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## Article

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# The Role of Environmental Quality, Financial Development and Institutional Quality in Sustainable Economic Growth: Evidence from China

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## ABSTRACT

China's robust economic growth serves as a key driver propelling the global economy forward. As such, understanding the factors influencing its sustainable economic growth remains a critical concern for stakeholders. In this context, this study aims to investigate the key determinants of China's sustainable economic growth. Specifically, it examines the effect of environmental quality, institutional quality and financial development on sustainability in the Chinese context. To achieve this, the study employs a range of econometric analyses, including Ordinary Least Square (OLS), Generalized Method of Moments (GMM), and Quantile Regression (QR), using data spanning 2002 to 2019. The empirical findings reveal that environmental quality, institutional quality and financial development significantly contribute to China's sustainable economic growth. Additionally, the interaction effects of the institutional environment provide nuanced insights into the relationship. This study offers valuable implications for policymakers, highlighting the need to prioritize impactful financial inclusion over mere financial sector expansion, alongside focusing on other growth-enhancing initiatives. This study contributes to the body of knowledge by providing empirical evidence of the interaction effect of the institutional environment within this framework.

**KEY WORDS:** sustainable economic growth, China, financial development, Quantile Regression, global indicators.

**JEL Classification:** F36, G28, O43, Q56.

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## 1. Introduction

Sustainable economic growth is fundamental for improving and maintaining real GDP, as it helps balance a country's income generation and expenditures. This study examines the critical role of environmental quality (measured by CO<sub>2</sub> emissions), institutional quality and financial development in influencing economic growth in China. According

to Michieka et al. (2013), China and other emerging countries have achieved substantial social and economic advancements through trade liberalization and economic reforms over recent decades. However, this growth has significantly increased energy demand, leading to challenges related to environmental degradation and sustainability (Ozturk & Al-Mulali, 2015). China remains one of the largest producers of carbon dioxide emissions glob-

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ally (EPA, 2014). While the relationship between environmental pollution and economic growth has been widely researched (Azam et al., 2016; Baek, 2015; Burnett et al., 2013; Feng et al., 2020; Onafowora & Owoye, 2014; Wang et al., 2016; Wang et al., 2024; Zhang & Zhao, 2024; Zou et al., 2016), further investigation is needed to understand how these factors interact in the context of emerging economies like China (Dogan & Seker, 2016).

China is actively exploring new avenues to expand its trade. The Silk Road Economic Belt, initiated by the Government of China, is a key component of their latest trade expansion agenda. Consequently, this initiative is expected to increase energy demand, potentially exacerbating environmental pollution. However, trade expansion also provides opportunities to mitigate environmental pollution. Through trade, countries can exchange advanced technology and capital, enabling the transformation of traditional manufacturing methods into modern, sustainable practices. Moreover, adopting environment-friendly strategies will foster sustainable economic growth and contribute to building a resilient economy. While examining the association between economic growth and environmental quality, assessing whether this relationship is compatible is essential. If compatibility exists, measures must be taken to control the CO<sub>2</sub> emissions relative to Gross Domestic Product (GDP). Achieving this goal requires large-scale deployment of energy-efficient technologies to meet energy demand while reducing CO<sub>2</sub> emission intensity (Medlock III & Soligo, 2001).

For a country like China to maintain CO<sub>2</sub>-efficient production units, a robust financial system is essential to ensure adequate financing, risk management and market liquidity (Eren et al., 2019). According to the figures provided by the National Bureau of Statistics of China, savings deposits reached up to 28.7 trillion dollars in 2019, with an increase of 2.3 trillion dollars by year-end. Total saving deposits amounted to 28 trillion dollars, while foreign currency loans across all financial intuitions totalled 23 trillion. Consequently, an adequate credit supply is vital for fostering a supportive financial environment that drives economic development to higher levels. Moreover, a sound

economic environment facilitates energy development. In addition, the role of financial development is particularly significant. Early work, such as Schumpeter (1934), highlighted the relationship between finance and growth, emphasizing that expanding the financial sector is a crucial prerequisite for growth in the real economy. Later studies support this concept (Beck et al., 2000; Beck & Levine, 2004; Demirgüç-Kunt & Levine, 1996; and Levine & Zervos, 1998). Although this relationship has a solid theoretical foundation, empirical research has often overlooked the impact of financial development on economic growth. According to Andersen and Tarp (2003), the connection between financial development and economic growth is more nuanced and less conventional than other economic theories. Some researchers argued that "too much finance" can hinder economic growth by diverting resources from the real economy and creating instability (Arcand et al., 2015; Cecchetti & Kharroubi, 2012; Dabla-Norris & Srivisal, 2013).

