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Economic growth and economic uncertainty: Evidence from panel granger causality tests

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ABSTRACT

Economic uncertainty has become a persistent feature of the global macroeconomic environment, influencing investment decisions, financial conditions, and long-term growth prospects. Motivated by these concerns, this study investigates whether economic uncertainty causally affects economic growth across a broad group of economies. Using quarterly data for 28 developed and developing economies from 1995Q1 to 2025Q1, the analysis includes three complementary measures of uncertainty: the world uncertainty index, economic policy uncertainty, and an optimal economic uncertainty index, to ensure robustness across economic uncertainty indicators. To examine the causal relationships between economic growth and its determinants, the study employs panel Granger causality methods, namely the Dumitrescu-Hurlin and the bias-corrected methods. These methods are suitable for macroeconomic panels, as they consider dependence, parameter heterogeneity, and dynamic panel bias. The empirical results show that economic uncertainty consistently Granger-causes economic growth, with higher uncertainty exerting a negative and statistically significant effect. Past economic growth, interest rates, and exchange rates also exhibit causal influences on economic growth. Evidence of reverse causality further indicates feedback effects between growth, uncertainty, and macroeconomic conditions. The findings highlight that managing economic uncertainty through credible policies, stable macroeconomic frameworks, and clear communication is essential for maintaining macroeconomic stability and sustaining long-term economic growth.

Contribution/ Originality: Based on heterogeneous panel causality tests, this study provides new evidence of causality effects between economic growth and economic uncertainty, as well as key macroeconomic conditions such as past economic growth, interest rates, and exchange rates. The empirical results offer policy-relevant insights for mitigating uncertainty and supporting sustainable growth.

1. INTRODUCTION

The global economy has been characterized by increasing economic uncertainty, which can affect the decisions of firms, individuals, and policymakers worldwide at different development levels. This uncertainty, arising from many sources, particularly including geopolitical tensions, technological innovation, and financial market instability, can shape the expectations of economic agents, leading to changes in macroeconomic performance. Bloom (2014) argues that if the level of uncertainty increases, economic agents are unclear about possible future outcomes and tend to delay their irreversible investment and important consumption plans. This "wait and see" behavior has essential macroeconomic implications, especially during periods of increased uncertainty and instability. These concerns are also emphasized by recent global assessments. Based on the International Monetary Fund (2025), persistent shocks from geopolitical dispersion and different patterns of recovery after the epidemic have caused increased instability for a long time. This has led to weak private demand, limited investment flows, and more caution in policy making. Thus, it is important to understand the role of economic uncertainty, not only to better forecast the macroeconomic performance but also to implement strategies against unexpected shocks. Since such uncertainty can spread across different countries, it is necessary to consider its impact on countries with different institutional capacities.

To quantify these developments, the literature has introduced a number of measures of economic uncertainty. Each one reflects different dimensions and captures separate channels through which it may lead to economic outcomes. Ahir, Bloom, and Furceri (2022) develop a broad macro-based indicator of economic uncertainty, namely, the world uncertainty index (WUI), calculated by the frequency of the term “uncertainty” from the reports of the Economist Intelligence Unit (EIU), which can capture both economic and political uncertainty. On the other side, Baker, Bloom, and Davis (2016) employ the economic policy uncertainty (EPU) index to measure ambiguity related to policy based on information reported in newspapers. Meanwhile, Gan (2014) presents the optimal economic uncertainty index (OEUI) based on the gaps of major macroeconomic indicators, namely, interest rate, inflation, and output from their fundamentals, and it captures the volatility inherent in economic gaps. A growing body of empirical evidence shows significant relationships between uncertainty indicators and economic growth, as mentioned by Lu, Thye, Muhairah, and Kumari (2023); Chatterjee (2023); Bannigidadmath, Ridhwan, and Indawan (2024), and Gomado (2025). However, despite this rich empirical evidence, the causal relationship between uncertainty and growth is not yet adequately explored in an equally unified framework that contrasts different indicators and considers cross-country heterogeneity. This study is motivated by this gap and seeks to further investigate the linkages between uncertainty and growth.

Besides economic uncertainty itself, other crucial macroeconomic conditions, such as interest rates and exchange rates, have important impacts on economic growth. When uncertainty interacts with these monetary and external conditions, the responses of growth may change. The level of interest rates represents the cost of borrowing, and it also shapes the allocation of credit to the real economy. Idris (2019) argues that interest rates are negatively related to economic growth. Paunović (2022) suggests that higher interest rates increase the borrowing cost and dampen economic growth, but lower interest rates may not result in better growth outcomes. Anjeli, Saputri, and Masitoh (2025) further propose that reductions in the cost of financing may increase output by increasing access to funds, particularly when the credit market is well developed. The volatility and movements of the exchange rate also determine the export competitiveness and investment decisions. Rapetti (2020) stresses the importance of the adjustment of exchange rates, as the overvaluation may be harmful to economic growth, while depreciation may contribute to stimulating growth. Ridhwan, Ismail, and Nijkamp (2024) confirm that depreciation of exchange rates can promote real economic growth. Aprilia, Hidayat, and Asngari (2024) find that in the short term, exchange rates causally impact economic output, and they also observe a reverse causal relationship. Overall, these studies reveal that economic uncertainty does not act in isolation to affect economic growth. The association with key macroeconomic conditions should be considered, as it affects aggregate demand, the external environment, and investment decisions.

