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# Impact of economic and climate resilience on sustainable development: A cross-country analysis

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# IMPACT OF ECONOMIC AND CLIMATE RESILIENCE ON SUSTAINABLE DEVELOPMENT

A CROSS-COUNTRY ANALYSIS

*Md. Bokhtiar Hasan, Gazi Salah Uddin, Donghyun Park, Md. Sumon Ali, and John Beirne*

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# Impact of Economic and Climate Resilience on Sustainable Development: A Cross-Country Analysis

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Donghyun Park, Md. Sumon Ali, and John Beirne

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## **ABSTRACT**

Economic and climate shocks inflict huge economic costs and undermine sustainable development (SD). This study is the first comprehensive attempt to empirically assess the influence of economic and climate resilience, which can mitigate those costs, on SD. Our analysis is based on a panel dataset of 31 countries from 2007 to 2021 and advanced econometric techniques, including panel-corrected standard errors, feasible generalized least squares, panel quantile regression, and local projections. We find that economic and climate resilience have significant effects on SD. Furthermore, dynamic analysis indicates that both types of resilience have persistent effects on SD and quantile analysis validates the robustness and consistency of our findings across different stages of development.

**Keywords:** sustainable economic development, economic resilience, climate resilience, panel data analysis

**JEL codes:** C33, O11, Q01, Q54

## 1. Introduction

In 2015, at the United Nations General Assembly, United Nations member states adopted the 2030 Agenda for Sustainable Development, embracing 17 Sustainable Development Goals (SDGs) and 169 associated targets aimed at ensuring global progress by 2030 (UNDP, 2015). This ambitious agenda is designed to promote progress in three core dimensions—economic, social, and environmental—with the supreme goals of promoting “people, planet, and prosperity” while ensuring that no one is left behind (Fuso Nerini et al., 2019; Simionescu et al., 2024). However, efforts to realize these objectives are severely challenged by two escalating disruptions: economic and climate change crises. Over the past decade, both developed and developing nations have grappled with a series of economic shocks triggered by financial crises, geopolitical conflicts, and pandemics—coupled with increasing frequency and intensity of climate-related catastrophes, such as floods, droughts, hurricanes, heatwaves, and wildfires (EDA, 2016; Brende and Sternfels, 2022). Failure to effectively mitigate or recover from these crises or shocks may erode decades of development progress, especially in economically vulnerable nations (World Bank, 2017). Consequently, bolstering resilience against climate and economic shocks is now an urgent priority for attaining sustainable economic development (SED). In this context, this study investigates how economic and climate resilience interact with SED across diverse countries.

Economic resilience denotes an economy’s ability to anticipate, resist, and bounce back from economic shocks, disruptions, or stresses without significantly damaging long-term growth trajectories (EDA, 2016; Brende and Sternfels, 2022). Economically resilient nations tend to bounce back faster from financial crises and recessions, sustaining development momentum (Eichengreen et al., 2024). Conversely, failing to create resilience against such shocks or crises may be associated with enormous economic costs and losses in the long run. The World Economic Forum (WEF) estimates the total cost of weak resilience to be between 1% and 5% of the global yearly gross domestic product (GDP) growth (WEF, 2022). Workforce attrition, such as during the coronavirus disease (COVID-19) pandemic, lowered economic growth by 3.6% in some

countries, while current energy and supply chain disruptions are predicted to cut global GDP by 1% to 2.5% (WEF, 2022). It should be emphasized that economic resilience cannot be achieved without social stability. If significant social issues such as income and gender inequality are ignored, the economy will suffer further. Brende and Sternfels (2022) estimate that a country with a 1% increase in income inequality could experience a 0.6% decline in GDP to 1.1%, with the worldwide economic costs of gender discrimination estimated at \$160.2 trillion. Hence, weak economic resilience is likely to result in acute financial and social consequences that could inhibit the course of sustainable development.

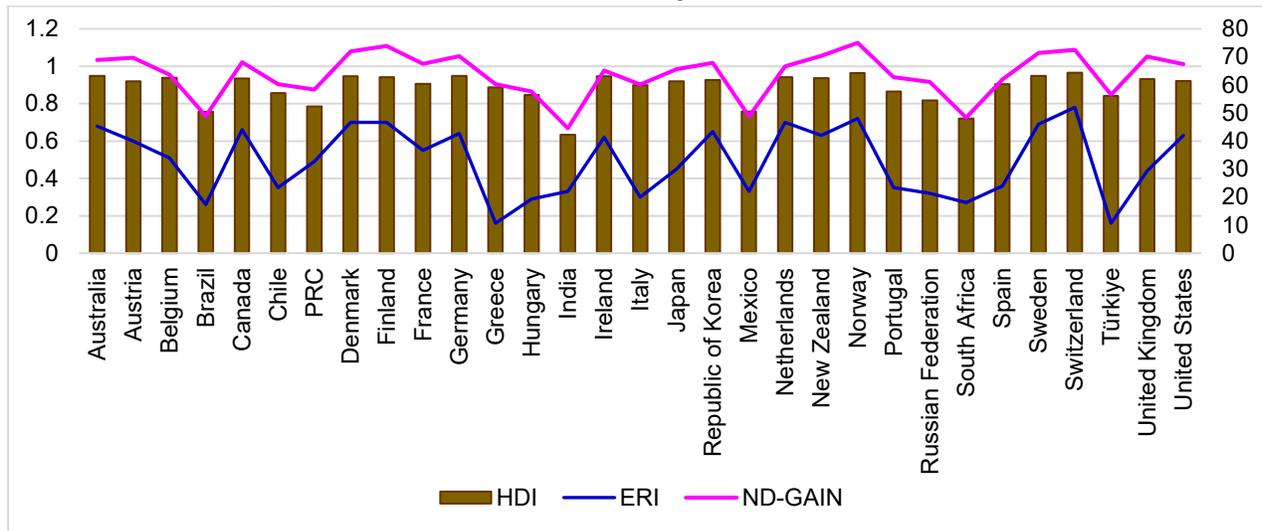
Climate resilience means a country's capability to foresee, minimize, and recover from climate impacts such as global heating, rising sea levels, extreme weather patterns, and depletion of resources, among others, without sacrificing economic development. In recent times, the occurrence and intensity of disasters triggered by climate change have jumped significantly worldwide. Like economic shock waves, climate-related shocks could also cause considerable economic costs. In 2022 alone, losses from disasters reached \$360 billion worldwide (US Chamber of Commerce, 2024). A recent study projects that climate change may lessen the GDP of developing Asia and the Pacific by over 17% by the year 2070 (ADB, 2024). The Global Commission on Adaptation (2019) estimates that investing \$1.8 trillion in adaptation measures globally between 2020 and 2030 may result in net benefits of \$7.1 trillion. According to Hallegatte et al. (2019), every dollar invested in infrastructure resilience would yield a \$4 payoff in developing nations, and the total benefits would be \$4.2 trillion over the new infrastructure's lifetime. Hence, climate resilience and economic resilience are equally crucial for promoting long-term sustainable economic development.

While ongoing debates exist regarding the cost–benefit dynamics of resilience, recent statistics, as discussed earlier, underscore the importance of strengthening resilience against economic and climate shocks to mitigate their mammoth economic costs and thereby support SED. Figure 1 demonstrates a clear correlation: countries with higher levels of economic and

climate resilience also tend to achieve better outcomes in SED, as indicated by higher Human Development Index (HDI) scores. This observation raises critical research questions: *To what extent do climate and economic resilience contribute to sustainable economic development? Does this impact vary across countries at different levels of sustainable development? And how does sustainable economic development dynamically respond over time to unexpected shocks in economic and climate resilience?* Empirically addressing these underexplored research questions is essential, given their direct linkage to sustainable development.