The essence of these studies is that an excessively developed financial sector may divert human capital from the real sector, leading to macroeconomic and financial fragility, which can undermine the broader economy instead of an economic boost. As economic growth drives financial development and energy consumption, it might be relevant to note that the financial development and energy consumption are crucial for enhancing social productivity (Khan et al., 2019; Rafindadi & Ozturk, 2016; Shahbaz et al., 2013, 2017). In the context of China's revolutionary strategy, economic growth influenced by financial development is critical, as it helps optimize the energy ecosystem and facilitate coordinated development in a multi-agent economy, thereby ensuring sustainable economic growth. Moreover, non-economic factors, particularly institutional factors, are increasingly recognized for their role in economic growth. Traditionally, most researchers focused exclusively on the nexus between economic factors and growth. According to Maruta et al. (2020), institutional factors are critical to economic growth and highlight the importance of governance in maintaining proper checks and balances on institutional quality. Institutional or governance quality is measured through the

Worldwide Governance Indicators (WGIs) provided by the World Bank, which are widely relied upon by policymakers and academics. The WGIs have six dimensions for institutional quality: voice and accountability, political stability, government effectiveness, regulatory quality, the rule of law, and control of corruption.

Generally, a robust governance system is advantageous for a country's economic growth. However, its impact varies significantly in regions or nations with weak institutional performance. For instance, freedom of speech, combined with freedom of the press and democratic accountability, plays a pivotal role in enhancing economic development. Democracy is also an essential condition for the efficient functioning of a market economy and fostering economic growth. According to the Asian Development Bank (ADB), while the economic performance of Asian countries is relatively strong compared to other regions, their poor institutional quality remains a significant obstacle to attracting foreign investment, promoting trade, and achieving sustainable economic development. Previous studies have also established a significant association between economic growth and direct and indirect governance (Adams & Mengistu, 2008; Ndulu & O'Connell, 1999; Pradhan, 2011).

To the authors' knowledge, the combined roles of environmental quality, institutional quality, and financial development have not been examined exclusively and empirically in previous research. Therefore, this study aims to empirically explore the relationship between environmental quality, financial development and institutional quality in relation to economic performance in China. Furthermore, the findings of this study offer country-specific insights that can guide global economies in addressing developmental diversity, particularly in the context of infrastructure development. This study also contributes to the literature by providing theoretical guidance on the interplay between these factors and their collective impact on economic performance. Previous studies have lacked a multivariate framework, resulting in insufficient models for capturing the complexities of economic performance. By incorporating environmental quality, financial development, and institutional

quality, this study seeks to develop a comprehensive model to understand better and improve economic growth. Many existing studies rely on direct regression analysis between two variables, which risks producing spurious results. To address this limitation, the present study employs advanced econometric techniques, including quantile regression, to identify the critical determinants of China's economic growth. This study further examines the moderating impact of institutional quality on the relationship between environmental quality, financial development, and economic performance within China's economy. By assessing these linkages across different economic development levels, this research addresses key deficiencies in the existing literature and provides actionable insights for policymakers and academics.

The remainder of the study is structured as follows: Section 2 synthesizes the relevant literature, Section 3 outlines the methodology, and the results are presented and discussed in Section 4. The final section concludes the study with recommendations and directions for future research.

## 2. Literature Review

This section reviews the previous research on the subject matter, which is organized into three main segments. The first segment focuses on environmental quality and economic growth. The second segment examines financial development and economic growth, while the final segment discusses institutional quality and economic growth.