To overcome the theoretical and empirical research gap identified above, panel Granger causality procedures by Dumitrescu and Hurlin (2012) and the bias-corrected approach by Juodis, Karavias, and Sarafidis (2021) are employed to examine whether economic uncertainty causally drives economic growth. The empirical tests are applied to 28 developed and developing economies from 1995Q1 to 2025Q1. These approaches are suitable for macroeconomic analysis because they allow for cross-sectional dependence, heterogeneous coefficients, and persistent time-series behavior, which are common in cross-country macroeconomic datasets. To ensure the results, we employ WUI by Ahir et al. (2022) as the main proxy for economic uncertainty, while two other proxies, namely EPU by Baker et al.

(2016) and the OEUI by Gan (2014), are addressed for robustness checks. By including these indicators in an empirical framework, the results can show whether economic uncertainty always has a causal effect on growth and whether the findings vary across different countries or uncertainty measures. Broadly, this study provides new evidence on the area of macroeconomic stability and resilience, and helps policymakers to prioritize policies to buffer the negative influence of economic uncertainty and encourage sustainable growth.

The subsequent sections of this paper are arranged as follows: Section 2 explains the theoretical framework, econometric specifications, and the panel Granger causality methods used. Section 3 includes the data description, results and discussion. Section 4 concludes the study and highlights key implications from the findings.

2. MODEL AND METHODOLOGY

2.1. Theoretical Model

The theoretical foundation of this study comes from the concept of uncertainty proposed by Keynes (1936). Keynes emphasizes that economic agents make decisions when they do not fully know what will happen in the future, and their expectations and confidence about the future can directly influence their decisions on investment and consumption, which are the main components of aggregate demand in the economy. Bloom (2014) expands this view; he argues that the future outcome is more complex and harder to predict under increasing uncertainty. In such a situation, firms and individuals tend to wait and delay decision-making to avoid a possible wrong choice, particularly when they make irreversible investments and major expenditures. Thus, during periods of heightened uncertainty, the decline of investment and consumption leads to the reduction of effective demand and, in turn, reduces economic output. Moreover, in interconnected global markets, uncertainty is also associated with monetary and external conditions. Cesa-Bianchi, Pesaran, and Rebucci (2020) find that global uncertainty shocks significantly depress expectations and contribute to tight monetary conditions, and interest rates and exchange rates are vital transmission channels of these uncertainty shocks (Auboin & Ruta, 2013; Barguellil, Ben-Salha, & Zmami, 2018; Cloyne, Ferreira, & Surico, 2020).

Taking these theoretical considerations into account, this study develops a growth framework that incorporates economic uncertainty, past economic growth, interest rates, and exchange rates. Therefore, economic growth is a function of these factors. The model can be expressed as:

$$y_t = \alpha_0 + \alpha_1 y_{t-1} + \alpha_2 r_t + \alpha_3 er_t + \alpha_4 eu_t + \mu_t \qquad (1)$$

From Equation 1, α_0 is the constant term, y_t means real economic growth, and y_{t-1} means lagged economic growth of the last period, which captures persistence driven by gradual changes in investment behavior, consumer trends, and production capacity. The expected sign of α_1 is positive ($\alpha_1 > 0$). The term r_t represents the real interest rate, showing the economy's financial conditions. The expected sign of α_2 is negative ($\alpha_2 < 0$), as increasing interest rates have a negative effect on borrowing and investment, discouraging spending and output growth (Anjeli et al., 2025; Idris, 2019; Paunović, 2022). The term er_t represents the real exchange rate, reflecting external competitiveness. The expected sign of α_3 is negative ($\alpha_3 < 0$), because the depreciation in the exchange rate always stimulates exports and national production growth.

The term eu_t denotes economic uncertainty, which influences expectations and confidence. Increased uncertainty delays investment and consumption, disrupts cyclical planning, and raises risk premiums; firms and individuals become more cautious, leading to adverse effects on economic activity (Bannigidadmath et al., 2024; Chatterjee, 2023; Gomado, 2025; Lu et al., 2023). Accordingly, $\alpha_4 < 0$ is theoretically consistent. μ_t denotes the error term capturing other unobserved influences on growth.

2.2. Methodology

This study employs panel Granger causality techniques to examine whether real interest rates, real exchange rates, and economic uncertainty Granger-cause economic growth. This approach can assess whether one variable's previous values contain predictive information about another. Panel data techniques improve inference reliability by combining cross-sections and time series, enhancing the ability to detect causal linkages (Shen, Ding, Sekhon, & Yu, 2023) and reducing omitted-variable concerns (Hill, Davis, Roos, & French, 2020).