Despite the significance of resilience being widely acknowledged, extant research provides a limited exploration of its role, particularly in the context of sustainable economic development. As such, Briguglio et al. (2009) argue that countries with solid economic resilience experience faster economic growth, potentially contributing to long-term economic development and vice versa. In the same vein, Ma and Huang (2023) show that economic resilience is strongly related to high quality economic growth, which serves as a mutually reinforcing stimulus for sustainable development. Hallegatte et al. (2016) place emphasis on the significance of specific climate adaptation strategies in attaining long-term economic stability, which potentially leads to sustainable development. Fuso Nerini et al. (2019) and Fuldauer et al. (2022) demonstrate that ecosystem-based climate resilience techniques effectively minimize climate-related risks and ensure sustainability. The findings of Wang et al. (2023) further strengthen the argument for ecosystem resilience's vital contribution toward achieving sustainable development. However, Estoque and Wu (2024) present a new perspective, focusing on the interrelationship between quality of life, social–ecological resilience, and sustainability, and argue that fortifying these factors is critical for achieving sustainable development.

**Figure 1: Plots of the Sampled Countries' Human Development, Economic Resilience, and Notre Dame Global Adaptation Initiative Indices for 2021**



PRC = People's Republic of China, ERI=economic resilience index, HDI=Human Development Index, ND-GAIN=Notre Dame Global Initiative Index.

Notes: The figure presents the values of the Human Development Index (a measure of sustainable economic development), the economic resilience index, and the ND-GAIN Climate Readiness Index (a measure of climate resilience) for 2021 for 31 economies in our sample. The HDI and ERI are plotted on the primary (left) axis, while the ND-GAIN Index is displayed on the secondary (right) axis.

Source: Authors' calculations.

From the review and discussion of the literature above, it can be seen that, although resilience is of great importance, the academic discourse still needs to fully capture how they (economic and climate resilience) collectively affect SED. Most previous studies focus on climate and economic resilience mainly in isolation, typically relating them to the three elements—economic growth, quality of life, or economic stability—rather than sustainable economic development, leaving a considerable gap or limitation. Hence, earlier research fails to directly link economic and climate resilience to SED. The abovementioned research gap in the extant literature urgently calls for a comprehensive analysis that uses both economic and climate resilience as frameworks to help understand how they, in turn, would affect SED. Such an analysis is instrumental for policymakers to come up with effective means and policies to support SED in the long run. Against this background, our research aims to examine the influence of climate and economic resilience on SED. To this end, we employ a panel dataset comprising 31 countries

from 2007 to 2021, utilizing a robust econometric framework. We initiate our analysis by establishing baseline relationships through the application of panel-corrected standard errors (PCSE) and feasible generalized least squares (FGLS) models. Subsequently, we investigate distributional heterogeneity using panel quantile regressions, followed by the application of local projection impulse response functions (LP-IRFs) to examine the dynamic responses to shocks or changes.

Our findings show that both economic and climatic resilience significantly drive SED, although their impacts vary and are context dependent. However, we observe a critical nonlinearity in the case of economic resilience: that its positive effect decreases and turns negative as a country reaches the highest development stages, revealing the existence of a threshold effect. Conversely, climate resilience benefits all stages of development. Our dynamic analysis strongly corroborates these findings, showing that positive changes to both kinds of resilience enhance SED in the long run. Our findings also indicate that trade openness and financial development encourage SED, whereas natural resources and gross fixed capital formation (GFCF) obstruct it. These findings have vital implications for policymakers regarding appropriate measures to accelerate sustainable development in the face of economic and climate challenges.

Our research extends the SED resilience literature significantly and has threefold contributions. First, unlike earlier studies, which often consider climate and economic resilience individually with little attention, this study is the pioneer in embracing both types of resilience in a single analytical framework to assess their impacts on SED. In addition, unlike our study, previous studies have not directly linked resilience to SED. Our research offers policymakers a new perspective on the importance of resilience in SED across a cross-country setup. It is also worth noting that we have included several vital control variables in our study, specifically GFCF, GDP growth, trade openness, financial development, and natural resources, to capture the overarching determinants of SED.

Secondly, to ensure the robustness and reliability of the results, we utilize a set of robust econometric techniques: static (panel cointegration, PCSE, FGLS), distributional (panel quantile regression), and dynamic (LP-IRFs). Our quantile regression analysis uncovers a novel, nonlinear relationship between economic resilience and SED, offering a crucial context-dependent outlook. Most importantly, we present dynamic analysis utilizing the LP-IRFs approach, a flexible (less restrictive) and robust econometric tool, for tracing the temporal trajectory of SED in response to resilience changes. Such a thorough examination from diverse perspectives in this context is often overlooked in prior studies.

Lastly, our results offer critical policy implications based on interesting findings. A vital empirical contribution is unearthing a nonlinear connection for economic resilience, which shows that its positive influence diminishes and eventually turns negative at the highest SED levels. This suggests that initiatives to enhance economic resilience should be adapted considering each nation's developmental stage to ensure adequate resource allocation. Our findings also demonstrate the universal significance of climate resilience in fostering sustainable development, independent of a country's economic maturity. Trade openness and financial development are observed to be beneficial to SED, but uneven capital formation and an overreliance on natural resources may be detrimental. These findings provide policymakers with meaningful guidelines for strengthening national resilience and advancing sustainability in the face of growing diverse global shocks.

The remainder of the paper is structured as follows: In Section 2, the data, selection of variables, and methodology are presented. Section 3 first explains the empirical results and the robustness checks, and then discusses the findings. Finally, Section 4 summarizes the research and discusses its inferences and constraints.

## 2. Data and Methodology

### 2.1. Data, Model Specification, and Variable Selection

This study investigates the effect of climate and economic resilience on SED, utilizing a balanced panel data set, covering 31 countries over 15 years (2007–2021). The availability of data determines the sample countries and the time period. Specifically, there are limits to the sample size because the economic resilience index data are only available for 31 countries. Our sample blends various developed and emerging markets.<sup>1</sup> Table 1 gives a detailed breakdown of the variables, including their specification, measurement, and data sources. To study SED factors, we use the following baseline panel regression model:

$$SED_{it} = \alpha + \beta_1 ERI_{it} + \beta_2 CRI_{it} + \beta_3 GFCF_{it} + \beta_4 GDPG_{it} + \beta_5 FD_{it} + \beta_6 TO_{it} + \beta_7 NR_{it} + \epsilon_{it}. \quad (1)$$

Here, *SED*, *ERI*, *CRI*, *GFCF*, *GDPG*, *FD*, *TO*, and *NR* denote, respectively: sustainable economic development; economic resilience index; climate resilience index; gross fixed capital formation; gross domestic product growth rate; financial development; trade openness; and natural resources.  $\alpha$  is the intercept term and  $\epsilon_{it}$  represents the error term. The coefficients,  $\beta_1$ ,  $\beta_2$ , ....., and  $\beta_7$ , denote the slopes of the *SED* (dependent variable) in relation to each independent variable. The subscript *i* is used for the cross-sectional unit (i.e., the country), and *t* is the time dimension.