### 2.1. Environmental Quality and Economic Growth

The Environmental Kuznets Curve (EKC) is a widely recognized theory for understanding the link between environmental quality and economic growth. According to the theory, an increase in income growth initially leads to higher environmental pollution. However, as income levels continue to rise, a threshold is reached where further income growth results in a reduction in environmental pollution. This creates an inverted U-shaped curve, suggesting that economic growth initially contributes to pollution, but eventually leads to its decline. The EKC connection is influenced by

a variety of interconnected factors, including the composition of production and consumption, the size of the economy, the vintage of technology, the structure of economic activity, income inequalities, forms of energy use, environmental priorities, and the effectiveness of regulations. Along similar lines, a strand of recent literature (Zhang & Zhao, 2024; Wang et al., 2024) highlights how green finance and renewable energy intersect with economic growth and environmental quality within the framework of the EKC hypothesis.

In the past three decades, the Chinese economy has experienced exponential growth. In the 1970s, the government of China introduced market reforms, and since then, China has maintained the growth rate of approximately 9.70% per annum (BP, 2010). This rapid economic expansion has allowed China to lift itself out of extreme poverty. With the increase in economic growth, the demand for fossil fuels has also risen, making China one of the largest producers of CO<sub>2</sub> emission. In addition to fossil fuels, China is the world's largest consumer of crude oil, accounting for 46.9% of global consumption (BP, 2010). According to Crompton and Wu (2005), China consumed 31%, 10.7%, 7.6%, and 1.2% of the world's coal, hydroelectricity, crude oil, and gas, respectively, in 2003. Furthermore, in 2009, consumption increased by 46.9% for coal, 18.8% for hydroelectricity, 10.4% for crude oil, and 3.0% for gas. This trend of rising fuel consumption continues each year. While energy consumption brings benefits, it also poses significant drawbacks. For instance, it has a strong negative impacts on the environment (Soytas & Sari, 2003). Environmentalists have found that as energy consumption increases, pollutant emission also rise, contributing to global warming (Si et al., 2021; Rahman, 2024). The government should support private firms in investing in innovation and production of renewable energy sources like solar, hydro, and wind. This shift would reduce the region's resilience on fossil fuels, which are an expensive environmentally harmful option (Aziz et al., 2020).

Green growth is one of the essential elements for achieving sustainable development. Like many other South Asian countries, China relies on

natural resource exploitation to meet its growth objectives. Therefore, effective policies are crucial for ensuring both sustainability and economic growth (Ahmed et al., 2022). Incremental increases in energy use to achieve higher growth result in higher CO<sub>2</sub> emissions, leading to environmental degradation. Financial development, however, can mitigate these effects by promoting investments in energy-efficient technologies, as demonstrated in the case of Portugal (Shahbaz et al., 2015). This highlights the challenge many countries face in achieving coordinated economic development while addressing environmental concerns (Wang et al., 2021). Global warming is a primary concern related to economic growth and current energy sources. Therefore, minimizing carbon emissions, particularly CO<sub>2</sub>, is crucial to mitigating global warming. Mardani et al. (2019) emphasize that CO<sub>2</sub> emissions are a major greenhouse gas (GHG), playing a central role in maintaining the planet's habitability. CO<sub>2</sub> emissions, which result from human activities and fossil fuel consumption, are the primary driver of global warming. Furthermore, fossil fuels account for approximately 80% of GHG emissions (Soytas & Sari, 2003).

Further, the Stanford Woods Institute for the Environment (2019) reports that controlling carbon emissions could reduce them by 50% by 2030. It is also worth noting that carbon emissions could be reduced to zero if the proposed practices are implemented by 2050. Using the Long-range Integrated Development Analysis (LINDA) model, Luukkanen et al. (2015) demonstrate that CO<sub>2</sub> emissions could reduce to one-third of their current level by 2030. However, Mladenović et al. (2016) argued that carbon emissions in relation to economic growth and population, could be predicted by employing techniques such as Support Vector Machine (SVM), genetic programming (GP), and Artificial Neural Network (ANN). According to Mardani et al. (2019), CO<sub>2</sub> emissions and economic growth remain critical issues that require immediate attention. To address the carbon emission problem and predict future emissions, Sun et al. (2017) used Particle Swarm Optimization (PSO) and the Extreme Learning Machine (ELM) method. Their study demonstrates that the

proposed method is accurate and suitable for future applications. Based on previous literature and the above discussion, it is concluded that creating a carbon-efficient economy is a global challenge that demands immediate attention from researchers and policymakers, along with a solid strategy to address this issue. According to recent studies, the financial sector must assess the ecological viability of projects before providing funding for their completion (Kihombo et al., 2021).