2.2.1. Dumitrescu and Hurlin (2012) Heterogeneous Panel Granger Causality Procedure

The Granger causality test developed by Dumitrescu and Hurlin (2012) is better suited for macro panels than traditional homogeneous tests because it handles heterogeneous coefficients across cross-sectional units (Isayev, 2024). Granger causality is not assumed in all countries under the null hypothesis, whereas the alternative hypothesis allows for causality in at least one country. This test effectively accounts for heterogeneity in both autoregressive parameters and causal relationships (Ho, Oueghlissi, & Ferktaji, 2024).

The test requires stationary variables (Ahmed et al., 2022) and a common lag order K, The Bayesian Information Criterion (BIC) is utilized to select the lag order. The equations for testing the causal relationships are specified as follows:

Causality from the real interest rate to growth.

$$y_{it} = \sigma_i + \sum_{k=1}^{K} \gamma_{ik} y_{i,t-k} + \sum_{k=1}^{K} \beta_{ik} r_{i,t-k} + \varepsilon_{it} \qquad (2)$$

Causality from the real exchange rate to growth.

$$y_{it} = \sigma_i + \sum_{k=1}^{K} \gamma_{ik} y_{i,t-k} + \sum_{k=1}^{K} \beta_{ik} er_{i,t-k} + \varepsilon_{it} \qquad (3)$$

Causality from economic uncertainty to growth.

$$y_{it} = \sigma_i + \sum_{k=1}^{K} \gamma_{ik} y_{i,t-k} + \sum_{k=1}^{K} \beta_{ik} eu_{i,t-k} + \varepsilon_{it} \qquad (4)$$

Unidirectional causality from past growth to current growth is assumed because current values cannot influence previous periods. Bidirectional causality between growth and other variables is allowed.

2.2.2. Juodis et al. (2021) Bias-Corrected Panel Granger Causality Procedure

Juodis et al. (2021) develop a panel Granger causality procedure with bias correction. This study employs this method as an additional robustness check. This method improves inference accuracy in dynamic panels by correcting for Nickell bias and accounting for cross-sectional dependence, which commonly arise in macroeconomic datasets. Dhaene and Jochmans (2015) develop the Half-Panel Jackknife (HPJ) estimator, which is used in this procedure to reduce finite-sample bias.

The general form of the model is:

$$y_{it} = \sigma_i + \sum_{k=1}^{K} \gamma_{ik} y_{i,t-k} + \sum_{k=1}^{K} \beta_{ik} x_{i,t-k} + \varepsilon_{it} \qquad (5)$$

Where x_{it} represents one of the predictors r_t, er_t, or eu_t. The null and alternative hypotheses are:

$$H_0: \beta_{ik} = 0 \text{ for all } i, k \qquad (6)$$

$$H_a: \beta_{ik} \neq 0 \text{ for at least one } i, k \qquad (7)$$

Failure to reject H_0 indicates no Granger causality. If x_{it} is a vector of variables, the method applies by testing joint significance of coefficients (Xiao, Karavias, Juodis, Sarafidis, & Ditzen, 2023).

3. DATA AND EMPIRICAL RESULTS

3.1. Data

In this study, quarterly data are collected for 28 economies, i.e., Brazil, China, Chile, Hong Kong, India, Indonesia, Malaysia, Mexico, the Philippines, Singapore, South Korea, Thailand, Australia, Denmark, France, Germany, Greece, Ireland, Italy, Japan, New Zealand, Spain, Sweden, the UK, and the US, for the period from 1995Q1 to 2025Q1. This broad sample enables an examination of uncertainty–growth linkages across developed and developing economies.

Real economic growth (y_t) serves as the dependent variable, while lagged growth (y_{t-1}), the real interest rate (r_t), the real exchange rate (er_t), and economic uncertainty (eu_t) are the independent variables. This study uses the World Uncertainty Index (WUI) as the primary economic uncertainty proxy. To strengthen robustness, the Economic Policy Uncertainty (EPU) as well as the optimal economic uncertainty index (OEUI) are employed as additional proxies. Due to data availability, EPU covers 24 of the 28 economies, excluding Indonesia, Malaysia, the Philippines, and Thailand, while the optimal uncertainty index covers 14 of the 28 economies (China, Hong Kong, India, Indonesia, Japan, Malaysia, the Philippines, Singapore, South Korea, Thailand, Australia, Canada, the UK, and the US).

Data are sourced from the BIS, Datastream, and the IMF's International Financial Statistics (IFS). Except for the real interest rate, all variables, including y_t, y_{t-1}, er_t, and eu_t are expressed in logarithms.

Variable Construction:

- Real economic growth (y_t)

Proxied by real GDP, calculated by dividing nominal GDP by the consumer price index (CPI). Quarterly data of nominal GDP and CPI are collected from the IFS.