In this research, HDI is used to represent SED. HDI encapsulates the human development concept by taking into account three critical dimensions of the development process: health (measured by life expectancy), the level of education, and the standard of living (measured by gross national income per person) (UNDP, 2025a; Simionescu et al., 2024). Yet, sustainable

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<sup>1</sup> Our sample comprises 31 countries: Australia, Austria, Belgium, Brazil, Canada, Chile, the People's Republic of China, Denmark, Finland, France, Germany, Greece, Hungary, India, Ireland, Italy, Japan, the Republic of Korea, Mexico, the Netherlands, New Zealand, Norway, Portugal, Russian Federation, South Africa, Spain, Sweden, Switzerland, Türkiye, the United Kingdom, and the United States.

economic development is a multifaceted concept consisting of three different development channels: economic, social, and environmental (Huang et al., 2024; Simionescu et al., 2024). While HDI does not consider environmental factors directly, it does capture economic and social aspects that help a country move towards SDGs (Witulski and Dias, 2020; Jain and Jain, 2020; Xu et al., 2024). Still, some argue that HDI is not a suitable indicator, due to lacking environmental elements. As a result, they have proposed to modify the index by adding more variables like carbon emissions or resource depletion to cover the ecological dimension (Lashmar, 2018; Biggeri and Mauro, 2018; Assa, 2021; Hickel, 2019). UNDP (2018) has expressed its reluctance to adjust the index because of the concern regarding the standardization, reliability, and availability of environmental data, mainly in developing countries, which might have a profound impact on the accuracy of the index. Furthermore, earlier research has demonstrated that countries with high levels of HDI scores do engage more in sustainable developmental practices, especially where the institutions are strong with long-term planning capabilities (e.g., Lashmar, 2018; Witulski and Dias, 2020; Jain and Jain, 2020). Consequently, HDI still serves as a widely used proxy for SED, as evidenced in the previous literature (e.g., Witulski and Dias, 2020; Malešević-Perović and Ćorić, 2023; and Simionescu et al., 2024, among others).

Swiss Re Institute (2025) has introduced the macroeconomic resilience index (ERI), which is applied as a proxy for economic resilience (an independent variable) since the index gauges an economy's ability to both withstand and recover from the influences of economic crises. ERI combines the factors of fiscal power, diversification of the economy, social stability, strength of the financial market, and environmental steadiness—all crucial for sustaining long-term development in times of economic crises. In this instance, ERI is a proper barometer of economic resilience as it denotes a country's economic performance and sustainability while recovering from the crises, which are critical to a nation's ability to maintain sustainable development in case of economic hardships (Brende and Sternfels, 2022).

On the flip side, to measure climate resilience (the other explanatory variable), we use the Notre Dame Global Adaptation Initiative (ND-GAIN) Climate Country Index. This index ranks countries according to how vulnerable they are to climate change and how ready they are to adapt to these changes (ND-GAIN, 2024). It evaluates a country's preparedness in terms of economic, governance, and social aspects against climate change. The inclusion of the ND-GAIN Index as a proxy of climate resilience in our model is justifiable, as it assesses a country's overall preparedness to deal with climate change vulnerability. Climate change adaptation is crucial for promoting sustainable development in the long run. This index is also used in past literature (e.g., Shear et al., 2023; UI-Haq et al., 2024), which verifies its relevance in resilience research.

This study uses some significant control variables to enhance the robustness of our outcomes. Specifically, these include GDP growth (GDPG), GFCF, trade openness, financial development, and natural resources. GDPG is essential in capturing the income dimension of development, which is one of the main components of HDI. We mainly control for GDPG to decouple the impacts of climate and economic resilience on SED, which provides further insights into the role of resilience in sustainable development. GFCF encompasses the investment in infrastructure, physical assets, and capital goods, which are essential for SED (Wang et al., 2022). Trade openness supports sustainable development by enabling access to global markets and the transfer of technology and innovation. Trade openness can improve health and education outcomes—core components of HDI—as well as help countries diversify their economies and build resilience against external shocks (Chien et al., 2023). The role of financial development in SED has strong evidence. A well functioning financial system promotes economic sustainability by offering access to credit and supporting investment while absorbing economic shock with minimal long-term disruption (Ahmad et al., 2024; Manigandan et al., 2024). It also contributes to broader sustainable development by financing infrastructure, health, and education projects (Simionescu et al., 2024; Manigandan et al., 2024). The impact of natural resources on

development is complex. While resource abundance can spur short-term economic growth, excessive dependence on natural resources is often associated with less diversification and lower resilience, a phenomenon referred to as the “resource curse” (Luo et al., 2022). Controlling natural resources is thus crucial to understanding the relationship between resilience and sustainable development, as countries rich in natural resources may exhibit distinct developmental trajectories (Ahmad et al., 2024).

**Table 1: Definitions of All Variables and Data Sources**

<b>Variable Types</b>	<b>Variables</b>	<b>Abb.</b>	<b>Variable Definition</b>	<b>Source</b>
Dependent	Sustainable economic development	<i>SED</i>	Proxied by the Human Development Index (HDI), which is a summary measure of average achievement in key dimensions of human development: a long and healthy life, being knowledgeable, and having a decent standard of living.	UNDP ( <a href="https://hdr.undp.org/data-center/documentation-and-downloads">https://hdr.undp.org/data-center/documentation-and-downloads</a> )
Explanatory	Economic resilience index	<i>ERI</i>	The macroeconomic resilience index (ERI) captures the extent to which an economy can withstand a shock such as a recession.	Swiss Re Institute ( <a href="https://sigma.swissre.com/">https://sigma.swissre.com/</a> )
Explanatory	Climate resilience	<i>CRI</i>	Proxied by the Notre Dame Global Adaptation Initiative (ND-GAIN) Country Index, a part of the Environmental Change Initiative, based at the University of Notre Dame in Indiana, United States (US). The index illustrates which countries are best prepared to deal with global changes brought about by overcrowding, resource constraints, and climate disruption.	University of Notre Dame in Indiana, US ( <a href="https://gain.nd.edu/our-work/country-index/">https://gain.nd.edu/our-work/country-index/</a> )
Control	Gross domestic product growth	<i>GDPG</i>	GDP growth (annual %).	World Bank national accounts data and OECD national accounts data files.
Control	Gross fixed capital formation	<i>GFCF</i>	Gross fixed capital formation (% of GDP): Land improvement, physical capital, construction.	World Bank national accounts data, and OECD national accounts data files.
Control	Trade openness	<i>TO</i>	Trade (% of GDP): Sum of exports and imports of goods and services measured as a share of GDP.	World Bank national accounts data, and OECD national accounts data files.

*Continued on the next page*

<b>Variable Types</b>	<b>Variables</b>	<b>Abb.</b>	<b>Variable Definition</b>	<b>Source</b>
Control	Financial development	<i>FD</i>	Domestic credit to private sector (% of GDP).	International Monetary Fund, International Financial Statistics and data files, and World Bank and OECD GDP estimates.
Control	Natural resources	<i>NR</i>	Total natural resources rents (% of GDP).	World Bank staff estimates based on sources and methods described in the World Bank's The Changing Wealth of Nations.

Source: Authors' calculations.

**2.2. Estimation Techniques**

In this part, we illustrate the methodological framework that addresses the problem of how economic and climate resilience relate to SED. A number of pre-estimation tests are conducted before estimating the baseline models, as panel data is often subject to econometric issues such as cross-sectional dependence (CSD), slope heterogeneity, unit root problem, and cointegration (Tariq et al., 2024). These issues should be addressed properly; otherwise, erroneous inferences may result (Lau et al., 2018; Eibinger et al., 2024). Moreover, the results of these tests help us select appropriate estimation techniques. Earlier studies often ignore these issues (Eibinger et al., 2024).

CSD has drawn substantial attention in macro panel data analysis in recent periods because of its considerable impact on the estimation precision. Estimates may become biased and inconsistent due to the lack of accommodation for the CSD factor in most traditional panel data analysis techniques (Lau et al., 2018). Therefore, in this study, we employ techniques that can effectively detect CSD, such as the Breusch and Pagan (1980) Lagrange Multiplier (LM) CSD tests, the Pesaran (2004) scaled LM tests, and the Pesaran (2021) cross-sectional dependence (CD) tests.

