

## The Role of Digital Connectivity in Economic Growth under Global Economic Uncertainty: Evidence from ASEAN Countries

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### Abstract

**Purpose:** This empirical study investigates the influence of digital connectivity on economic growth amidst global economic uncertainty in ASEAN countries, and examines its potential moderating effect on the relationship between global economic uncertainty and economic growth.

**Design/methodology/approach:** The analysis utilizes balanced panel data from seven ASEAN countries spanning the period 2011–2024. Economic growth is quantified using the natural logarithm of GDP, digital connectivity is represented by the percentage of Internet users in the population, and global economic uncertainty is measured by the World Uncertainty Index (WUI). The Random Effects Model was selected as the most suitable estimation method, based on the results of the Chow, Hausman, and Breusch–Pagan Lagrange Multiplier tests. HC1 heteroskedasticity-consistent robust standard errors were employed following the detection of heteroskedasticity and serial correlations through diagnostic tests.

**Findings:** The findings indicate that digital connectivity exerts a positive and statistically significant impact on economic growth, while global economic uncertainty does not have a significant direct effect. Furthermore, the interaction between digital connectivity and global economic uncertainty is found to be insignificant, suggesting that digital connectivity does not moderate the relationship between global economic uncertainty and economic growth.

**Practical implications:** These results imply that enhancing digital infrastructure and improving Internet accessibility are crucial for promoting sustainable economic growth in ASEAN, although digitalization alone is inadequate to counteract the negative effects of global economic uncertainty.

**Originality/value:** This study contributes to the literature by providing recent evidence that digital connectivity acts as a direct catalyst for economic growth rather than a moderating mechanism under conditions of global economic uncertainty in ASEAN countries.

**Paper type:** Empirical.

**Keywords:** Digital Connectivity, Economic Growth, Global Economic Uncertainty, ASEAN, Panel Data Analysis.

### 1. Introduction

Global economic uncertainty has become one of the most prominent challenges confronting both developed and developing economies in the past decade. Escalating geopolitical conflicts, persistent inflation, monetary policy tightening, climate-related disasters, and disruptions to global supply chains have substantially increased uncertainty in the international economic environment. These shocks have adversely affected international trade, investment decisions, business confidence, and productivity, ultimately constraining economic growth worldwide. The World Uncertainty Index (WUI) has shown a significant increase following major global events, including the COVID-19 pandemic, the Russia–Ukraine conflict, and the recent escalation of geopolitical fragmentation, highlighting the growing vulnerability of national economies to external disturbances. As economies become increasingly interconnected, the transmission of global uncertainty across countries has intensified, making economic resilience a central concern for policymakers.

Among developing regions, ASEAN represents an important case for examining the relationship between global uncertainty and economic performance. ASEAN has emerged as one of the world's fastest-growing economic blocs, with a combined gross domestic product exceeding USD 3.9 trillion

in 2024, making it the fifth-largest economy globally. The region is characterized by strong export orientation, increasing foreign direct investment, and deep integration into global value chains. While these characteristics have contributed to sustained economic expansion, they also expose ASEAN countries to external shocks originating from global financial markets, international trade disruptions, and geopolitical instability. Consequently, maintaining stable economic growth under an increasingly uncertain global environment has become a major policy priority for ASEAN governments.

At the same time, ASEAN has experienced remarkable progress in digital transformation. According to the International Telecommunication Union (ITU), global Internet usage reached approximately 68% of the world's population in 2024, while ASEAN has become one of the fastest-growing digital markets globally. The region's digital economy is projected to exceed USD 300 billion by 2025, supported by rapid growth in internet penetration, e-commerce, digital payments, and online business activities. Digital connectivity has therefore evolved beyond being merely a technological indicator; it has become an essential economic infrastructure that facilitates information exchange, improves productivity, lowers transaction costs, expands market access, and supports business continuity. These characteristics suggest that digital connectivity may strengthen countries' capacity to sustain economic activities during periods of heightened global uncertainty.

Despite the rapidly expanding literature on economic uncertainty and digital transformation, important gaps remain. Previous studies have primarily examined the direct impact of global economic uncertainty on economic growth or investigated the contribution of digitalisation to economic performance as an independent growth determinant. Existing research has focused predominantly on digital finance, financial technology, information and communication technology (ICT), or composite digital economy indices. However, limited attention has been given to whether digital connectivity itself can enhance economic resilience by mitigating the adverse effects of global uncertainty. Moreover, empirical evidence for ASEAN remains relatively scarce despite the region's rapid digital transformation and substantial exposure to external economic shocks. This limitation restricts our understanding of whether digital connectivity functions merely as a driver of economic growth or also serves as a resilience-enhancing mechanism under uncertain global conditions.

From a theoretical perspective, this study integrates Endogenous Growth Theory and Economic Resilience Theory. Endogenous Growth Theory argues that technological progress and knowledge accumulation are fundamental drivers of long-run economic growth, while Economic Resilience Theory suggests that economies possessing stronger adaptive capacities are better able to absorb and recover from external shocks. Digital connectivity, through wider Internet access and improved digital infrastructure, may simultaneously enhance productivity and strengthen adaptive capacity during periods of uncertainty. Nevertheless, empirical evidence remains inconclusive regarding whether digital connectivity actually moderates the relationship between global economic uncertainty and economic growth, particularly in emerging regional economies such as ASEAN.

