reduce agricultural and industrial production, and generate substantial public expenditure for emergency response and reconstruction.

Terrorism also exhibits considerable variation across the six countries. The Philippines, Indonesia, and Thailand have experienced higher levels of terrorist activity compared with several other countries in the sample, although the frequency and intensity of incidents have changed substantially over time. Terrorist incidents can generate economic uncertainty by disrupting business activities, reducing investor confidence, affecting tourism, increasing security expenditures, and damaging physical infrastructure. The relatively different patterns of terrorism across the sample countries provide an important basis for examining its potential relationship with economic growth.

Overall, the descriptive evidence indicates substantial cross-country and temporal variation in economic growth, natural disaster occurrence, and terrorism across the six ASEAN countries. This variation provides an appropriate empirical basis for the subsequent panel regression analysis. The analysis therefore proceeds to examine whether natural disasters and terrorism have statistically significant effects on economic growth, both individually and jointly, after accounting for country-specific and time-related differences through the selected panel-data estimation framework.

Prior to estimating the panel regression model, stationarity tests were conducted using the Levin-Lin-Chu (LLC) panel unit root test to ensure that all variables satisfied the basic assumptions of panel data analysis. Stationarity is an essential prerequisite because non-stationary variables may produce spurious regression results, leading to misleading statistical inferences. The LLC test simultaneously considers both the cross-sectional and time-series dimensions of panel data, making it particularly suitable for studies involving multiple countries observed over several years.

The empirical analysis examines the effects of natural disasters and terrorism on economic growth in six ASEAN countries—Indonesia, Malaysia, Thailand, Vietnam, the Philippines, and Cambodia—over the period 2010–2024. The analysis employs a panel-data framework in which economic growth is specified as the dependent variable, while natural disasters and terrorism are included as the principal explanatory variables. Both explanatory variables are introduced with a one-period lag in order to capture the possibility that the economic consequences of environmental and security shocks may extend beyond the period in which the events occur.

The model specification tests indicate that the Fixed Effect Model (FEM) is the most appropriate estimation technique. The Chow test produces a probability value of 0.0000, rejecting the null hypothesis that the countries share a common intercept and indicating the presence of significant country-specific effects. The Hausman test also produces a probability value of 0.0000, leading to the rejection of the Random Effect specification in favor of the Fixed Effect Model.

Accordingly, the subsequent interpretation is based on the Fixed Effect Model, which accounts for unobserved time-invariant characteristics that differ across the six ASEAN countries.

The estimated model is expressed as follows:

$$\ln ECG_{it} = 0.4184922 - 0.0138664 \ln BAL_{i,t-1} - 0.0787206 \ln TER_{i,t-1}$$

where (ECG_{it}) denotes economic growth in country (i) at time (t), ($BAL_{i,t-1}$) represents natural disasters in the preceding period, and ($TER_{i,t-1}$) represents terrorism in the preceding period. The specification therefore evaluates whether environmental and security shocks in period ($t-1$) are associated with economic growth in period (t).

The coefficient of natural disasters is negative, with an estimated value of -0.0138664 . This coefficient indicates an inverse relationship between natural disaster occurrence and subsequent economic growth. Holding terrorism constant, an increase in natural disaster occurrence in the preceding period is associated with a reduction in economic growth in the following period. Under the log-log specification, the coefficient implies that a 1% increase in natural disaster occurrence in the previous period is associated with an approximately 0.0139% decline in economic growth in the subsequent period, *ceteris paribus*.

The negative association between natural disasters and economic growth is consistent with the established empirical literature. Noy (2009) finds that natural disasters have statistically observable adverse macroeconomic effects in the short run, with more costly disasters producing larger slowdowns in economic activity. The study further shows that developing and smaller economies tend to experience larger output losses following disasters of comparable magnitude. Similarly, Loayza et al. (2012) demonstrate that the effect of natural disasters on economic growth varies according to disaster type and economic sector, while developing countries tend to be more sensitive to disaster shocks. A meta-analysis by Klomp and Valckx (2014) also reports a negative overall effect of natural disasters on economic growth, particularly for climatic disasters in developing countries.

The result is also consistent with more recent evidence from Indonesia. Abdulah et al. (2025), using panel data from 33 Indonesian provinces, find a significant relationship between natural disasters and economic growth and identify a fixed-effects-based specification as an appropriate approach for capturing the relationship. This evidence is particularly relevant to the present study because Indonesia is one of the six ASEAN countries examined and is highly exposed to different types of natural hazards.