We also perform the slope homogeneity test proposed by Pesaran and Yamagata (2008), which helps us understand whether the relationship between the two variables differs across the cross sections. Since the first generation unit root tests usually do not consider CSD, we use the second generation tests (developed by Pesaran (2007)), namely the Cross-sectionally Augmented Dickey-Fuller (CADF) test and the Cross-sectionally Augmented IPS (CIPS) test. These tests account for both CSD and slope heterogeneity. Following the stationarity analysis, we then turn to estimate the long run relationships (cointegration) between the variables. To perform cointegration tests, we use several tests, including Kao's residual-based cointegration test, Pedroni's panel cointegration tests, and Westerlund's error correction based cointegration tests, as recommended by earlier literature (e.g., Tariq et al., 2024; Skare et al., 2024; Usman et al., 2024, among others). Given the presence of CSD and slope heterogeneity issues in our dataset (Sub-section 3.2), the choice of these cointegration methods is appropriate. In this study, we use several techniques for each test and estimation because no single approach is perfect. This strategy enables us to overcome the inherent limits of individual approaches, warranting the robustness of our results.

Initially, we employ the FGLS method proposed by Parks (1967), which accounts for CSD by incorporating cross-sectional averages of both the regressors and the dependent variable, along with their respective lags (Farebrother, 2018). Additionally, we use PCSE, introduced by Beck and Katz (1995), which is effective in handling several data challenges like heteroscedasticity, serial correlation, and endogeneity issues (Imran et al., 2024; Usman et al., 2024). In this way, the PCSE method modifies the standard errors of the coefficients by incorporating the correlation structure, which is embedded in the panel data (Imran et al., 2024). This method is especially appropriate when the number of cross-sectional units (N) exceeds the periods (T), as in our case (Reed and Webb, 2010; Millo, 2017). Recent studies (e.g., Imran et

al., 2024; Ha, 2024; Usman et al., 2024; Uddin et al., 2024, among others) have also utilized these methods.

We also conduct further robustness checks using panel quantile regression analysis. Quantile regression, in contrast to the traditional ordinary least squares method that typically investigates the mean level effect, examines the effect on diverse distribution levels, like the lower, middle, and upper quantiles (Imran et al., 2024). In our case, this approach is beneficial for capturing the heterogeneous effects of climate and economic resilience on SED. The quantile regression, first developed by Koenker and Bassett (1978) and later extended by Koenker and Hallock (2001), is an effective technique because it does not require any severe restrictions on the distribution of the residuals. In particular, we apply bootstrapped panel quantile regression, which is more suitable for the current analysis due to its robustness against distributional assumptions and its effectiveness in handling small sample sizes (where  $N > T$ ) (Guo et al., 2023).

Finally, we employ LP-IRF, devised by Jordà (2005), to explore the dynamic, time dependent influence of resilience on SED. Our baseline models (PCSE and FGLS) and panel quantile regression provide useful insights into the mean and diverse impacts of independent variables, but they are primarily static estimates. LP-IRFs permit us to study how SED responds to economic and climatic resilience changes over time, differentiating between short-term and long-term effects and verifying the temporal dynamics of the relationships. Unlike traditional VAR-based methods like VAR and SVAR, LP-IRF does not necessitate estimating the full system of equations and imposes fewer constraints, such as deficient lag selection, allowing the data to estimate the IRFs' forms more freely (Jordà, 2005). As a result, LP-IRF is less sensitive to model misspecification and can effectively handle country heterogeneity (Sheng et al., 2023; Lusompa, 2023). This is particularly relevant in our case, as it provides a dependable and adaptable framework to assess how unforeseen changes to economic and climate resilience spread across the system can affect sustainable development over time.

### 3. Result Analysis and Discussion

#### 3.1. Summary Statistics and Correlation Matrix

Table 2 shows the descriptive statistics of the sample variables. The skewness values show a mixed tail distribution (some variables show positive values, while others display negative values), while the high kurtosis values across most variables suggest the non-normality of the distribution for most variables. The significant Jarque-Bera statistics results verify that our sample data set is not normally distributed at the 1% significance level.

**Table 2: Results of Summary Statistics**

Statistics	SED	ERI	CRI	GFCF	GDPG	FD	TO	NR
Mean	0.869	0.511	63.916	23.185	1.896	115.283	77.600	2.158
Maximum	0.964	0.850	76.990	54.274	24.475	305.439	252.495	19.105
Minimum	0.550	0.100	39.150	10.687	-11.167	19.755	22.106	0.008
Std. Dev.	0.085	0.186	8.152	5.697	3.758	54.250	41.823	3.474
Skewness	-1.500	-0.394	-0.662	1.554	0.128	0.634	1.477	2.328
Kurtosis	4.727	1.947	2.712	7.759	6.960	3.354	5.095	8.581
Jarque-Bera	231.18***	33.35***	35.37***	623.38***	303.71***	33.43***	252.97***	1019.21***

CRI=climate resilience index, ERI=economic resilience index, FD=financial development, GDPG=gross domestic product growth rate, GFCF=gross fixed capital formation, NR=natural resources, SED=sustainable economic development, TO=trade openness.

Notes: Std. Dev. denotes standard deviation. The 1%, 5%, and 10% significance levels are marked by \*\*\*, \*\*, and \*, respectively.

Source: Authors' calculations.

The correlation matrix, presented in Table 3, reveals significant relationships among variables. Sustainable economic development is highly correlated with both climate and economic resilience, with climate resilience being the most substantial. The correlation coefficients of below 0.80 for the rest suggest the nonexistence of multicollinearity, a vital condition for reliable regression (Farrar and Glauber, 1967).

**Table 3: Correlation Matrix**

Variables	SED	ERI	CRI	GFCF	GDPG	TO	FD	NR
SED	1.000							
ERI	0.608***	1.000						
CRI	0.889***	0.759***	1.000					
GFCF	-0.227***	0.218***	-0.082*	1.000				
GDPG	-0.222***	0.119***	-0.137***	0.421***	1.000			
TO	0.332***	0.135***	0.204***	0.048	0.080*	1.000		
FD	0.445***	0.525***	0.517***	0.028	-0.132***	-0.153***	1.000	
NR	-0.339***	-0.116**	-0.190***	0.055	0.173***	-0.292***	-0.189***	1.000

CRI=climate resilience index, ERI=economic resilience index, FD=financial development, GDPG=gross domestic product growth rate, GFCF=gross fixed capital formation, NR=natural resources, SED=sustainable economic development, TO=trade openness.

Note: The 1%, 5%, and 10% significance levels are marked by \*\*\*, \*\*, and \*, respectively.

Source: Authors' calculations.

### 3.2. Cross-sectional Dependence and Slope Homogeneity Tests

Table 4 summarizes the results of the cross-sectional dependence tests. The results of all tests, including the Pesaran CD test, the Breusch-Pagan LM test, and the Pesaran scaled LM test, are significant at 1%, meaning that there are CSD issues across all variables. That is, shocks in one country might have a spillover impact on other countries. This emphasizes employing estimating methods that account for cross-country interdependence to avoid biased estimates.

**Table 4. Cross-sectional Dependence Estimates**

Variable	Breusch-Pagan LM	Pesaran scaled LM	Pesaran CD
SED	6027.79***	182.411***	77.481***
ERI	2304.416***	60.317***	34.381***
CRI	2274.582***	59.338***	12.737***
GFCF	1728.894***	41.445***	9.555***
GDPG	3332.966***	94.044***	54.726***
TO	1941.584***	48.419***	21.829***
FD	3366.778***	95.153***	4.417***
NR	2384.801***	62.953***	37.804***

CD=cross-sectional dependence, CRI=climate resilience index, ERI=economic resilience index, FD=financial development, GDPG=gross domestic product growth rate, GFCF=gross fixed capital formation, LM=logarithms multiplier, NR=natural resources, SED=sustainable economic development, TO=trade openness.

Note: \*\*\* indicates the significance level of 1%.

Source: Authors' calculations.

The delta and adjusted delta statistics results in Table 5 highlight that the null hypothesis of slope homogeneity is discarded at 1% significance. This implies that the slope coefficients vary across cross sections (heterogeneous). The presence of CSD and heterogeneity in our model supports the application of advanced panel data techniques (e.g., FGLS and PCSE), which are resilient to such data issues to obtain consistent outcomes.