Accordingly, this study investigates the role of digital connectivity in economic growth under global economic uncertainty using balanced panel data from seven ASEAN countries covering the period 2011–2024. Specifically, the study examines the direct effects of global economic uncertainty and digital connectivity on economic growth and evaluates whether digital connectivity moderates the impact of global uncertainty. By combining the World Uncertainty Index with Internet penetration in a panel data framework, this study contributes to the literature in three ways. First, it extends previous research by examining digital connectivity as a potential resilience mechanism rather than solely as a growth determinant. Second, it provides updated empirical evidence using recent ASEAN data that capture post-pandemic and geopolitical uncertainty. Third, it offers policy implications regarding the development of digital infrastructure as a strategy for promoting sustainable economic growth in an increasingly uncertain global environment.

## **2. Literature Review and Hypotheses Development**

### **Theoretical Foundation**

#### **Endogenous Growth Theory**

The relationship between digital connectivity and economic growth can be explained by Endogenous Growth Theory, originally developed by Paul Romer (1986, 1990). Unlike the neoclassical growth model, Endogenous Growth Theory argues that long-run economic growth is primarily driven by technological progress, knowledge accumulation, innovation, and human capital rather than by

exogenous technological change. Investment in information and communication technology (ICT) and digital infrastructure enhances productivity by facilitating knowledge diffusion, reducing transaction costs, improving market efficiency, and stimulating innovation. Consequently, greater digital connectivity enables firms and households to access information more efficiently, improve resource allocation, and increase economic productivity, thereby promoting sustainable economic growth.

Within the ASEAN context, rapid improvements in internet penetration, digital platforms, and e-commerce have accelerated digital transformation and expanded economic opportunities. These developments suggest that digital connectivity should be viewed as a productive form of infrastructure capable of supporting long-run economic growth.

### **Economic Resilience Theory**

While Endogenous Growth Theory explains the direct contribution of digital connectivity to economic growth, Economic Resilience Theory provides the conceptual basis for understanding how economies respond to external shocks.

Economic resilience refers to the ability of an economy to absorb, adapt to, and recover from unexpected disturbances while maintaining its core economic functions. Countries with stronger adaptive capacity are generally more capable of limiting the adverse effects of crises, uncertainty, and global disruptions.

Digital connectivity may strengthen economic resilience by enabling firms to maintain production, facilitating digital trade, supporting remote working arrangements, expanding access to financial services, and improving the dissemination of market information during periods of uncertainty. Therefore, digital connectivity is expected not only to stimulate economic growth directly but also to reduce the adverse consequences of global economic uncertainty.

However, whether digital connectivity actually functions as a resilience-enhancing mechanism remains an empirical question.

### **Global Economic Uncertainty and Economic Growth**

Economic uncertainty has long been recognised as an important determinant of macroeconomic performance. According to Real Options Theory, firms tend to postpone investment decisions when uncertainty increases, while households reduce consumption because of precautionary behaviour. Consequently, elevated uncertainty may weaken aggregate demand and reduce economic growth.

Empirical evidence generally supports this argument. Studies have shown that increases in the World Uncertainty Index are associated with lower investment, slower trade expansion, and weaker economic growth. Nevertheless, the magnitude of these effects differs considerably across countries depending on institutional quality, economic structure, and policy responses.

More recent studies suggest that emerging economies may exhibit greater resilience to global uncertainty than previously expected because of stronger domestic demand and regional economic integration. This implies that the relationship between global uncertainty and economic growth may not be uniform across ASEAN countries.

### **Digital Connectivity and Economic Growth**

Digital connectivity has become one of the principal drivers of economic development in both developed and developing economies. Improvements in internet accessibility enhance productivity by reducing information asymmetry, lowering transaction costs, encouraging innovation, and facilitating market expansion.

Empirical studies consistently report a positive relationship between digitalisation and economic growth. Jing and Ab-Rahim (2020) found that ICT significantly contributes to economic growth in ASEAN-5 countries. Similarly, Ali et al. (2018), Zhang et al. (2022), Feng and Qi (2024), Ahmad Radhi et al. (2024), and Mahroof et al. (2025) conclude that digital infrastructure and internet penetration stimulate economic performance by supporting technological innovation and business digitalisation.

Recent reports also indicate that ASEAN has become one of the world's fastest-growing digital regions, with increasing internet penetration and expanding digital markets. These developments suggest that digital connectivity has evolved beyond a technological indicator and now constitutes an important determinant of regional economic competitiveness.

### **Can Digital Connectivity Buffer Global Economic Uncertainty?**

Although previous studies consistently demonstrate the positive contribution of digitalisation to economic growth, considerably less attention has been devoted to its potential role during periods of global uncertainty.

From the perspective of Economic Resilience Theory, digital connectivity may strengthen economic resilience by enabling firms to continue operating despite external disruptions. Digital platforms facilitate online transactions, remote working, digital financial services, and efficient communication, all of which may reduce the economic costs associated with uncertainty.