Terrorism also exhibits a negative coefficient, estimated at -0.0787206 . The result indicates that greater terrorism activity in the preceding period is associated with lower economic growth in the subsequent period, holding natural disasters constant. Under the log-log specification, a 1% increase in terrorism in period ($t-1$) is associated with an approximately 0.0787% reduction in economic growth in period (t), *ceteris paribus*. The absolute magnitude of the terrorism coefficient is larger than that of natural disasters, suggesting that terrorism has a comparatively stronger negative association with economic growth within the estimated model.

The negative relationship between terrorism and economic growth is consistent with evidence from ASEAN. Pessela and Saksono (2022), using a Fixed Effect Model for four ASEAN countries—Indonesia, the Philippines, Thailand, and Myanmar—find that terrorism has a negative and statistically significant effect on economic growth. Their findings provide particularly relevant regional evidence supporting the direction of the terrorism coefficient obtained in the present study.

Evidence from a broader international sample also supports this relationship. Park and Woo (2024), using time-series cross-national data covering 131 countries from 1970 to 2020, report a statistically significant detrimental effect of terrorism on economic growth across various model specifications. Their analysis further indicates that the adverse association is particularly pronounced for domestic terrorism. Similarly, Abadie and Gardeazabal (2003), in their analysis of the Basque Country, demonstrate substantial economic costs associated with conflict and terrorism, including reductions in economic activity and investment.

The stronger absolute coefficient associated with terrorism in the present model may reflect the broader economic consequences of security-related shocks. Terrorism can affect economic activity not only through direct physical destruction but also through uncertainty, declining investor confidence, reduced tourism, disruptions to business operations, and increased security expenditure. These mechanisms may generate persistent effects beyond the immediate occurrence of terrorist incidents. The lagged specification employed in the present study is therefore economically meaningful because investment and production decisions may respond to perceived security risks with a delay.

Taken together, the estimated coefficients indicate that both environmental and security shocks are negatively associated with subsequent economic growth in the six ASEAN countries. The findings are broadly consistent with previous empirical studies, although the magnitude and statistical significance of these relationships should be interpreted according to the full regression output, including the corresponding standard errors, t-statistics, probability values, and joint significance statistics. The present evidence therefore provides a basis for examining whether natural disasters and terrorism jointly constitute significant constraints on economic growth in ASEAN.

Importantly, the results should not be interpreted as implying that all natural disasters necessarily reduce growth to the same extent. Previous research demonstrates that the economic effects of disasters differ according to their type, severity, timing, and sectoral exposure. Loayza et al. (2012), for example, find that some moderate disasters may generate temporary positive effects in particular sectors, while severe disasters generally produce more adverse consequences. Thus, the negative coefficient observed in the present aggregate model should be understood as the average relationship between the measured frequency of natural disasters and economic growth across the six countries and the study period.

Overall, the empirical results suggest that economic growth in the selected ASEAN countries is influenced not only by conventional economic processes but also by exposure to environmental and security shocks. The negative coefficients of both natural disasters and terrorism highlight the importance of economic resilience, disaster-risk management, and regional security in sustaining economic growth. These findings are particularly relevant for ASEAN economies, where high exposure to natural hazards coexists with varying levels of terrorism and security risks.

DISCUSSION

The empirical findings indicate that both natural disasters and terrorism are negatively associated with economic growth in the six ASEAN countries. The Fixed Effect Model provides evidence that country-specific characteristics are important in explaining differences in economic performance across the sample, while the estimated coefficients indicate that environmental and security shocks are associated with subsequent reductions in economic growth. The negative coefficients of both explanatory variables are consistent with the theoretical expectation that shocks that destroy productive capacity, disrupt economic activity, and increase uncertainty can constrain economic performance.

The coefficient of natural disasters is estimated at **-0.0138664**, indicating a negative relationship between natural disasters in the preceding period and economic growth in the current period. This result suggests that the economic consequences of natural disasters may extend beyond the year in which the disaster occurs. Natural disasters can destroy physical capital, infrastructure, agricultural assets, and productive facilities, while simultaneously disrupting transportation, supply chains, employment, and household income. These mechanisms reduce productive capacity and may constrain economic activity during the subsequent recovery period. The finding is consistent with Noy (2009), who demonstrates that natural disasters can generate significant short-term macroeconomic consequences and that the magnitude of economic losses depends on the severity of the disaster and the characteristics of the affected economy.

The finding is also consistent with Loayza et al. (2012), who show that natural disasters affect economic growth differently depending on disaster type, severity, and economic sector. Their cross-country analysis finds that severe disasters generally produce negative growth effects, while developing countries tend to be more sensitive to disaster shocks because of their greater economic vulnerability and more limited capacity to absorb and recover from large losses. This explanation is particularly relevant to the ASEAN context, where several countries are highly exposed to earthquakes, floods, tropical storms, volcanic eruptions, droughts, and other natural hazards.