**Table 5. Estimates of the Slope Homogeneity Test (Pesaran and Yamagata, 2008)**

Test Statistics	Entire Sample
Delta	6.511*** (0.000)
Adjusted Delta	10.294*** (0.000)

Notes: \*\*\* indicates significance level of 1%. The estimations are performed using the STATA command “xthst,” developed by Bersvendensen and Ditzen (2021).

Source: Authors’ calculations.

### 3.3. Panel Unit Root and Cointegration Tests Analysis

Since our panel data has a CSD issue, we have used second generation unit root tests—i.e., CIPS and CADF—to ensure consistent outcomes. The results of both tests reported in Table 6 indicate that most variables have stationarity issues at levels but become stationary after the first difference ( $I(1)$ ). This substantiates the presence of a unit root in our dataset.

**Table 6. Estimates of Second Generation Unit Root Tests**

Variables	CIPS		CADF	
	level	First difference	level	First difference
SED	-1.991	-3.363***	-2.469***	-2.934***
ERI	-1.461	-2.994***	-1.516	-2.333***
CRI	-1.897	-2.896***	-1.897	-3.345***
GFCF	-1.732	-2.873***	-2.375***	-2.555***
GDPG	-2.590***	-4.404***	-1.785	-2.373***
TO	-1.438	-2.872 ***	-1.491	-2.872***
FD	-0.784	-2.769 ***	-0.736	-1.980*
NR	-2.092*	-3.425***	-1.321	-1.974*

CADF=Cross-sectionally Augmented Dickey-Fuller test, CIPS=Cross-sectionally Augmented IPS test, CRI=climate resilience index, ERI=economic resilience index, FD=financial development, GDPG=gross domestic product growth rate, GFCF=gross fixed capital formation, NR=natural resources, SED=sustainable economic development, TO=trade openness.

Notes: The 1% and 10% significance levels are marked by '\*\*\*\*' and '\*', respectively. The unit root tests are performed with STATA commands "xtcips" and "pescadf" (with one lag).

Source: Authors' calculations.

Table 7 reports the outcomes of the panel cointegration tests. The outcomes of the Kao, Pedroni, and Westerlund cointegration tests confirm the existence of a long run relationship among the investigated variables. These findings further demonstrate that climate and economic resilience are likely linked to sustainable economic development over the long-term, justifying the use of long-term dynamic regression models.

**Table 7. Panel Cointegration Tests**

<b>Cointegration Test</b>	<b>Statistics</b>	<b>Prob.</b>
<b>Kao's residual cointegration test</b>		
Modified Dickey-Fuller t	0.2886	0.3865
Dickey-Fuller t	-1.9525**	0.0254
Augmented Dickey-Fuller t	-1.6229**	0.0523
Unadjusted modified Dickey-Fuller t	0.3081	0.3790
Unadjusted Dickey-Fuller t	-1.9386**	0.0263
<b>Pedroni cointegration test</b>		
Modified Phillips-Perron t	-9.0040***	0.0000
Phillips-Perron t	-2.0545**	0.0200
Augmented Dickey-Fuller t	-3.5138***	0.0002
<b>Westerlund cointegration test</b>		
Variance ratio	-8.0214*	0.0000

Notes: The 1%, 5%, and 10% significance levels are marked by \*\*\*, \*\*, and \*, respectively. The null hypothesis=no cointegration. The cointegration tests are performed with the STATA command "xtcointtest."

Source: Authors' calculations.

### 3.4. Panel-Corrected Standard Errors and Feasible Generalized Least Squares Analysis

Table 8 exhibits the outcomes of the PCSE and FGLS models. Both models show that climate and economic resilience significantly and positively influence SED, underscoring their critical role in promoting it. It is also observed that the coefficient of economic resilience is larger than that of climate resilience, indicating that economic resilience has a slightly more pronounced effect. Conversely, GFCF and NR display a significant negative impact on SED. These findings suggest that heavy dependence on natural resources or investment inefficiency may have an adverse effect on SED. GDP growth has a positive and significant effect on SED

(in the case of the FGLS model only), underlining the relevance of economic growth for long-term development. Finally, TO and FD have positive effects on SED at 1% significance in both models, implying that open trade policies and strong financial institutions promote sustainability. These results are consistent across both approaches (i.e., FGLS and PCSE), lending credibility to the conclusions.

**Table 8. Panel-corrected Standard Errors and Feasible Generalized Least Squares Estimates**

Dependent Variable: Sustainable Economic Development		
	Panel-corrected Standard Errors	Feasible Generalized Least Squares
Variables	Coefficients	Coefficients
ERI	0.0166* (0.0098)	0.0125*** (0.0028)
CRI	0.0049*** (0.0006)	0.0046*** (0.0002)
GFCF	-0.0005** (0.0002)	-0.0006*** (0.0001)
GDPG	0.0001 (0.0002)	0.0001** (0.0001)
TO	0.0004*** (0.0001)	0.0004*** (0.000)
FD	0.0003*** (0.0001)	0.0003*** (0.000)
NR	-0.0011*** (0.0004)	-0.0008*** (0.0002)
Constant	0.5020*** (0.0394)	0.5240*** (0.0123)
Observations	465	465
R-squared	0.997	
<i>Wald statistics</i>		
Chi2	559.92	1324.23
(P-value)	0.000	0.000

CRI=climate resilience index, ERI=economic resilience index, FD=financial development, GDPG=gross domestic product growth rate, GFCF=gross fixed capital formation, NR=natural resources, TO=trade openness.

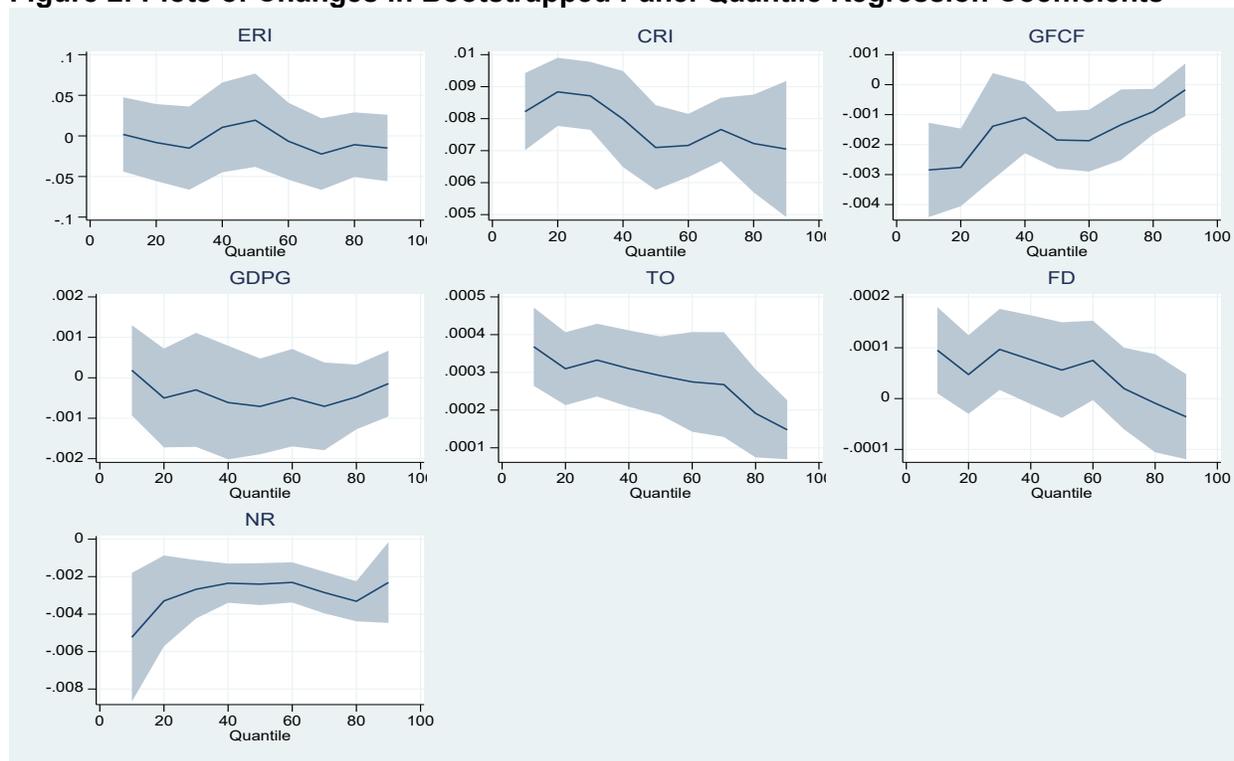
Notes: The table reports the results of panel-corrected standard errors (PCSE) and feasible generalized least squares (FGLS) estimates with the assumption of panel-specific AR(1) autocorrelation structure and heteroscedastic with cross-sectional correlation. The 1%, 5%, and 10% significance levels are marked by \*\*\*, \*\*, and \*, respectively. Standard errors are in parentheses. The PCSE and FGLS are performed with STATA commands 'xtpcse' and 'xtgls', respectively.