However, empirical evidence remains inconclusive. Cheng and Masron (2023) argue that digital transformation can improve firms' adaptability under uncertain conditions, whereas Yang et al. (2026) emphasise that resilience depends not only on digitalisation but also on investment, institutional quality, demographic characteristics, and human capital. Similarly, Sermcheep (2024) highlights substantial differences in digital readiness among ASEAN countries, suggesting that internet connectivity alone may be insufficient to enhance resilience.

These mixed findings indicate that the moderating role of digital connectivity remains underexplored and warrants further empirical investigation.

### **Research Gap and Hypothesis Development**

Despite the rapidly growing literature on digitalisation and economic growth, several important research gaps remain.

First, previous studies have predominantly focused on the direct effects of digitalisation on economic performance. Limited attention has been given to whether digital connectivity alters the relationship between global economic uncertainty and economic growth.

Second, existing research mainly employs indicators such as ICT development, digital finance, fintech, or composite digital economy indices. Few studies specifically investigate internet connectivity as an independent dimension of digital transformation.

Third, empirical evidence for ASEAN remains relatively limited despite the region's rapid digital transformation and increasing exposure to global economic uncertainty.

Finally, recent geopolitical conflicts, post-pandemic recovery, and global supply-chain disruptions have substantially altered the international economic environment, yet empirical evidence using recent panel data remains scarce.

Accordingly, this study addresses these gaps by examining the direct effects of global economic uncertainty and digital connectivity on economic growth while also investigating whether digital connectivity moderates the relationship between uncertainty and economic growth using balanced panel data from seven ASEAN countries covering the period 2011–2024.

Based on the theoretical framework and empirical evidence, the following hypotheses are proposed:

**H<sub>1</sub>:** Global economic uncertainty negatively affects economic growth.

**H<sub>2</sub>:** Digital connectivity positively affects economic growth.

**H<sub>3</sub>:** Digital connectivity moderates the relationship between global economic uncertainty and economic growth.

**H<sub>4</sub>:** Inflation negatively affects economic growth.

**H<sub>5</sub>:** Urbanisation growth positively affects economic growth.

## **3. Research Method**

### **Research Design**

This study employs a quantitative research design using balanced panel data to examine the direct and moderating effects of digital connectivity on economic growth under global economic uncertainty in ASEAN countries. Panel-data analysis is appropriate because it simultaneously captures both cross-country heterogeneity and temporal dynamics while improving estimation efficiency compared with pure cross-sectional or time-series approaches. The empirical analysis covers seven ASEAN countries over the period 2011–2024, yielding 98 balanced observations.

The analysis proceeds through four stages. First, descriptive statistics and correlation analysis are conducted to understand the characteristics and preliminary relationships among the variables. Second, three alternative panel-data estimators—Pooled Ordinary Least Squares (POLS), Fixed Effects Model (FEM), and Random Effects Model (REM)—are estimated. Model selection is performed sequentially using the Chow, Hausman, and Breusch–Pagan Lagrange Multiplier tests. Third, several diagnostic tests, including multicollinearity, cross-sectional dependence, heteroskedasticity, and serial correlation, are conducted to evaluate the validity of the estimated models. Finally, because the selected model

exhibits heteroskedasticity and serial correlation, HC1 heteroskedasticity-consistent robust standard errors are employed to obtain reliable statistical inference.

### Data Sources

This study relied exclusively on secondary data obtained from internationally recognized databases. Economic growth, inflation, urbanization growth, and the number of Internet users were collected from the World Development Indicators (WDI) published by the World Bank. Global economic uncertainty was measured using the World Uncertainty Index (WUI), which quantifies uncertainty by measuring the frequency of uncertainty-related terms in the Economist Intelligence Unit (EIU) country report.

**Table 1. Variable and Data Sources**

| Variable                          | Measurement                                 | Source                           |
|-----------------------------------|---------------------------------------------|----------------------------------|
| Economic Growth (GDP)             | Natural logarithm of Gross Domestic Product | World Bank                       |
| Global Economic Uncertainty (WUI) | World Uncertainty Index                     | World Uncertainty Index Database |
| Digital Connectivity              | Internet Users (% of Population)            | World Bank                       |
| Inflation                         | Consumer Price Index (Annual %)             | World Bank                       |
| Urbanization Growth               | Urban Population Growth (Annual %)          | World Bank                       |

### Variable Measurement

#### Dependent Variable

Economic growth (GDP) is the dependent variable. Following previous macroeconomic studies, the natural logarithm of the gross domestic product was used to reduce heteroscedasticity and normalize the distribution of the data.

#### Independent Variable

Global Economic Uncertainty (WUI) represents the degree of uncertainty faced by each country. Higher values indicate greater uncertainty in future economic conditions.

#### Control Variables

Digital connectivity is proxied by Internet Users (% of the population). This variable reflects the proportion of individuals using the Internet and serves as an indicator of a country's digital infrastructure and connectivity. Higher Internet penetration facilitates information exchange, digital transactions, online business activities, and communication, thereby potentially strengthening economic resilience during heightened uncertainty periods.

Inflation is included to capture macroeconomic stability, while urbanization growth controls for demographic and structural changes.