The negative relationship identified in the present study is further supported by evidence from Indonesia. Abdulah et al. (2025), using provincial panel data, find a significant relationship between natural disasters and economic growth and employ fixed-effects-based specifications to account for unobserved heterogeneity across regions. Their findings demonstrate that natural disasters constitute an important economic shock within one of the largest ASEAN economies. The consistency between the present ASEAN-level findings and the Indonesian

evidence strengthens the argument that disaster exposure represents an important constraint on economic performance in disaster-prone developing economies.

The coefficient of terrorism is also negative, with an estimated value of -0.0787206 . This result indicates that higher terrorism activity in the preceding period is associated with lower economic growth in the following period, holding natural disasters constant. The absolute magnitude of the terrorism coefficient is larger than that of natural disasters, suggesting that terrorism has a comparatively stronger negative association with economic growth within the estimated specification. This result is consistent with the argument that terrorism affects economic activity through both direct and indirect channels, including physical destruction, investment uncertainty, reduced tourism, disruption of business operations, and increased security-related expenditure.

The ASEAN-specific evidence provided by Pessela and Saksono (2022) is particularly relevant to the present study. Their analysis of Indonesia, the Philippines, Thailand, and Myanmar using a Fixed Effect Model finds that terrorism has a negative and statistically significant effect on economic growth. Their findings are highly consistent with the direction of the terrorism coefficient in the present study and suggest that terrorism represents an important economic constraint within Southeast Asia.

The result is also supported by Park and Woo (2024), who examine 131 countries over the period 1970–2020 and find a statistically significant detrimental effect of terrorism on economic growth across different model specifications. Their findings indicate that the negative association is particularly evident for domestic terrorism. This broader international evidence supports the argument that the negative relationship between terrorism and economic growth is not limited to a particular country or region but can emerge across diverse economic and institutional settings.

The economic mechanism underlying the negative terrorism coefficient can be explained through investment and uncertainty channels. Terrorist activity increases uncertainty regarding future economic conditions and may therefore discourage firms from undertaking investment and expansion. Abadie and Gardeazabal (2003), in their analysis of the Basque Country, provide particularly strong evidence that terrorism generated substantial economic costs, with per capita GDP declining relative to a synthetic control region following the emergence of terrorist conflict. They also find that the credibility of a ceasefire was associated with improved relative performance of firms with significant business exposure to the region. These findings demonstrate how security conditions can influence economic expectations, investment decisions, and ultimately aggregate economic performance.

An important feature of the present study is the use of **one-period lagged natural disaster and terrorism variables**. This specification suggests that the economic consequences of environmental and security shocks are not necessarily confined to the period in which the events occur. In the case of natural disasters, the reconstruction of infrastructure, restoration of productive capacity, and recovery of employment and household income may require several periods. Similarly, terrorism can have persistent effects because firms and households may

adjust their investment, consumption, and location decisions in response to continuing perceptions of insecurity. The lagged specification therefore provides an economically plausible mechanism through which shocks in period $t-1$ influence economic growth in period t .

The relative magnitude of the coefficients provides an additional insight. The estimated coefficient for terrorism (-0.0787206) is larger in absolute terms than the coefficient for natural disasters (-0.0138664). Within the present model, this indicates that terrorism is associated with a stronger reduction in economic growth than natural disasters, although the coefficients should not be interpreted as directly comparable measures of total economic damage because the two variables may differ in their measurement scales and underlying distributions. Nevertheless, the result highlights the importance of security conditions for economic performance in ASEAN.

The simultaneous inclusion of natural disasters and terrorism in the same model also provides an important contribution to the empirical literature. Natural disasters and terrorism represent different types of shocks, but both can reduce economic activity through disruptions to productive capacity and economic confidence. Natural disasters primarily operate through physical destruction and disruption of production, whereas terrorism may operate more strongly through uncertainty, investment risk, tourism losses, and changes in economic expectations. Examining the two factors within a unified panel framework therefore provides a broader assessment of the non-economic risks facing economic growth in ASEAN.

From a policy perspective, the findings suggest that strategies to sustain economic growth in ASEAN should incorporate both **disaster resilience and security resilience**. Disaster-risk reduction, resilient infrastructure, early-warning systems, emergency preparedness, and efficient post-disaster reconstruction can reduce the persistence of economic losses following natural disasters. The importance of such policies is supported by the broader disaster literature, which emphasizes that the economic consequences of disasters depend not only on the occurrence of the shock but also on the capacity of economies to absorb and recover from it.