Source: Authors' calculations.

### 3.5. Results of Panel Quantile Regression Estimation

Figure 2 portrays the outcomes of the bootstrapped panel quantile regression (QR) (see Appendix Table for the estimates). The figure indicates that several variables exhibit varied effects across quantiles. Notably, economic resilience exhibits a positive effect in the lower quantiles, while it has a negative effect in the upper quantiles, showing diverse effects across quantiles. Therefore, the benefits of economic resilience may fade out in more developed economies. Conversely, climate resilience and trade openness demonstrate consistently positive effects throughout all quantiles, which underscore their universal significance in fostering SED. However, GFCF and NR show adverse effects throughout all quantiles. Though statistically insignificant, GDPG initially promotes SED but shows diminishing returns and turns negative in the higher quantiles. This suggests growth-related environmental or social trade-offs. Finally, FD generally supports SED across quantiles, except for a few, such as the eighth and ninth quantiles, where its influence wanes.

**Figure 2: Plots of Changes in Bootstrapped Panel Quantile Regression Coefficients**



*Continued on the next page*

CRI=climate resilience index, ERI=economic resilience index, FD=financial development, GDPG=gross domestic product growth rate, GFCF=gross fixed capital formation, NR=natural resources, TO=trade openness.

Notes: The x-axis represents the conditional quantiles of SED, and the y-axis denotes the coefficient values of explanatory variables (ERI, CRI, GFCF, GDPG, TO, FD, and NR). The blue line shows the coefficients of panel quantile regression, while the gray area covers the 95% confidence interval. The estimations of the panel quantile model are performed using the STATA command “sqreg”.

Source: Authors’ calculations.

### *3.6. Results of Local Projection-based Impulse Response Functions*

We have also employed LP-IRFs, established by Jordà (2005), for providing further robustness and trustworthiness of our baseline models’ outcomes. Earlier estimates (e.g., PCSE, FGLS, and Panel QR) primarily focus on static or mean-based effects, whereas LP-IRFs estimate the dynamic responses of SED to changes in economic or climate resilience over multiple time horizons—giving insights into short-term versus long-term impacts and thus substantiating the temporal dynamics of the associations. Figure 3 depicts the findings of the LP-IRFs, which show that a positive shock to economic resilience causes a considerable and durable increase in SED. The reaction emerges instantly in the first year and is favorable and significant for around 8 years, peaking at around years 4–5. This continuous positive impact suggests that enhancing economic resilience might have enduring advantages for sustainable development.

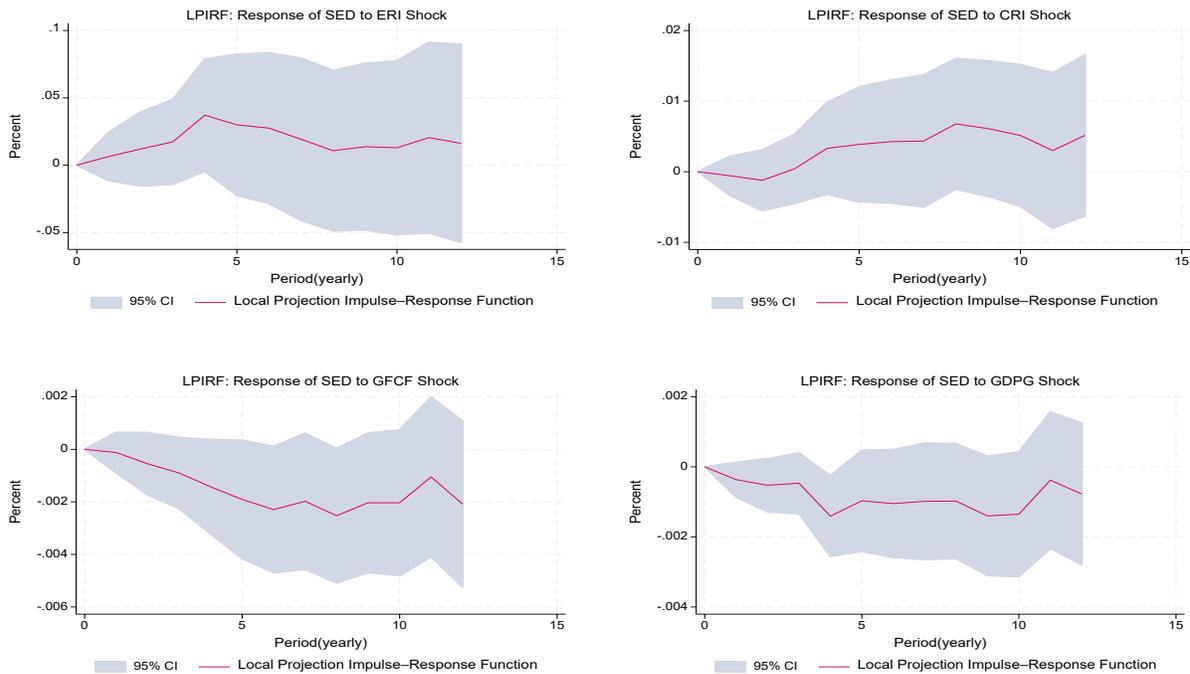
Similarly, a positive shock to climate resilience produces a favorable and substantial response in SED, but with a lesser magnitude than ERI. The influence progressively increases, becomes considerable during the third year, and is consistent over the whole 12-year period. This suggests that investments in climate resilience (for example, climate adaptation, climate legislation, and disaster preparedness) may provide delayed but lasting benefits for economic sustainability. Hence, these findings provide evidence that both economic and climate resilience tend to play a critical role in sustainable economic development.