### Empirical Model

To estimate the direct effects of global uncertainty and digital connectivity on economic growth, the following baseline model was estimated.

$$GDP_{it} = \alpha_0 + \alpha_1 WUI_{it} + \alpha_2 DC_{it} + \alpha_3 INF_{it} + \alpha_4 URB_{it} + \epsilon_{it} \quad (1)$$

where:

- GDP denotes the natural logarithm of gross domestic product;
- WUI represents the World Uncertainty Index.
- DC denotes digital connectivity, measured by Internet Users (% of the population).
- INF represents inflation.
- URB denotes urbanization growth (URB).
- *i* refers to country;
- *t* refers to year.

### Estimation Procedure

#### The empirical analysis followed several steps.

First, descriptive statistics were computed to examine the distribution and characteristics of variables. Correlation analysis was performed to identify preliminary relationships among the variables.

Second, three alternative panel regression models are estimated: the common effects model (Pooled Ordinary Least Squares), Fixed Effects Model (FEM), and Random Effects Model (REM).

Model selection was conducted using Chow, Hausman, and Breusch–Pagan Lagrange Multiplier (LM) tests. The Chow test determines whether the fixed-effects model is preferable to the pooled model. The Hausman test evaluates the consistency of the Random Effects estimator relative to the Fixed Effects estimator. Finally, the LM test compares the Random Effects Model with the pooled model.

Third, several diagnostic tests were performed to ensure the validity of the estimated models. Multicollinearity was examined using the Variance Inflation Factor (VIF). Heteroscedasticity was tested using the Breusch–Pagan test. Autocorrelation was evaluated using the Wooldridge test for panel data and the Breusch–Godfrey serial correlation test. The normality of the residuals was assessed using the Jarque–Bera test.

When heteroscedasticity or serial correlation is detected, robust standard errors are estimated using a heteroscedasticity-consistent covariance matrix estimator (HC-Cov). To further improve the reliability of the results, Driscoll and Kraay's robust standard errors were employed as a robustness check because they are robust to heteroscedasticity, serial correlation, and cross-sectional dependence.

All statistical analyses were conducted using R statistical software (version 4.4 or later) employing the packages plm, lmtest, sandwich, car, and stargazer.

## 4. Result and Discussion

### Descriptive Statistics

Table 1 presents the descriptive statistics of the variables used in this study based on a balanced panel dataset comprising 98 observations from seven ASEAN countries over the period 2011–2024. The average value of the natural logarithm of GDP is 26.300, with a standard deviation of 1.260, indicating moderate variation in economic size across the sampled countries. Inflation averages 3.476%, although its relatively high standard deviation (4.401) and wide range, from –0.693% to 24.422%, suggest considerable differences in macroeconomic conditions both across countries and over time. Digital connectivity, measured by Internet Users as a percentage of the population, records an average of 58.096%, ranging from 17.500% to 98.021%, reflecting substantial disparities in Internet penetration among ASEAN economies.

The World Uncertainty Index (WUI) has a mean value of 0.126 and a standard deviation of 0.088, indicating that the sampled countries experienced varying levels of global economic uncertainty during the study period. Urbanization growth averaged 2.338%, with values ranging from –2.913% to 4.858%, suggesting heterogeneous urban development patterns across the region. Overall, the descriptive statistics reveal sufficient variation in both the dependent and explanatory variables, supporting the suitability of the dataset for panel data analysis and enabling the investigation of the relationships between digital connectivity, global economic uncertainty, and economic growth in ASEAN countries.

**Table 2. Descriptive Statistics**

| Variable                         | Obs. | Mean   | Std. Dev. | Min    | Max    |
|----------------------------------|------|--------|-----------|--------|--------|
| GDP (ln)                         | 98   | 26.300 | 1.260     | 22.914 | 27.965 |
| Inflation (%)                    | 98   | 3.476  | 4.401     | -0.693 | 24.422 |
| Internet Users (% of population) | 98   | 58.096 | 25.592    | 17.500 | 98.021 |
| World Uncertainty Index          | 98   | 0.126  | 0.088     | 0.001  | 0.384  |
| Urbanisation Growth (%)          | 98   | 2.338  | 1.113     | -2.913 | 4.858  |

Source(s): Authors' own creation, 2026

### Correlation Analysis and Multicollinearity

Table 2 reports the correlation matrix and the Variance Inflation Factor (VIF) values for all variables included in the analysis. The correlation coefficients indicate that economic growth is positively associated with global economic uncertainty ( $r = 0.289$ ) and the number of internet users ( $r = 0.312$ ), while it is negatively correlated with inflation ( $r = -0.345$ ) and urbanization growth ( $r = -0.365$ ). Among the explanatory variables, the highest correlation was observed between internet users and urbanization growth ( $r = -0.412$ ), followed by the relationship between internet users and inflation ( $r = -0.149$ ). However, all pairwise correlation coefficients were well below the commonly accepted threshold of 0.80, suggesting the absence of severe linear relationships among the independent variables.