## 2.2. Financial Development and Economic Growth

In the current context, the ongoing issue regarding financial development theory is the complex relationship between financial development and economic growth. According to King and Levine (1993), numerous studies have addressed the link between financial development and economic growth, yet their findings remain inconclusive. Countries focusing on financial development to boost economic growth can achieve this by efficiently allocating resources (Shahbaz et al., 2022). While financial development influences economic growth, the significance and magnitude of this effect vary depending on the specific context (Boikos et al., 2022). Therefore, the existing literature can be divided into three segments. The first segment asserts that financial development significantly influences economic growth (Nyasha, 2015; Yang, 2019). According to the growth model outlined by Diallo & Al-Titi (2017), financial development positively affects local-level economic growth. Similarly, using data from China's Beijing–Tianjin–Hebei region, Wang et al. (2019) found similar results to those of Diallo and Al-Titi (2017). The second segment of the literature suggests a negative association between financial development and economic growth (Ouyang & Li, 2018; Sassi & Gasmı, 2014). Sassi and Gasmı (2014) used data from 27 European countries from January 1995 to December 2012 and found a negative relationship between financial development and economic growth. They attributed this negative relationship to the heterogeneity of financial development across the 27 European countries.

In contrast, several studies (Liu & Zhang, 2020; Luukkanen et al., 2015; S. Wang et al., 2016; Yang,

2014) highlight the non-linearity between financial development and economic growth. For instance, Liu and Zhang (2020) examined the financial structure mechanism and economic growth across 29 provinces in China from 1996 to 2013. The study found an inverse U-shaped relationship between financial structure and economic growth. Additionally, Law and Singh (2014) used data from 87 countries to provide evidence of a non-linear relationship between financial development and economic growth. Their study revealed threshold effects, suggesting that economic growth is primarily influenced by the lack of financial development. Similarly, the non-linear impact of financial development on economic growth is also observed in the context of China (Chen et al., 2013; Guender, 2018). However, despite extensive empirical analysis and theoretical support, the literature on the relationship between financial development and economic growth remain inconclusive.

## 2.3. Institutional Quality and Economic Growth

Institutions play a crucial role in promoting economic development and driving economic progress. Poor institutional quality undermines capital accumulation and income distribution (Qamruzzaman, 2022). The significant role of institutions is emphasized in existing literature, highlighting factors such as governmental efficiency, government mechanism, democracy and freedom, and property protection for fostering economic growth (Acemoglu et al., 2005; Rodrik, 2018; Ploeg & Poelhekke, 2010). Institutional quality positively influences a country's economic development (Singh & Pradhan, 2022). Economic growth depends on how people adapt themselves to the existing institutional context and institutional change (Urbano, Audretsch, Aparicio, & Noguera, 2020). In theory, institutional quality has a critical macroeconomic role. Its relationship with economic growth is optimal in ensuring economic development (Mehmood, Mohy Ul Din, Aman Ullah, Khan, & Fareed, 2023). These studies argue that a single index cannot adequately capture the performance of institutional quality over time at the country level. They also contend that investment,

financial development, and institutional quality variables can be further explored within the context of economic development dynamics, which are essential to understanding the growth processes (Brunnschweiler & Bulte, 2008; Rodrik, 2018). Lastly, the studies mentioned above did not address how institutional quality influences economic growth with varying effects at different stages. Previous literature shows both negative and positive significant associations between institutional quality and economic growth (Acemoglu & Robinson, 2008; Sarmidi et al., 2014). Similarly, improvements in institutional quality may reduce trade barriers in the international market and promote economic growth (Kurtz & Brooks, 2011; Lederman & Maloney, 2006).

Economists and policy experts worldwide agree that institutional quality is crucial in determining growth differentials. Kilishi et al. (2013) used the GMM system approach to test the role of institutional quality in determining the economic performance of Sub-Saharan Africa (SSA). Their empirical evidence showed that regulatory quality is critical for the economic performance of SSA. This finding underscores the importance of regulatory quality in improving SSA's performance. Similarly, Vianna and Mollick (2018) conducted a similar study on 192 countries, specifically focusing on Latin America between 1996 and 2015. They found that every 0.1% improvement

in institutional quality results in a 3.9% increase in per capita income and 2.6% increase in world development. These findings also highlight the limited opportunities and the weak rule of law in Latin America.