Concerning control variables, FD and TO changes provide a positive and substantial response in SED. The FD change has both an immediate and long-term effect. Similarly, the impact of the TO shock becomes positive and substantial after the first year and remains so in

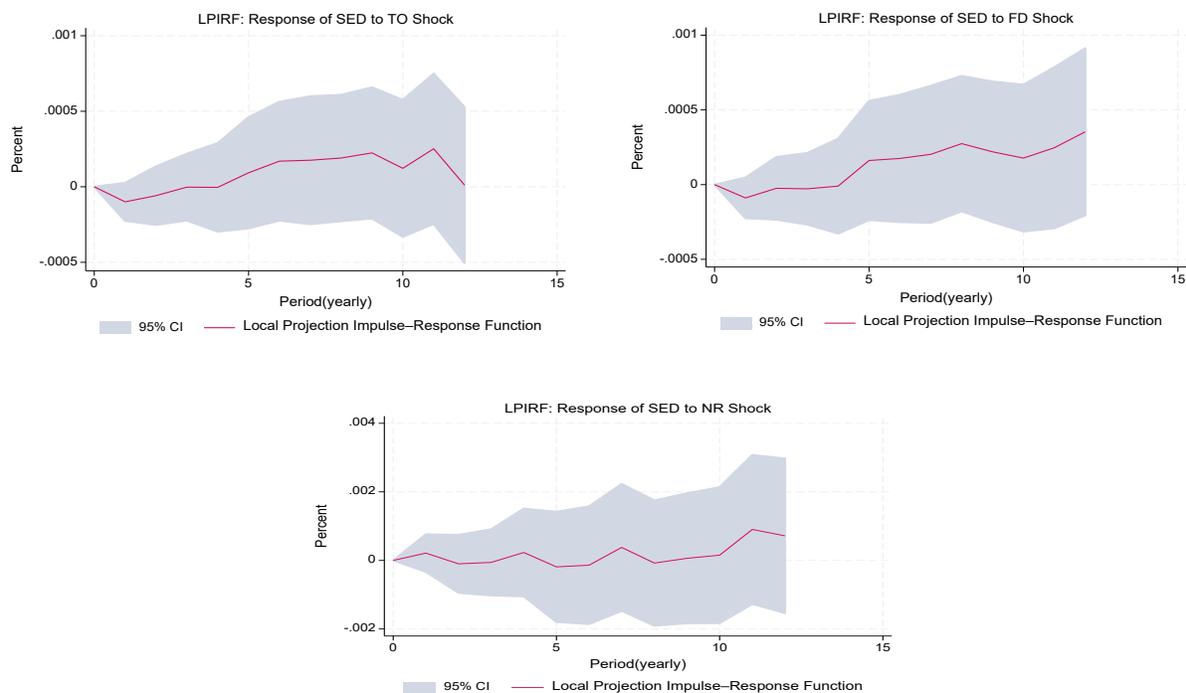
the medium term. In contrast, the GFCF and GDPG changes have an insignificant but positive response in SED in the very short run, which turns significantly negative and remains so until the entire period. However, the NR shock produces a statistically insignificant, negative, and persistent reaction in SED across the whole time.

Taken together, the LP-IRF outcomes provide convincing evidence for the dynamic interaction of resilience indicators and key control variables on sustainable economic development. Overall, the outcomes are highly consistent with the baseline findings, which strengthen the overall validity and reliability of our conclusions. These outcomes provide important insights into how resilience and other macroeconomic factors influence sustainable economic development over time.

**Figure 3: Impulse Response Functions of Sustainable Economic Development to Economic and Climate Resilience Changes**



*Continued on the next page*



CRI=climate resilience index, ERI=economic resilience index, FD=financial development, GDPG=gross domestic product growth rate, GFCF=gross fixed capital formation, LPIRF=local projection impulse response function, NR=natural resources, SED=sustainable economic development, TO=trade openness. Notes: The figure depicts the response of sustainable economic development to economic and climate resilience changes, based on local projections, over a 12-year horizon. The figure also shows the responses of SED to key control variables' changes (e.g., GFCF, GDPG, TO, FD, and NR). The red line illustrates the estimated responses of SED to the various variables' changes, while the shaded region represents the 95% confidence interval. The y-axis denotes the percentage points, whereas the x-axis refers to the years after the shock. The AIC criteria are used to select the optimal lag of the variables utilized in the estimation (including all endogenous variables).

Source: Authors' calculations.

### 3.7. Discussion

The outcomes of both our static and dynamic models are largely consistent and complementary, providing compelling evidence of the critical role of economic and climate resilience in promoting SED across countries. Together, they suggest that both types of resilience are not only important drivers of SED but also display diverse impacts across development stages and time horizons.

Across all static models, ERI is found to exert a robust and positive effect on SED. These outcomes are somewhat consistent with previous studies such as Briguglio et al. (2009) and Ma

and Huang (2023), which highlight the importance of economic stability, quality development, and diversification as key components of long-term development. Countries with greater economic resilience are better equipped to survive and bounce back from shocks, warranting a stable environment beneficial to sustainable economic growth (Briguglio et al., 2009). Our analysis extends this understanding by providing cross-country panel evidence that ERI significantly promotes SED, particularly through channels such as fiscal robustness, institutional strength, and social stability. The LP-IRF estimates support this dynamic linkage, indicating that a positive change to ERI causes a substantial boost in SED, with effects lasting for up to a decade. This suggests that improving ERI has immediate as well as cumulative effects, underlining the long-term policy importance of investing in economic resilience. However, our panel quantile regression analysis indicates that while the ERI coefficients vary in sign across quantiles, they are not statistically significant. Therefore, we cannot confirm the presence of a statistically robust nonlinear relationship. This tentative pattern calls for further research but offers a potential nuance to the existing literature.

Similarly, climate resilience shows a consistently positive and significant impact on SED across all econometric techniques. Although the effect is slightly smaller than that of ERI in the static analyses, LP-IRF estimates suggest that CRI changes generate a progressively intensifying and sustained impact on SED, with statistically significant effects appearing from the third year onward and persisting over the long-term. This delay may indicate the lag feature of environmental investments and adaptation measures, which take some time to generate material outcomes. However, the persistence of the effect underscores the strategic significance of embedding climate resilience into the national development strategy. This result is partly consistent with Hallegatte et al. (2016), Fuso Nerini et al. (2019), and Fuldauer et al. (2022), who argue that adaptive capacity is imperative in mitigating climate-related risks and furthering long-term economic stability and, consequently, leading to sustainable development. Notably, CRI

consistently promotes SED throughout all quantiles, signifying its importance regardless of a country's economic stage. In other words, investing in climate resilience can benefit both developing and developed nations (Georgieva et al., 2022). The likely reason for the findings is that climate resilience can help developing countries manage climate change impacts, including extreme weather events, sea level rise, and resource depletion (UNDP, 2025b), protecting people, lives, infrastructure, and natural resources that are essential for sustainable development (Georgieva et al., 2022). Even if advanced countries have the resources to deal with climate change, they remain vulnerable to its impacts (Wijaya, 2014). Investing in climate resilience can also assist developed countries in avoiding risks, minimizing economic losses, and ensuring long-term sustainability.

Concerning control variables, the outcomes reveal important asymmetries in their effects on SED. Gross fixed capital formation exhibits consistently negative impacts on SED throughout all analyses. This finding contrasts with the traditional view that capital investment contributes significantly toward sustainable economic development, as suggested by Wang et al. (2022) and Shi and Xu (2023). It means that not all forms of capital investment are conducive to sustainability. When capital investments are directed toward activities that deplete natural resources or exacerbate environmental degradation, they may impede sustainable development (Zakari and Musibau, 2024). To be effective, capital investments should prioritize sustainable infrastructure, green technologies, and socially inclusive projects. Similarly, natural resources also exhibit a consistent adverse influence on SED, which aligns with the “resource curse” hypothesis (Sachs and Warner, 2001). That is, excess dependence on natural resource extraction can hinder sustainable economic development because it frequently leads to economic instability, environmental degradation, and weakened institutions (Ahmad et al., 2024). These findings align with prior research, such as Xie et al. (2021) and Ahmad et al. (2024), which suggest that

economic diversification and adopting sustainable resource management techniques, particularly in resource rich countries, might mitigate the negative consequences of resource dependencies.

Trade openness and financial development show a significant positive effect on SED in all models. These findings are aligned with previous research, such as Chien et al. (2023) and Kindo et al. (2024), which suggest that trade openness helps countries reach global markets, speeds up the sharing of new technologies, and encourages innovation. Together, these things likely improve health, education, and economic growth. Our findings are also consistent with Chien et al. (2023), Ahmad et al. (2024), and Manigandan et al. (2024), who argue that a strong financial system can mobilize savings, distribute resources efficiently, and ensure the supply of necessary capital for sustainable investments. However, quantile regressions show that financial development's impact diminishes—and may even turn negative (albeit insignificantly)—at higher developmental stages. The findings suggest that less developed countries may benefit more from financial development than developed countries, consistent with Masten et al. (2008) and Ibrahim and Alagidede (2018). As developed economies' financial systems mature, further development may have a less pronounced or even a negative impact on sustainable development (Ibrahim and Alagidede, 2018).