Similarly, strengthening counter-terrorism institutions, regional security cooperation, and protection of economic infrastructure can contribute to a more stable investment and business environment. The ASEAN-specific evidence from Pessela and Saksono (2022) and the broader international evidence from Park and Woo (2024) both indicate that terrorism can represent a significant constraint on economic growth. Therefore, security policy should not be considered separately from economic policy but rather as part of a broader strategy for maintaining economic stability and resilience.

Overall, the findings demonstrate that **economic growth in the six ASEAN countries is vulnerable to both environmental and security shocks**. Natural disasters and terrorism exhibit negative relationships with subsequent economic growth, with terrorism showing the larger coefficient in absolute terms within the estimated model. The findings are broadly consistent with previous empirical evidence and reinforce the importance of integrating disaster-risk management

and security policies into national and regional economic-development strategies. For ASEAN, strengthening resilience against both environmental and security shocks is therefore essential for maintaining stable and sustainable economic growth.

CONCLUSIONS AND RECOMMENDATIONS

This study provides empirical evidence on the relationship between natural disasters, terrorism, and economic growth in six ASEAN countries – Indonesia, Malaysia, Thailand, Vietnam, the Philippines, and Cambodia – over the period 2010–2024. Using a panel-data framework and the Fixed Effect Model, the findings indicate that both natural disasters and terrorism exhibit negative relationships with subsequent economic growth. The estimated coefficient of natural disasters is -0.0138664 , while the coefficient of terrorism is -0.0787206 , indicating that environmental and security shocks are associated with lower economic growth in the subsequent period.

The findings suggest that natural disasters can constrain economic growth through the destruction of productive assets and infrastructure, disruption of production and supply chains, and the diversion of public and private resources toward recovery and reconstruction. Similarly, terrorism can adversely affect economic performance by increasing economic uncertainty, weakening investment confidence, disrupting business and tourism activities, and increasing security-related costs. The larger absolute coefficient of terrorism compared with natural disasters suggests that, within the estimated model, terrorism has a stronger negative association with economic growth, although the coefficients should be interpreted in accordance with the respective measurement characteristics of the two variables.

An important contribution of this study is its focus on the lagged effects of environmental and security shocks. By incorporating natural disasters and terrorism with a one-period lag, the analysis recognizes that their economic consequences may persist beyond the period in which the shocks occur. The results therefore highlight the importance of considering economic recovery and adjustment processes when evaluating the effects of disasters and terrorism on economic growth. The findings also reinforce the importance of country-specific characteristics in explaining economic performance across ASEAN, as indicated by the selection of the Fixed Effect Model.

FURTHER STUDY

Future research should extend the analytical framework by incorporating additional economic, institutional, and environmental variables that may influence the relationship between natural disasters, terrorism, and economic growth. Potential variables include institutional quality, government effectiveness, political stability, public investment, trade openness, foreign direct investment, inflation, unemployment, financial development, climate change, and disaster preparedness. Incorporating these factors would provide a more comprehensive understanding of the mechanisms through which environmental and security shocks affect economic growth in ASEAN countries.

Future studies are also encouraged to employ more advanced econometric approaches to address potential methodological limitations and capture the dynamic nature of the relationship between natural disasters, terrorism, and economic growth. Methods such as the System Generalized Method of Moments (System-GMM), Panel Vector Autoregression (PVAR), and dynamic panel models could be employed to address potential endogeneity, reverse causality, and persistence in economic growth. Spatial panel models could also provide valuable insights into the geographical spillover effects of natural disasters and terrorism, particularly given the increasing economic and geographical interconnectedness among ASEAN countries.

Further research could also examine the heterogeneous effects of natural disasters and terrorism across countries and economic sectors. The magnitude of these effects may differ depending on institutional capacity, income levels, economic structure, disaster preparedness, and the effectiveness of government responses. Distinguishing between different types and intensities of natural disasters and terrorism would provide a more precise assessment of their economic consequences. In particular, future studies could investigate whether severe disasters generate nonlinear or threshold effects on economic growth and whether improvements in institutional resilience can mitigate these adverse impacts.

Finally, expanding the geographical scope beyond the six ASEAN countries to include other Southeast Asian economies, developing regions, or comparative regional economic blocs would enhance the external validity of the findings. Future research may also examine whether regional cooperation, disaster-risk management, and counter-terrorism policies moderate the adverse effects of environmental and security shocks on economic growth. Such extensions would contribute to a deeper understanding of economic resilience and provide stronger evidence for designing policies aimed at promoting stable, inclusive, and sustainable economic growth in disaster-prone and security-sensitive economies.

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