The multicollinearity assessment further supports this conclusion. The VIF values ranged from 1.023 to 1.241, with all values substantially below the conservative threshold of 5.0 (or the more lenient threshold of 10.0). Specifically, the VIF values are 1.041 for the World Uncertainty Index, 1.228 for Internet Users, 1.023 for Inflation, and 1.241 for Urbanization Growth. These results indicate that multicollinearity is not a concern in the estimated model, implying that the regression coefficients are unlikely to be distorted by the high correlations among the explanatory variables. Therefore, all independent variables were retained for the subsequent panel regression analysis.

**Table 3. Correlation Matrix + VIF**

| Variables           | GDP    | WUI    | Internet | Inflation | Urbanisation |
|---------------------|--------|--------|----------|-----------|--------------|
| GDP                 | 1.000  | 0.289  | 0.312    | -0.345    | -0.365       |
| WUI                 | 0.289  | 1.000  | 0.097    | 0.002     | -0.196       |
| Internet Users      | 0.312  | 0.097  | 1.000    | -0.149    | -0.412       |
| Inflation           | -0.345 | 0.002  | -0.149   | 1.000     | 0.057        |
| Urbanisation Growth | -0.365 | -0.196 | -0.412   | 0.057     | 1.000        |
| VIF                 | -      | 1.041  | 1.228    | 1.023     | 1.241        |

Source(s): Authors' own creation, 2026

### Panel Model Selection

Table 3 presents the results of the panel model selection tests used to identify the most appropriate estimation approaches. The Chow test yields an F-statistic of 1146.50 with a p-value below 0.001, indicating that the Fixed Effects Model (FEM) is preferred over the Common Effects Model (CEM). This finding suggests the presence of significant unobserved individual heterogeneity across ASEAN countries, implying that the pooled regression model is inappropriate for the data.

The Hausman test was performed to determine whether the Fixed Effects Model or the Random Effects Model (REM) was more suitable. The test produced a chi-square statistic of 0.141 with a p-value of 0.9976, indicating that the null hypothesis cannot be rejected. Therefore, the Random Effects Model is preferred because it provides consistent and more efficient parameter estimates. This result is further supported by the Breusch–Pagan Lagrange Multiplier (LM) test, which reports a chi-square statistic of 409.83 ( $p < 0.001$ ), confirming that the Random Effects Model is superior to the Common Effects Model. Based on these diagnostic tests, the Random Effects Model was selected as the final estimation model for subsequent analyses.

**Table 4. Panel Model Selection**

| Test                  | Statistic         | p-value | Decision                                 |
|-----------------------|-------------------|---------|------------------------------------------|
| Chow Test             | F = 1146.50       | <0.001  | Fixed Effect preferred to Common Effect  |
| Hausman Test          | $\chi^2 = 0.141$  | 0.9976  | Random Effect preferred to Fixed Effect  |
| Breusch–Pagan LM Test | $\chi^2 = 409.83$ | <0.001  | Random Effect preferred to Common Effect |

Source(s): Authors' own creation, 2026

### Random Effects Estimation Results

Table 4 presents the Random Effects regression results for the baseline, moderation, and final models estimated with HC1 robust standard errors. Overall, the coefficient estimates remain relatively stable across the three specifications, indicating the robustness of the estimated relationship. Since the diagnostic tests detected heteroskedasticity and serial correlation, the discussion focuses primarily on Model (3), which provides a more reliable statistical inference based on robust standard errors.

The results reveal that digital connectivity, proxied by Internet Users, has a positive and statistically significant effect on economic growth across all model specifications. In the final model, a one-unit increase in the number of internet users was associated with a 0.00864 increase in the natural logarithm of GDP ( $p < 0.01$ ), highlighting the important role of digital connectivity in enhancing economic performance in ASEAN countries. In contrast, the World Uncertainty Index (WUI) does not

exert a statistically significant direct effect on economic growth, suggesting that fluctuations in global economic uncertainty did not substantially influence the economic performance of the sampled countries during the study period. Similarly, the interaction term between the WUI and Internet Users is statistically insignificant, indicating that digital connectivity does not moderate the relationship between global economic uncertainty and economic growth. Among the control variables, inflation exhibits a weak negative effect on economic growth and remains significant at the 10% level after applying robust standard errors, whereas urbanization growth does not have a statistically significant impact. These findings suggest that digital connectivity functions as a direct driver of economic growth rather than as a mechanism that mitigates the adverse effects of global economic uncertainties.

**Table 5. Random Effect Regression Results**

| <b>Variables</b>    | <b>(1) Baseline REM</b> | <b>(2) Moderation REM</b> | <b>(3) Moderation REM + HC1 Robust SE</b> |
|---------------------|-------------------------|---------------------------|-------------------------------------------|
| cWUI                | 0.140<br>(0.165)        | 0.065<br>(0.404)          | 0.139<br>(0.195)                          |
| cInternet           | 0.00865***<br>(0.001)   | 0.00848***<br>(0.001)     | 0.00864***<br>(0.002)                     |
| cWUI ×<br>cInternet | —                       | 0.00127<br>(0.006)        | 0.00127<br>(0.008)                        |
| Inflation           | -0.0102***<br>(0.003)   | -0.0103***<br>(0.003)     | -0.0103*<br>(0.006)                       |
| Urbanisation        | 0.0010<br>(0.014)       | 0.0010<br>(0.014)         | 0.0010<br>(0.019)                         |
| Constant            | 25.813***               | 25.823***                 | 26.334***                                 |
| Observations        | 98                      | 98                        | 98                                        |
| Countries           | 7                       | 7                         | 7                                         |
| Years               | 14                      | 14                        | 14                                        |
| R <sup>2</sup>      | 0.638                   | 0.638                     | —                                         |