Finally, GDP growth contributes favorably to SED on average but has varying (nonlinear) effects across quantiles. This reinforces the proposition that imbalanced or unsustainable growth might undermine developmental quality over time, especially in weak economies. Furthermore, while GDP growth helps SED, a development model focused only on growth might face difficulties at higher stages of development, because of increasing environmental problems and social inequality (Jackson, 2016).

#### **4. Conclusions and Policy Implications**

The world's economy increasingly confronts risks from both climate change and economic shocks, which elevate vulnerabilities and impede sustainable development efforts. It is imperative to enhance resilience against these shocks. Despite its strong relevance, the linkage between different types of resilience and sustainable economic development has received inadequate attention in the literature. This study fills this gap by evaluating how climate and economic resilience impact SED across a diverse panel of 31 countries over 15 years (2007–2021). By blending static, distributional, and dynamic economics tools such as panel quantile regression, FGLS, PCSE, and LP-IRFs, our study offers an in-depth and multifaceted comprehension of these critical connections.

Our findings demonstrate that both economic and climate resilience are critical drivers of SED. The quantile analysis confirms a consistent and significant positive impact of climate resilience on SED across all quantiles, emphasizing its critical relevance for all countries, regardless of the country's development level. Nonetheless, the impacts of economic resilience exhibit variability and are contingent upon context, indicating a potential nonlinear relationship, although lacking statistical significance. That is, its beneficial effect might be strongest in less developed countries but lessens and eventually turns negative in the most developed economies. Our dynamic analysis obtained from LP-IRFs strongly supports and extends these conclusions. It demonstrates that positive changes to both economic and climate resilience lead to substantial and long-term improvements in SED. This signifies that proactive resilience policy measures can yield long-term development advantages. Our findings also demonstrate that trade openness and financial development significantly boost SED, while GDP growth, gross fixed capital formation, and natural resources may obstruct SED if not handled prudently.

Our study's findings carry vital and actionable policy implications. Policymakers should formulate a comprehensive development plan that includes both climate and economic resilience in their national policies, as both significantly promote sustainable development. Specifically, the

subtle effects of economic resilience suggest that a “one size fits all” solution is ineffective in this instance. For countries with lower SED, building core economic resilience remains the key and most successful tool for achieving sustainable economic development. However, policymakers should be aware of the diminishing returns of economic resilience at higher quantiles and pursue balanced strategies beyond economic measures, such as emphasizing social welfare improvement and promoting higher quality growth and environmental sustainability to further progress toward SED. Second, our dynamic findings indicate the need for a prompt policy response. The enduring benefits of resilience changes suggest that large-scale, upfront expenditures in sectors like green infrastructure, economic diversification, or climate adaptive technology should be viewed not as mere expenses but also highly profitable initiatives for future prosperity. Finally, our outcomes reiterate that building fiscal and institutional capacity via financial development and trade openness is a critical step toward attaining resilient and sustainable development. Capital expenditures should be strategically directed toward projects that support environmental and social sustainability objectives, such as renewable energy, green infrastructure, and socially inclusive development initiatives. Similarly, natural resource-rich countries must emphasize sustainable resource management and economic diversification to mitigate the “resource curse”.

This study, despite its significant contributions, is limited by certain shortcomings. Our quantile regression reveals a nonlinear relationship between economic resilience and sustainable development, although it fails to attain statistical significance. Future studies could revisit their connection using more sophisticated methodologies and diverse perspectives to expose their intricate interrelations. While HDI is a solid measure of sustainable economic development, it does not fully cover environmental aspects, which limits its ability to show the complete picture of sustainability. Future research should include more detailed environmental indicators, like carbon emissions or ecological footprints, and analyze a more extensive and diverse group of countries if data is available. Lastly, future studies could offer more insights into the connection between

resilience and sustainable development by dividing countries into different groups, such as developing and developed economies, and comparing them.

**Appendix Table: Results of Bootstrapped Panel Quantile Estimation**

Variables	(1) q10	(2) q20	(3) q30	(4) q40	(5) q50	(6) q60	(7) q70	(8) q80	(9) q90
ERI	0.0018 (0.0237)	-0.0082 (0.0221)	-0.0151 (0.0243)	0.0105 (0.0242)	0.0193 (0.0272)	-0.0065 (0.0210)	-0.0223 (0.0203)	-0.0108 (0.0186)	-0.0149 (0.0184)
CRI	0.0082*** (0.0004)	0.0088*** (0.0004)	0.0087*** (0.0004)	0.0079*** (0.0006)	0.0071*** (0.0005)	0.0071*** (0.0004)	0.0076*** (0.0004)	0.0072*** (0.0006)	0.0070*** (0.001)
GFCF	-0.0028*** (0.0008)	-0.0027*** (0.0007)	-0.0014 (0.0008)	-0.0011* (0.0006)	-0.0018*** (0.0005)	-0.0018*** (0.0005)	-0.0013** (0.0005)	-0.0009** (0.0004)	-0.0002 (0.0005)
GDPG	0.0002 (0.0007)	-0.0005 (0.0005)	-0.0002 (0.0007)	-0.0006 (0.0007)	-0.0007 (0.0006)	-0.0005 (0.0005)	-0.0007 (0.0005)	-0.0004 (0.0004)	-0.0001 (0.0004)
TO	0.0003*** (0.0001)	0.0003*** (0.0001)	0.0003*** (0.0001)	0.0003*** (0.0001)	0.0003*** (0.0001)	0.0003*** (0.0001)	0.0003*** (0.0001)	0.0002*** (0.0001)	0.0001*** (0.0000)
FD	0.0001* (0.0001)	0.0001 (0.0000)	0.0001** (0.0000)	0.0001* (0.0000)	0.0001 (0.0000)	0.0001** (0.0000)	0.0000 (0.0000)	-0.0000 (0.0000)	-0.0000 (0.0000)
NR	-0.00523** (0.002)	-0.0033** (0.0012)	-0.0026*** (0.0008)	-0.00235*** (0.0006)	-0.0024*** (0.0006)	-0.0023*** (0.0004)	-0.0028*** (0.0005)	-0.0033*** (0.0005)	-0.0023** (0.001)
Constant	0.342*** (0.0287)	0.322*** (0.0264)	0.305*** (0.030)	0.343*** (0.0380)	0.428*** (0.0339)	0.444*** (0.0241)	0.426*** (0.027)	0.455*** (0.0362)	0.467*** (0.0500)
Observations	465	465	465	465	465	465	465	465	465

CRI=climate resilience index, ERI=economic resilience index, FD=financial development, GDPG=gross domestic product growth rate, GFCF=gross fixed capital formation, NR=natural resources, TO=trade openness.

Notes: The 1%, 5%, and 10% significance levels are marked by \*\*\*, \*\*, and \*, respectively. Standard errors are in parentheses.

Source: Authors' calculations.

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# Impact of Economic and Climate Resilience on Sustainable Development

## *A Cross-Country Analysis*

This paper analyzes the influence of economic and climate resilience on sustainable development (SD) using a panel dataset of 31 countries from 2007 to 2021. It uses advanced econometric techniques, including panel-corrected standard errors, feasible generalized least squares, panel quantile regression, and local projections. It finds that economic and climate resilience have significant effects on SD. Furthermore, dynamic analysis indicates that both types of resilience have persistent effects on SD and quantile analysis validates the robustness and consistency of our findings across different stages of development.

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