- Lagged real economic growth (y_{t-1})

Constructed directly as the one-period lag of y_t.

- Real interest rate (r_t)

Proxied by the real money market rate (MMR), computed as:

$$\text{Real MMR} = \text{Nominal MMR} - \text{Inflation rate.}$$

The inflation rate is calculated as:

$$\text{Inflation Rate} = \frac{\text{CPI}_t - \text{CPI}_{t-1}}{\text{CPI}_{t-1}} \times 100.$$

- Real exchange rate (er_t)

Using the real effective exchange rate (REER) from BIS for measurement, reflecting external competitiveness.

- Economic uncertainty (eu_t)

Proxied by WUI (hereafter eu_t^{WUI}), EPU (hereafter eu_t^{EPU}), and OEUI (hereafter eu_t^{oeui}).

- eu_t^{WUI}: From Ahir et al. (2022) number of times "uncertainty" appears in country-level reports published by EIU, scaled by total word count.
- eu_t^{EPU}: From Baker et al. (2016), capturing policy-related uncertainty using newspaper-based methods.
- eu_t^{oeui}: Following Gan (2014), constructed using uncertainty in four macroeconomic gaps, i.e., output, inflation, interest rates, and exchange rate deviations from long-run trends.

3.2. Results and Discussion

In the macro panel analysis, cross-sectional dependence should be considered; ignoring this dependence may lead to biased and misleading results (Nazlioglu & Karul, 2024). Thus, this study examines whether the variables are independent across cross-sections before the panel causality procedures. To evaluate this, different methods are employed in this study, namely, the Breusch-Pagan LM test, Pesaran scaled LM test, Bias-corrected scaled LM test, and Pesaran CD test. The null hypothesis of all these methods states that the variables are independent across cross-sections. The results from Table 1 show that for these four tests, the null hypothesis is strongly rejected; cross-sectional dependence is exhibited. Such dependence is common in macroeconomic data due to shared global shocks, financial linkages, and synchronized business cycles. Given the cross-sectional interdependence, the new generation panel unit root test and heterogeneous panel causality methods explicitly account for interdependence across countries.

Table 1. Results of cross-sectional dependence test.

Variables	Breusch-Pagan LM test	Scaled LM test	Bias-adjusted LM test	Pesaran CD test
y_t	33981.620 *** (0.000)	1222.152 *** (0.000)	1222.035 *** (0.000)	172.777 *** (0.000)
y_{t-1}	33773.23 *** (0.000)	1214.573 *** (0.000)	1214.456 *** (0.000)	171.031 *** (0.000)
r_t	18251.19 *** (0.000)	650.042 *** (0.000)	649.925 *** (0.000)	127.602 *** (0.000)
er_t	8893.568 *** (0.000)	298.797 *** (0.000)	298.681 *** (0.000)	10.974 *** (0.000)
eu_t^{WUI}	1747.047 *** (0.000)	49.792 *** (0.000)	49.675 *** (0.000)	27.839 *** (0.000)
eu_t^{EPU}	7944.884 *** (0.000)	326.409 *** (0.000)	326.309 *** (0.000)	68.854 *** (0.000)
eu_t^{oeui}	498.2456 *** (0.000)	30.18711 *** (0.000)	30.1287 *** (0.000)	12.8359 *** (0.000)

Note: *** indicates significance at the 1%. ( ) indicates probability.

Since the variables have dependence across countries, second-generation panel unit root tests are more suitable for this study. Pesaran (2007) proposes new-generation methods to examine the unit root of panel data, namely, the cross-sectionally augmented Dickey–Fuller (CADF) approach and the cross-sectionally augmented IPS (CIPS) approach, which control for common unobserved factors and improve the robustness of stationarity assessment in dependent panels (Qamruzzaman, 2024; Westerlund, Hosseinkouchack, & Solberger, 2016). This study employs CADF and CIPS to assess stationarity. From Table 2, the results indicate rejection of the null hypothesis of non-stationarity, all the series, i.e., y_t, y_{t-1}, r_t, er_t, and all uncertainty measures are judged to be I(0). The first-difference statistics, also reported in Table 2, confirm this conclusion. Therefore, the variables meet the stationarity requirement for subsequent panel Granger causality analysis.

Table 2. Results of panel unit root test.

Variables	CIPS		CADF	
	Level	1st Diff	Level	1st Diff
y_t	-3.477 ***	-6.190 ***	-2.359 ***	-5.873 ***
y_{t-1}	-3.407 ***	-6.037 ***	-2.465 ***	-5.920 ***
r_t	-5.214 ***	-6.190 ***	-4.262 ***	-6.190 ***
er_t	-2.082 *	-6.143 ***	-2.051 *	-6.618 ***
eu_t^{WUI}	-6.187 ***	-6.190 ***	-5.564 ***	-6.190 ***
eu_t^{EPU}	-3.830 ***	-6.190 ***	-3.137 ***	-6.190 ***
eu_t^{oeui}	-5.042 ***	-6.149 ***	-4.197 ***	-6.020 ***

Note: *** and * indicate significance at 1% and 10%, respectively.