Source(s): Authors' own creation, 2026

### Robustness Check

Table 5 summarizes the diagnostic tests and robustness checks performed to assess the validity of the estimated panel-regression model. The correlation matrix indicates that all pairwise correlation coefficients are below 0.80, while the mean Variance Inflation Factor (VIF) is approximately 1.13, confirming the absence of severe multicollinearity among the explanatory variables. The panel model selection tests further justify the use of the Random Effects Model. Specifically, the Chow test rejected the Common Effects Model in favor of the Fixed Effects Model ( $p < 0.001$ ), whereas the Hausman test supported the Random Effects Model over the Fixed Effects Model ( $p = 0.9976$ ). This result is reinforced by the Breusch–Pagan Lagrange Multiplier test, which confirms that the Random Effects Model is preferable to the Common Effects Model ( $p < 0.001$ ).

Additional diagnostic tests were performed to evaluate the assumptions underlying the selected model. The Pesaran Cross-sectional Dependence (CD) test indicates no evidence of cross-sectional dependence ( $p = 0.9363$ ), suggesting that the error terms are independent across countries. However, the Breusch–Godfrey test reveals the presence of serial correlation ( $p < 0.001$ ), while the Breusch–Pagan test confirms the presence of heteroskedasticity ( $p < 0.001$ ). To address these violations and ensure reliable statistical inference, the final Random Effects Model was estimated using HC1 heteroskedasticity-consistent robust standard errors. Consequently, the reported coefficient estimates and significance levels are robust to both heteroskedasticity and serial correlation, enhancing the credibility and reliability of our empirical findings.

The coefficient signs and significance remain largely unchanged after applying HC1 robust standard errors, indicating that the empirical findings are robust despite the presence of heteroskedasticity and serial correlation.

**Table 6. Diagnostic and Robustness Tests**

| Diagnostic Test                    | Result                    | Conclusion                               |
|------------------------------------|---------------------------|------------------------------------------|
| Correlation Matrix                 | All correlations $< 0.80$ | No severe correlation                    |
| VIF                                | Mean $\approx 1.13$       | No multicollinearity                     |
| Chow Test                          | $p < 0.001$               | Fixed Effect preferred to Common Effect  |
| Hausman Test                       | $p = 0.9976$              | Random Effect preferred to Fixed Effect  |
| LM Test                            | $p < 0.001$               | Random Effect preferred to Common Effect |
| Pesaran CD Test                    | $p = 0.9363$              | No cross-sectional dependence            |
| Breusch–Godfrey Test               | $p < 0.001$               | Serial correlation detected              |
| Breusch–Pagan Test                 | $p < 0.001$               | Heteroskedasticity detected              |
| HC1 Robust Standard Errors Applied |                           | Valid inference obtained                 |

Source(s): Authors' own creation, 2026

### Summary of Hypothesis Testing

Table 6 summarizes the outcomes of the hypothesis testing based on the final Random Effects Model with HC1 robust standard errors. The results indicate that only one of the four main hypotheses was fully supported. Digital connectivity, measured by Internet Users, has a positive and statistically significant effect on economic growth, supporting the view that greater Internet penetration contributes to improved economic performance in ASEAN countries. This finding highlights the importance of digital connectivity as a key driver of economic development, facilitating information exchange, technological adoption, and productivity improvements.

In contrast, global economic uncertainty, represented by the World Uncertainty Index, does not significantly affect economic growth, leading to the rejection of the first hypothesis. Similarly, urbanization growth does not exhibit a significant relationship with economic growth, suggesting that differences in urbanization rates alone are insufficient to explain variations in economic performance across the sampled countries. Meanwhile, inflation shows a weak negative association with economic growth and remains significant only at the 10% significance level after applying robust standard errors, providing limited support for the third hypothesis. Overall, these findings suggest that digital connectivity plays a more prominent role in fostering economic growth than global economic uncertainty or urbanization growth in the ASEAN context during the study period.

**Table 7. Summary of Hypothesis Testing**

| Hypothesis | Result                     | Decision |
|------------|----------------------------|----------|
| H1         | $WUI \rightarrow GDP$      | Rejected |
| H2         | $Internet \rightarrow GDP$ | Accepted |
| H3         | $WUI \times Internet$      | Rejected |
| H4         | Inflation                  | Accepted |
| H5         | Urbanisation               | Rejected |

Source(s): Authors' own creation, 2026

### Discussion

The empirical findings indicate that global economic uncertainty, measured by the World Uncertainty Index (WUI), does not have a statistically significant effect on economic growth in ASEAN countries. This result suggests that fluctuations in global uncertainty were insufficient to directly influence the economic performance of the sampled countries during the period 2011–2024. One possible explanation is that ASEAN economies have become increasingly resilient to external shocks

through stronger macroeconomic fundamentals, expanding domestic markets, and deeper regional economic integration. These structural characteristics may have reduced the transmission of global uncertainty to domestic economic activity.