Similarly, Butkiewicz and Yanikkaya (2006) emphasized that certain characteristics, such as the rule of law, significantly affect growth performance. They suggested that effectively implementing the rule of law can help improve a country's economic growth. Using data from 20 countries in a comparative study, Gurchich (2016) argued that most developmental programs failed in Russia between 2000 and 2010 due to a rigid institutional framework. They also suggested that economic growth is unattainable without proper institutional reforms. Institutions play a crucial role in enhancing various sectors of the economy. To the best of the author's knowledge, a gap exists in the existing literature regarding the combined effect of environmental quality, financial development, and institutional quality on economic growth, particularly in the context of the Chinese market. Therefore, country-specific implications can guide the region in formulating strategies that take into account its unique challenges and reforming its developmental approaches to foster economic growth. The next section of this paper presents the research methodology used to conduct this research.

**Table 1**  
*Description of Study Variables*

Variable	Notation	Measurement
Sustainable Economic Growth	SEG	GDP growth (Annual %)
Environmental Quality	ENV	CO2 Emission Per Capita
Financial Development	FND	Domestic credit to the private sector by banks (% of GDP)
Institutional Quality	INQ	The index is created using Principal Component Analysis (PCA) of six governance indicators: (1) Control of Corruption, (2) Government Effectiveness, (3) Political Stability and Absence of Violence or Terrorism, (4) Regulatory Quality, and (5) Rule of Law, and (6) Voice and Accountability. The percentile rank is used as a reference.
Debt	DTE	External debt stocks, public and publicly guaranteed (PPG)
Global Index	GEI	S&P Global Equity Indices (annual % change)

*Note.* The SEG, FND, INQ, DTE and GEI data is collected from the World Development Indicators (WDI, 2019). The data for the ENV is collected from the Knoema Data Base. For brevity, we do not include the PCA. However, the results of the PCA are available on request.

### 3. Research Methodology

#### 3.1. Data Sources and Study Variables

This study used quarterly data from 2002 to 2019 to examine 'China's sustainable economic growth determinants. The dependent variable is measured by the Gross Domestic Product (GDP) growth rate, following the approach suggested by Sala-i-Martin and Barro (1995), who argued that economic growth in developing countries is often low and is better assessed through growth per capita. The study incorporates three critical independent variables: (1) environmental quality, (2) financial development, and (3) institutional quality. Carbon dioxide (CO<sub>2</sub>) emission per capita was used to measure environmental quality, reflecting the environmental impact of economic activities. The proxy aligns with the Environmental Kuznets Curve (EKC) hypothesis, which posits a relationship between economic growth and environmental quality. The role of banks in economic development is well-documented, with bank credit serving as a critical indicator of financial development and a primary source of enterprise financing and growth. Considering the structure of China's financial market, this study uses the balance of credit funds for financial institutions as a proxy for financial development (Obeng-Amponsah et al., 2019). This measure is consistent with the Finance-Growth Nexus, which underscores the importance of financial systems in fostering economic growth.

Institutional quality (IQ) is also included as a critical variable based on the framework developed by Acemoglu and Robinson (2008), who emphasized the role of institutions in addressing economic inequalities and promoting growth. While previous studies often used the democracy or polity index to measure institutional quality (Brunnschweiler & Bulte, 2008; Sachs & Warner, 2001), this study employs six governance indicators from the World Bank to capture a broader perspective of institutional quality. These indicators include voice and accountability, control of corruption, the rule of law, political stability, regulatory quality, and government effectiveness. These dimensions align with theories linking governance quality to economic performance, particularly in emerging economies.

In addition to these core variables, the study incorporates two control variables: public debt and global index performance. The relationship between public debt

and economic growth has been widely discussed in the literature, with numerous studies exploring their interdependence (Reinhart & Rogoff, 2010; Josten, 2002; Easterly, 2001). Global index performance, representing the stock market's overall performance, is included to account for the impact of international trade and financial flows on China's economy (Arslanalp et al., 2016). This variable reflects China's interconnectedness with global economic systems and its vulnerability to external shocks. A conceptual framework links these variables to the theoretical models underpinning this. These include the EKC hypothesis for environmental quality, the Finance-Growth Nexus for financial development, and governance theories for institutional quality. This framework ensures theoretical grounding for the empirical analysis. The notations, measurements and sources of selected variables are provided in Table I.