By analyzing macro panels, assuming homogeneous slope coefficients across countries can lead to misleading conclusions when structural characteristics differ significantly (Dumitrescu & Hurlin, 2012). To test this assumption, panel homogeneity is examined using the procedure developed by Pesaran, Ullah, and Yamagata (2008). This method can evaluate whether the panel has slope coefficients across different economies. Table 3 shows the homogeneity test results. For all variables, the statistics of Delta and adjusted Delta reach the 1% significance level, and slope homogeneity is rejected by the test, reflecting that the coefficients differ across economies. The existence of heterogeneity suggests the use of a heterogeneous panel Granger causality method, which allows different coefficients across countries. Ignoring heterogeneity may lead to biased results of causal inference.

Table 3. Results of homogeneity test.

Variables	Delta	Delta_{adj}
y_t	6.788 ***	6.874 ***
y_{t-1}	13.673 ***	13.906 ***
r_t	43.035 ***	43.578 ***
er_t	2.946 ***	2.983 ***
eu_t^{WUI}	6.952 ***	7.039 ***
eu_t^{EPU}	15.949 ***	16.151 ***
eu_t^{oeui}	18.681 ***	18.917 ***

Note: *** indicates significance at 1%.

In line with the research objective, this study is to examine eu_t causally affects y_t, using the WUI as the primary proxy. Table 4 reports the Dumitrescu and Hurlin (2012) heterogeneous panel Granger causality results. The results provide strong evidence that eu_t^{WUI} Granger-causes $y_t$with significance at the 1% level, indicating that increasing uncertainty contains predictive information for future economic growth, supporting the theoretical view that heightened uncertainty weakens expectations, delays investment, and constrains aggregate demand. To strengthen the robustness of this core result, the analysis is subsequently extended by replacing eu_t^{WUI} with alternative measures of uncertainty, namely the eu_t^{EPU} and the eu_t^{oeui}. As shown in Tables 5 and 6, rejection of no Granger causality from economic uncertainty (i.e., eu_t^{EPU} and eu_t^{oeui}) to economic growth is observed across both proxies. The consistency of the causality results across eu_t^{WUI}, eu_t^{EPU}, and eu_t^{oeui} confirms that the predictive role of uncertainty is not sensitive to the choice of indicator.

While y_{t-1}, r_t and er_t also exhibit significant causal effects on y_t, these variables are included as control channels rather than the primary focus of the analysis. Reverse causality tests further reveal feedback effects between y_t and uncertainty (i.e., eu_t^{WUI}, eu_t^{EPU}, and eu_t^{oeui}) in several cases, suggesting dynamic interactions rather than one-way transmission. Overall, the Dumitrescu–Hurlin results provide robust evidence that economic uncertainty acts as a statistically significant and economically meaningful causal driver of economic growth, consistent with findings reported by Hong, Xu, Wang, and Pan (2022) in the US and Sakar, Sasmaz, and Ozen (2025) among the G7 economies.

Table 4. Dumitrescu and Hurlin (2012) panel causality results for the economic growth function with WUI.

Null Hypothesis	Lags	Average W-statistic	Average Z-statistic	Adjusted Z-statistic	Result
y_{t-1} does not Granger cause y_t	1	14.3517	49.9576 *** (0.0000)	48.4014 *** (0.0000)	Reject
y_t does not Granger cause r_t	1	4.5874	13.4228 *** (0.0000)	12.9585 *** (0.0000)	Reject
r_t does not Granger cause y_t	1	4.4528	12.9193 *** (0.0000)	12.4701 *** (0.0000)	Reject
y_t does not Granger cause er_t	1	3.3178	8.6725 *** (0.0000)	8.3502 *** (0.0000)	Reject
er_t does not Granger cause y_t	1	3.3818	8.9119 *** (0.0000)	8.5824 *** (0.0000)	Reject
y_t does not Granger cause eu_t^{WUI}	1	5.2024	15.7241 *** (0.0000)	15.1910 *** (0.0000)	Reject
eu_t^{WUI} does not Granger cause y_t	3	2.2283	-1.6670 * (0.0955)	-1.1741 * (0.0865)	Reject

Note: *** and * indicate significance at 1% and 10%, respectively. ( ) denotes the p-values.

Table 5. Dumitrescu and Hurlin (2012) panel causality results for the economic growth function with EPU.