The insignificant effect of WUI is consistent with recent evidence suggesting that developing economies may be less sensitive to global uncertainty when supported by stable domestic demand and appropriate macroeconomic policies. Yang et al. (2026), for example, argued that economic resilience in ASEAN is strengthened by investment, demographic dynamics, and the digital economy, allowing countries to maintain economic performance despite global disturbances. Similarly, Hersadajat et al. (2025) emphasized that regional cooperation and coordinated economic strategies have enhanced ASEAN's resilience in responding to external economic shocks. Therefore, the findings imply that domestic economic capacity and regional integration may play a more important role than external uncertainty in explaining economic growth across ASEAN countries.

The results demonstrate that digital connectivity, proxied by Internet Users, has a positive and statistically significant effect on economic growth. This finding indicates that greater internet penetration contributes to higher economic output by improving access to information, enhancing productivity, facilitating digital trade, and encouraging technological innovation. As internet infrastructure expands, businesses are able to reduce transaction costs, improve operational efficiency, and access broader domestic and international markets, thereby stimulating economic growth.

This result is consistent with the growing literature on the contribution of digitalisation to economic development. Hjort and Tian (2025) argue that internet connectivity enhances productivity, employment opportunities, and market efficiency in developing countries. Similarly, Jing and Ab-Rahim (2020) found that information and communication technology (ICT) significantly promotes economic growth in ASEAN-5 countries through technological diffusion and improved resource allocation. More recent studies by Ahmad Radhi et al. (2024) and Mahroof et al. (2025) also confirm that digital connectivity has become an increasingly important determinant of economic performance in ASEAN by supporting innovation, entrepreneurship, and digital business activities. These findings reinforce the argument that investment in digital infrastructure is an essential component of sustainable economic development strategies.

Contrary to the initial expectation, the interaction between global economic uncertainty and digital connectivity is not statistically significant. This finding suggests that although digital connectivity directly promotes economic growth, it does not significantly alter the relationship between global economic uncertainty and economic performance. In other words, digital connectivity functions as an independent growth-enhancing factor rather than as a mechanism that buffers the adverse effects of external uncertainty.

Several explanations may account for this result. First, internet penetration alone may not adequately capture the broader concept of digital transformation. Effective economic resilience likely depends on complementary factors such as digital skills, institutional quality, digital governance, financial inclusion, and innovation capacity. Second, the ASEAN countries included in this study exhibit considerable heterogeneity in terms of digital infrastructure, technological readiness, and institutional development, which may reduce the effectiveness of digital connectivity as a moderating mechanism. Cheng and Masron (2023) argue that the economic benefits of digital transformation depend not only on digital infrastructure but also on supportive institutional and policy environments. Likewise, Sermcheep (2024) highlights that substantial differences in digital readiness across ASEAN countries continue to constrain the region's ability to fully leverage digital connectivity for economic resilience. Therefore, digital connectivity alone appears insufficient to offset the adverse consequences of global economic uncertainty.

Among the control variables, inflation exhibits a weak negative relationship with economic growth after applying HC1 robust standard errors. This finding is consistent with macroeconomic theory, which suggests that rising prices reduce purchasing power, increase production costs, and create uncertainty that discourages investment and consumption. However, the relatively weak statistical significance indicates that inflation was not the primary determinant of economic growth across the sampled ASEAN countries during the study period, possibly reflecting effective monetary policy frameworks that successfully maintained macroeconomic stability.

In contrast, urbanisation growth does not significantly affect economic growth. Although urbanisation is generally expected to stimulate economic activity through agglomeration economies,

labour market expansion, and infrastructure development, its impact may depend on the quality rather than the speed of urbanisation. Rapid urban expansion without corresponding improvements in infrastructure, human capital, and public services may limit its contribution to economic performance. This finding is broadly consistent with previous studies suggesting that the economic benefits of urbanisation materialise only when supported by effective urban planning, institutional capacity, and productive employment opportunities. Consequently, the results imply that digital connectivity is a more important determinant of economic growth than urbanisation growth in the ASEAN context during the period under investigation.

Although digital connectivity significantly promotes economic growth, the empirical results indicate that it does not moderate the relationship between global economic uncertainty and economic growth in ASEAN countries. This finding suggests that greater internet penetration alone is insufficient to strengthen the resilience of economic growth against external uncertainty. While digital connectivity enhances access to information, communication, and digital services, these benefits do not necessarily translate into greater macroeconomic resilience when economies are exposed to global shocks.

The findings contribute to the growing literature on digital economics by extending both Endogenous Growth Theory and Economic Resilience Theory. Consistent with Endogenous Growth Theory (Romer, 1986; 1990), digital connectivity functions as productive infrastructure that enhances knowledge diffusion, reduces transaction costs, and improves economic productivity, thereby stimulating long-run economic growth. However, the insignificant moderating effect indicates that digital connectivity alone is insufficient to strengthen economic resilience during periods of heightened global uncertainty.

From the perspective of Economic Resilience Theory, resilience is not generated solely through technological infrastructure but also depends on complementary institutional capacities, governance quality, innovation capability, and adaptive policy responses. Consequently, this study suggests that digital connectivity should be viewed as a necessary—but not sufficient—condition for enhancing resilience against external shocks in emerging economies. This finding refines previous theoretical arguments by distinguishing between digital connectivity as a driver of economic growth and its more limited role as a resilience-enhancing mechanism.