#### 3.2. Empirical Model

This study aims to investigate the relationship between economic growth (GDP) and its key determinants, such as environment quality (ENV), financial development (FnD), institutional quality (INQ), Debt (DTE) and global index performance (GEI). The analysis of these factors aims to provide a comprehensive understanding of how each influences economic growth. The relationship using a simple regression framework, as outlined below.

$$SEG_t = \alpha + \beta_1 ENV_t + \beta_2 FND_t + \beta_3 INQ_t + \beta_4 DTE_t + \beta_5 GEI_t + \varepsilon_t \quad (1)$$

All the variables are defined in Table I. We also include the squared term of ENV in model 1 to examine the Environmental Kuznets Curve (EKC) suggested by Rahman et al. (2020). The independent variables are expected to be correlated, possibly leading to multicollinearity issues. To address this, we apply instrumental variable analysis to isolate the effect of each independent variable from potential group effects. In this study, institutional quality is treated as a moderating variable, measured using a composite index of six indicators: voice and accountability, political stability, absence of violence, government effectiveness, regulatory quality, the rule of law, and control of corruption. The interaction terms between institutional quality and the other independent variables are presented in equations 2 to 5.

$$SEG_t = a + \beta_1 SEG_{t-1} + \beta_2 ENV_t + \beta_3 FND_t + \beta_4 INQ_t + \beta_5 DTE_t + \beta_6 GEI_t + \beta_7 (ENV_t)(INQ_t) + \varepsilon_t \tag{2}$$

$$SEG_t = a + \beta_1 SEG_{t-1} + \beta_2 ENV_t + \beta_3 FND_t + \beta_4 INQ_t + \beta_5 DTE_t + \beta_6 GEI_t + \beta_7 (FD_t)(INQ_t) + \varepsilon_t \tag{3}$$

$$SEG_t = a + \beta_1 SEG_{t-1} + \beta_2 ENV_t + \beta_3 FND_t + \beta_4 INQ_t + \beta_5 DTE_t + \beta_6 GEI_t + \beta_7 (DE_t)(INQ_t) + \varepsilon_t \tag{4}$$

$$SEG_t = a + \beta_1 SEG_{t-1} + \beta_2 ENV_t + \beta_3 FND_t + \beta_4 INQ_t + \beta_5 DTE_t + \beta_6 GEI_t + \beta_7 (GEI_t)(INQ_t) + \varepsilon_t \tag{5}$$

$$y_t = x_t \beta_0 + \varepsilon_t \text{ with } Quant(y_i, x_i) = x_i \tag{6}$$

$$Q_{0.50} SEG_t = \beta_{0.50,1} ENV_t + \beta_{0.50,2} FND_t + \beta_{0.50,3} INQ_t + \beta_{0.50,4} DTE_t + \beta_{0.50,5} GEI_t + \varepsilon_t \tag{7}$$

$$Q_{0.75} SEG_t = \beta_{0.75,1} ENV_t + \beta_{0.75,2} FND_t + \beta_{0.75,3} INQ_t + \beta_{0.75,4} DTE_t + \beta_{0.75,5} GEI_t + \varepsilon_t \tag{8}$$

$$Q_{0.90} SEG_t = \beta_{0.90,1} ENV_t + \beta_{0.90,2} FND_t + \beta_{0.90,3} INQ_t + \beta_{0.90,4} DTE_t + \beta_{0.90,5} GEI_t + \varepsilon_t \tag{9}$$

Moreover, we employed quantile regression to enhance the robustness of the empirical model. Quantile regression was conducted at the 50th, 75th, and 90th percentiles to examine the impact of predictor variables across different dependent variable levels. The coefficients at these percentiles also change with each unit change in the predictor variable. Quantile regression provides more reliable coefficient estimates by minimizing the influence of outliers compared to traditional least squares regression.

Quantile regression is considered a suitable tool for addressing variables with distributional characteristics and handling time series data (Angrist & Pischke, 2008). According to Andriansyah and Messinis (2016), quantile regression is particularly well-suited for analyzing economic growth due to its ability to account for distributional characteristics. It also provides the added advantage of explaining the relationship between variables beyond just the mean. This technique helps uncover non-normal and non-linear relationships between variables.