Null Hypothesis	Lags	Average W-statistic	Average Z-statistic	Adjusted Z-statistic	Result
y_{t-1} does not Granger cause y_t	1	10.4051	32.5802 *** (0.0000)	31.5480 *** (0.0000)	Reject
y_t does not Granger cause r_t	1	4.6635	12.6807 *** (0.0000)	12.2530 *** (0.0000)	Reject
r_t does not Granger cause y_t	1	3.4309	8.4207 *** (0.0000)	8.1106 *** (0.0000)	Reject
y_t does not Granger cause er_t	1	3.3384	8.10006 *** (0.0000)	7.8000 *** (0.0000)	Reject
er_t does not Granger cause y_t	1	2.5867	5.4965 *** (0.0000)	5.2738 *** (0.0000)	Reject
y_t does not Granger cause eu_t^{EPU}	1	9.5776	29.7135 *** (0.0000)	28.7670 *** (0.0000)	Reject
eu_t^{EPU} does not Granger cause y_t	2	3.2621	3.0915 *** (0.0020)	2.8990 *** (0.0037)	Reject

Note: *** indicates significance at 1%. ( ) denotes the p-values.

Table 6. Dumitrescu and Hurlin (2012) panel causality results for the economic growth function with OEUI.

Null Hypothesis	Lags	Average W-statistic	Average Z-statistic	Adjusted Z-statistic	Result
y_{t-1} does not Granger cause y_t	1	15.9283	39.4966 *** (0.0000)	38.2716 *** (0.0000)	Reject
y_t does not Granger cause r_t	1	5.2048	11.1250 *** (0.0000)	10.7478*** (0.0000)	Reject
r_t does not Granger cause y_t	1	4.7488	9.9184 *** (0.0000)	9.5774 *** (0.0000)	Reject
y_t does not Granger cause er_t	1	3.0440	5.4079 *** (0.0000)	5.2017 *** (0.0000)	Reject
er_t does not Granger cause y_t	1	3.9485	7.8011 *** (0.0000)	7.5233 *** (0.0000)	Reject
y_t does not Granger cause eu_t^{oeui}	2	7.8742	10.9896 *** (0.0000)	10.5412 *** (0.0000)	Reject
eu_t^{oeui} does not Granger cause y_t	1	16.9539	42.2102 *** (0.0000)	40.9040 *** (0.0000)	Reject

Note: *** indicates significance at the 1% level. ( ) denotes the p-values.

Additionally, the bias-corrected panel causality test conducted by Juodis et al. (2021) is employed to further examine whether eu_t acts as a causal driver of y_t. This method is well-suited to dynamic macro panel settings since it corrects for Nickell bias and incorporates cross-sectional dependence, thereby improving inference reliability. Both multivariate (covariate) and univariate versions of the test are estimated. Using the WUI as the primary proxy, Table 7 shows the causality results from the multivariate version. Results from the HPJ Wald test indicate rejection of the null hypothesis at the 1% level, indicating that the selected covariates (i.e., eu_t, y_{t-1}, r_t and er_t) jointly exert a causal effect on y_t, reflecting their combined predictive role. Moreover, the results of the HPJ estimator address the individual impact of each covariate variable on growth. eu_t^{WUI} has negative causal effects on y_t at the 5% significance level. To strengthen the results, this study employs eu_t^{EPU} and eu_t^{oeui} as alternative proxies for economic uncertainty (see Tables 8 and 9). The results remain consistent across different uncertainty measures, namely, the interaction of eu_t, y_{t-1}, r_t and er_t can collectively causally influence economic growth, and eu_t negatively affects growth. This finding is consistent with Liu and Zhang (2020) and Li and Huang (2021) which emphasize that rising economic uncertainty negatively influences expectations and brings greater caution, causing delays in investment and a decline in economic activities.

Table 7. Judois et al. (2021) panel causality results for economic growth function with WUI (covariate version).

HPJ Wald test	Lags	HPJ p-value	Null Hypothesis
705.8437***	1	0.000	Covariates do not Granger-cause y_t
Results for the HPJ estimator			
Variables	**Coefficient**	**p-values**	**Std. Error**
y_{t-1}	0.4617 ***	0.000	0.0184
r_t	-0.0014 ***	0.000	0.0001
er_t	0.0128	0.235	0.0108
eu_t^{WUI}	-0.0021 **	0.023	0.0009

Note: *** and ** indicate significance at 1% and 5%, respectively.

Table 8. Juodis et al. (2021) panel causality results for economic growth function with EPU (Covariate version).

HPJ Wald test	Lags	HPJ p-value	Null Hypothesis
686.7523 ***	1	0.000	Covariates do not Granger-cause y_t
Results for the HPJ estimator			
Variables	**Coefficient**	**p-values**	**Std. Error**
y_{t-1}	0.6640 ***	0.000	0.0265
r_t	-0.0024 ***	0.000	0.0005
er_t	0.1108 ***	0.002	0.0358
eu_t^{EPU}	-0.0063 **	0.047	0.0032

Note: *** and ** indicate significance at 1% and 5%, respectively.

Table 9. Juodis et al. (2021) panel causality results for economic growth function with OEUI (Covariate version).