One possible explanation is that Internet Users, used as a proxy for digital connectivity, primarily measures access to digital infrastructure rather than the effective utilisation of digital technologies. A high level of internet penetration does not automatically imply widespread adoption of digital innovation, advanced digital skills, or productive digital business activities. Consequently, countries with similar levels of internet access may differ substantially in their ability to transform digital connectivity into economic resilience. This argument is consistent with the view that digital transformation depends not only on connectivity but also on complementary factors such as digital capabilities, innovation ecosystems, institutional quality, and regulatory effectiveness (Ali et al., 2018; Sermcheep, 2024).

A second explanation relates to the structural heterogeneity of ASEAN economies. Although ASEAN has made remarkable progress in digital development, substantial disparities remain in digital infrastructure, technological readiness, human capital, and institutional capacity across member countries. More advanced economies, such as Singapore and Malaysia, have developed mature digital ecosystems that support innovation and business continuity during periods of uncertainty, whereas several developing ASEAN economies continue to face limitations in broadband quality, digital literacy, and technological adoption. Consequently, the economic benefits of digital connectivity are unlikely to be distributed evenly across the region, reducing its effectiveness as a moderating factor. Similar observations are reported by Curtis et al. (2022) and Ha and Chuah (2023), who emphasise that ASEAN's digital transformation remains uneven despite rapid regional progress.

Furthermore, global economic uncertainty affects economies through multiple transmission channels, including international trade, foreign direct investment, financial markets, commodity prices, and exchange rate volatility. Digital connectivity may improve communication and facilitate business activities, but it cannot fully offset the adverse effects of these macroeconomic shocks. Therefore, the capacity of digital connectivity to moderate the relationship between global uncertainty and economic growth may be inherently limited. This interpretation is consistent with Yang et al. (2026), who argue that economic resilience in ASEAN is determined by a combination of investment, demographic characteristics, institutional quality, and digital development rather than by digitalisation alone.

The insignificant moderating effect should therefore not be interpreted as evidence that digital connectivity lacks economic value. Instead, it suggests that digital connectivity functions primarily as a direct driver of economic growth rather than as a mechanism that cushions the impact of global economic uncertainty. In other words, expanding internet access contributes to long-term economic development, but strengthening resilience against global shocks requires a broader policy framework that combines digital transformation with institutional reforms, macroeconomic stability, innovation capacity, and human capital development. This finding refines the role of digital connectivity in the existing literature by distinguishing its growth-enhancing function from its resilience-enhancing capacity.

## 5. Conclusion

Unlike previous studies that primarily consider digital connectivity as a direct determinant of economic growth, this study demonstrates that digital connectivity does not necessarily strengthen macroeconomic resilience under global uncertainty.

This study examined the role of digital connectivity in economic growth under global economic uncertainty using balanced panel data from seven ASEAN countries over the period 2011–2024. Employing the Random Effects Model with HC1 robust standard errors, the study found that digital connectivity, measured by Internet Users, has a positive and statistically significant effect on economic growth. In contrast, global economic uncertainty, represented by the World Uncertainty Index, does not significantly affect economic growth. Furthermore, the interaction between digital connectivity and global economic uncertainty is statistically insignificant, indicating that digital connectivity does not moderate the relationship between global economic uncertainty and economic growth. Among the control variables, inflation exhibits a weak negative effect on economic growth, whereas urbanisation growth does not have a significant influence.

These findings contribute to the literature in several ways. First, the study provides updated empirical evidence on the relationship between digital connectivity, global economic uncertainty, and economic growth in ASEAN using recent panel data covering the post-pandemic period. Second, by integrating Endogenous Growth Theory and Economic Resilience Theory, the study demonstrates that digital connectivity primarily functions as a direct driver of economic growth rather than as a mechanism that enhances resilience against external economic uncertainty. This distinction extends the current understanding of digital transformation by showing that expanding internet connectivity alone is insufficient to mitigate the adverse effects of global shocks. Instead, digital connectivity should be viewed as one component of a broader resilience strategy that includes strong institutions, macroeconomic stability, innovation capability, and human capital development.

From a policy perspective, the findings suggest that ASEAN governments should continue investing in digital infrastructure and expanding internet accessibility to promote sustainable economic growth. However, digital infrastructure development should be complemented by policies that strengthen digital skills, institutional quality, innovation ecosystems, and digital governance to improve economic resilience against future external shocks.

Despite these contributions, this study has several limitations. Digital connectivity is measured only by Internet Users, which may not fully capture the multidimensional nature of digital transformation. In addition, the analysis is limited to seven ASEAN countries, potentially restricting the generalisability of the findings. Future research is therefore encouraged to employ broader indicators of digital development, such as the Digital Adoption Index, ICT Development Index, or digital financial inclusion measures, while incorporating additional institutional and technological variables. Future studies may also expand the geographical scope and apply dynamic panel estimation techniques to provide a deeper understanding of how digital transformation influences economic growth and resilience under global uncertainty.

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