HPJ Wald test	Lags	HPJ p-value	Null Hypothesis
565.7785 ***	1	0.000	Covariates do not Granger-cause y_t
Results for the HPJ estimator			
Variables	**Coefficient**	**p-values**	**Std. Error**
y_{t-1}	0.3918 ***	0.000	0.0227
r_t	-0.0010 ***	0.006	0.0004
er_t	0.0980 **	0.002	0.0292
eu_t^{oeui}	-0.0111 ***	0.000	0.0013

Note: *** and ** indicate significance at 1% and 5%, respectively.

Next is the univariate version of the bias-corrected causal test. Using WUI as the proxy for economic uncertainty, the results are shown in Table 10. The causal effect of eu_t^{WUI} on economic growth can be confirmed, and higher economic uncertainty is related to a decrease in economic growth.

Consistent with the findings from the multivariate specification. When eu_t^{EPU} and eu_t^{oeui} are employed (see Tables 11 and 12), the tested null hypothesis of no Granger causality from economic uncertainty to economic growth is again rejected, significant at the 5% and 1%, respectively. The robustness of the causality results across eu_t^{WUI}, eu_t^{EPU}, and eu_t^{oeui} indicates that the predictive influence of economic uncertainty is not affected by the specific proxy used. The results also show that y_{t-1}, r_t, and er_t Granger-cause y_t at conventional significance levels, indicating their causal role as control channels in shaping economic growth. Several reverse causality relationships are also detected, indicating feedback between economic growth and economic uncertainty (i.e., eu_t^{WUI}, eu_t^{EPU}, and eu_t^{oeui}), consistent with the findings from the Dumitrescu–Hurlin test.

Taken together, the Dumitrescu and Hurlin (2012) and Juodis et al. (2021) panel Granger causality results provide strong evidence that economic uncertainty causally influences economic growth, with uncertainty emerging as a robust and significant predictor across all model specifications, while the causal roles of past economic growth, along with monetary and external indicators, should be considered as well.

Table 10. Juodis et al. (2021) panel causality results for economic growth function with WUI (Univariate version).

Null Hypothesis	Lags	HPJ Wald test	Results for the HPJ estimator		
			Variables	Coefficient	Std. Error
y_{t-1} does not Granger cause y_t	1	615.8441 *** (0.000)	y_{t-1}	0.4579 *** (0.000)	0.0185
y_t does not Granger cause r_t	1	4.1861 ** (0.0408)	y_t	-0.7471 *** (0.0041)	0.3651
r_t does not Granger cause y_t	1	61.3947 *** (0.000)	r_t	-0.0012 *** (0.000)	0.0002
y_t does not Granger cause er_t	1	17.3071 *** (0.0000)	y_t	0.0198 *** (0.000)	0.005
er_t does not Granger cause y_t	1	5.3428 ** (0.0208)	er_t	0.0264 ** (0.021)	0.0114
y_t does not Granger cause eu_t^{WUI}	1	12.8988 *** (0.0003)	y_t	0.2651 *** (0.000)	0.0738
eu_t^{WUI} does not Granger cause y_t	1	4.9380 ** (0.0263)	eu_t^{WUI}	-0.0021 ** (0.026)	0.0010

Note: *** and ** indicate significance at 1% and 5%, respectively. ( ) denotes the p-value.

Table 11. Juodis et al. (2021) panel causality results for economic growth function with EPU (Univariate version).

Null Hypothesis	Lags	HPJ Wald test	Results for the HPJ estimator		
			Variables	Coefficient	Std. Error
y_{t-1} does not Granger cause y_t	1	4468.5517 *** (0.0000)	y_{t-1}	0.4353 ** (0.000)	0.0206
y_t does not Granger cause r_t	1	25.8043 *** (0.0000)	y_t	-1.1578 *** (0.000)	0.2279
r_t does not Granger cause y_t	1	47.7935 *** (0.0000)	r_t	-0.0011 *** (0.000)	0.0002
y_t does not Granger cause er_t	1	4.7653 ** (0.0290)	y_t	0.0064 ** (0.029)	0.0029
er_t does not Granger cause y_t	2	8.5556 *** (0.0139)	er_t	0.0813 *** (0.007)	0.0201
y_t does not Granger cause eu_t^{EPU}	1	68.8468 *** (0.0000)	y_t	0.3062 *** (0.000)	0.0369
eu_t^{EPU} does not Granger cause y_t	2	7.5845 ** (0.0225)	eu_t^{EPU}	-0.0056 ** (0.015)	0.0023

Note: *** and ** indicate significance at 1% and 5%, respectively. ( ) denotes the p-value.

Table 12. Juodis et al. (2021) panel causality results for economic growth function with OEUI (Univariate version).

Null hypothesis	Lags	HPJ Wald test	Results for the HPJ estimator		
			Variables	Coefficient	Std. Error
y_{t-1} does not Granger cause y_t	1	423.5237 *** (0.0000)	y_{t-1}	0.4549 *** (0.000)	0.0221
y_t does not Granger cause r_t	1	23.9083 *** (0.0000)	y_t	-0.6865 *** (0.000)	0.1404
r_t does not Granger cause y_t	1	35.2345 *** (0.0000)	r_t	-0.0025 *** (0.000)	0.0004
y_t does not Granger cause er_t	1	25.7399 *** (0.0000)	y_t	0.0175 *** (0.000)	0.0034
er_t does not Granger cause y_t	4	45.9168 *** (0.0000)	er_t	0.0380 ** (0.030)	0.0175
y_t does not Granger cause eu_t^{oeui}	3	31.9225 *** (0.0000)	y_t	-2.5155 *** (-0.000)	0.6361
eu_t^{oeui} does not Granger cause y_t	1	205.8899 *** (0.0000)	eu_t^{oeui}	-0.0178 *** (0.000)	0.0012

Note: *** and ** indicate significance at 1% and 5%, respectively. ( ) denotes the p-value.

The results of this study provide some essential policy implications for both developed and developing economies. First, the consistent findings further confirm that economic uncertainty has a clear negative causal impact on economic outcomes (Hong et al., 2022; Sakar et al., 2025). This emphasizes that governments should prioritize transparent communication strategies to improve the transmission efficiency of policies in order to enhance policy predictability and institutional credibility. The improvement of forward guidance is helpful in stabilizing expectations and buffering the adverse impact of uncertainty on investment, consumption and long-term planning (Li & Huang, 2021; Liu & Zhang, 2020). Second, it is essential to implement supportive or counter-cyclical monetary policies, as real interest rates pressure real output. Central banks need to pay special attention to changes in borrowing costs and adjust interest rates to support economic activity without undermining price stability. For economies with undeveloped financial markets or weak interest rate transmission mechanisms, interest rate tools have limited effects; macroprudential tools such as liquidity support, credit guarantees, or targeted lending programs can be used as complements to make sure that easing monetary policy effectively supports investment and aggregate demand during uncertain periods (Deleidi & Levrero, 2021).

Third, the evidence that the real exchange rate causally influences economic growth indicates the importance of external competitiveness in promoting output growth. Governments should avoid persistent real exchange rate overvaluation, as it can depress external exports and reduce the stimulation of national productivity. With strong macroeconomic foundations, exchange rate flexibility can help absorb external shocks and preserve a competitive environment. Notably, the multiple export strategies can also reduce exchange rate volatility risk, especially for emerging countries with narrow export bases (Rapetti, 2020; Ridhwan et al., 2024). Fourth, economic uncertainty and key macroeconomic conditions such as past economic growth, interest rates, and exchange rates jointly cause economic growth, indicating that policymakers should better take integrated measures rather than isolated ones. The growth response to integrating monetary actions, fiscal measures, and structural reforms may be much more efficient. For instance, a clearer communication policy can decrease agents' uncertainty and promote the effectiveness of monetary policy, and stronger institutions and a stable external environment can also reduce the sensitivity of investment to uncertainty shocks.

Finally, policymakers should pay enough attention to the effect of economic uncertainty arising from persistent global shocks, including geopolitical tensions, supply chain disturbances, and financial volatility. It is possible to lessen the negative impact of uncertainty shocks and promote sustained economic stability by constructing fiscal buffers, strengthening financial sector resilience, and investing in credible institutions. Emerging economies can improve their governance structures, increase data transparency, and strengthen the rule of law to reduce uncertainty risks and attract sustained domestic and foreign investment.

Overall, the results demonstrate that managing uncertainty cannot be ignored by economic policymaking; it is a central component of sustaining stable and robust economic growth.

4. CONCLUSION

This study investigates the causal relationship between economic growth and economic uncertainty, along with other key determinants, such as past economic growth, interest rates, and exchange rates, for 28 developed and developing economies. Both the Dumitrescu-Hurlin panel Granger causality test and the Juodis et al. (2021) bias-corrected approach are employed. Three complementary indicators (WUI, EPU, and the OEUI) are used as economic uncertainty proxies. The causal effects of economic uncertainty on economic growth are confirmed across different methods and various uncertainty measures, providing robust evidence for the uncertainty-growth nexus. This supports the theoretical view that increasing uncertainty influences expectations, delays investment, and shapes economic activity. The results also reveal causality from past economic growth, interest rates, and exchange rates to economic growth, underscoring their importance as transmission channels. Moreover, the study finds feedback causal effects from economic growth to economic uncertainty and other determinants; these feedback impacts should be considered by economic management and policymaking. Overall, this study contributes to empirical evidence across countries by demonstrating consistent causality through diverse proxies and empirical techniques. Regarding policy implications, the findings emphasize that governments should reduce policy ambiguity, maintain supportive financing conditions, and improve external competitiveness to buffer the negative effects of economic uncertainty.

Several limitations are identified in this research. First, the study takes 28 different economies as a sample; future studies can utilize more regional or global economies. Second, this study focuses on economic uncertainty and several key macro variables; more factors could be investigated. Third, the approaches employed in the study are linear causality methods; future studies may utilize nonlinear, asymmetric, or time-varying frameworks to further examine the uncertainty-growth dynamics.

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