**Table 2**  
*Descriptive Statistics*

	SEG	ENV	FND	INQ	DTE	GEI
Mean	9.0900	6.3717	130.7655	0.0000	138.5081	15.8165
Median	9.2662	7.0720	126.0474	-0.6178	108.4710	7.0895
Maximum	14.2309	8.2319	164.6643	3.5135	318.0652	80.7194
Minimum	6.1101	3.0294	101.9897	-1.8396	83.7359	-52.7044
Std. Dev.	2.1764	1.5473	19.0577	1.6339	64.1347	36.6699
Skewness	0.6832	-0.7023	0.3193	0.9990	1.4788	0.3700
Kurtosis	2.7857	2.1547	1.8771	2.7652	4.4436	2.3200
Jarque-Bera	5.7386	8.0619	5.0058	12.1404	32.4932	3.0300
Probability	0.0567	0.0178	0.0818	0.0023	0.0000	0.2198
VIF	3.201	4.021	3.958	2.936	4.025	3.162
Sum	654.4825	458.7600	9415.1130	0.0000	9972.5850	1138.7890
Sum Sq. Dev.	336.3111	169.9847	25786.9000	189.5451	292041.8000	95472.5600
Observations	72	72	72	72	72	72

Note. SEG, ENV, FND, INQ, DTE and GEI indicate sustainable economic growth, environmental quality, institutional quality, external debt stock and global equity index. For further details, see Table 1.

**Table 3**  
*Correlation Results*

Variable	ENV	FND	INQ	DTE	GEI
ENV	1				
FND	0.629*	1			
INQ	0.493*	0.851*	1		
DTE	0.756*	0.875*	0.859*	1	
GEI	0.010	0.334*	0.038	0.105	1

Note. \* $p < 0.01$ , \*\* $p < 0.05$ , \*\*\* $p < 0.10$ .

## 4. Results and Discussion

### 4.1. Descriptive Statistics and Correlation

The descriptive statistics for the selected variables are presented in Table II. The maximum and minimum values for sustainable economic growth are 14.231% and 6.110%, respectively, indicating a significant difference in growth rates. The highest growth occurred during 2006 and 2007, with a subsequent downward trend following the global financial crisis. Despite this decline, maintaining a minimum growth of 6% highlights the resilience of the Chinese economy. Table II also presents the variance inflation factor (VIF) to address potential multicollinearity. The VIF result indicates no significant multicollinearity, with values ranging from 1 to 4.025. A high correlation between two independent variables is considered problematic when the correlation exceeds 0.90, but no such issue was found here. Values below 1 suggest a weak correlation, and the derived VIF values between 1 and 10 confirm that multicollinearity is not a concern in the dataset.

The correlation between the variables is also analyzed, as shown in Table III. The findings indicate that the correlation between (1) INQ and FND, and (2) INQ and DTE is relatively high, but still below the accepted threshold of 0.90 (Pallant, 2007). FND has a strong and significant correlation with DTE, GEI, ENV, and INQ, while the lowest and statistically insignificant correlation is observed between GI and ENV. As noted earlier, these results suggest a potential multicollinearity issue. Therefore, we do not rely solely on ordinary least square (OLS) estimates. The next section presents the results and discusses them in detail.

## 5. Results and Discussion

Table IV displays the results of models 1 to 5. Specifically, columns 1 and 2 show the Generalized Methods of Moments (GMM) estimates of model 1. In this model, we included ENV2 to examine potential evidence of the Environmental Kuznets Curve (EKC). Columns 3 and 4 present the estimates for model 1, while columns 5 to 12 provide the coefficients and test statistics for models 2 to 5, respectively.

It is evident from Model 1 that all independent variables significantly contribute to economic growth. However, there is mixed evidence regarding institutional quality and debt. In models 2, 3 and 5, the interaction of INQ shows a significant and positive influence on the relationship between FND, DTE, ENV, and SEG. In contrast, a negative coefficient is observed when analyzing the moderating impact of INQ on the relationship between GEI and SEG. The relationship between INQ and SEG was found to be significant and positive, indicating that improvement in China's institutional environment will contribute positively to China's sustainable economic growth. These findings are consistent with the claim made by Nee and Sijin (1990), who state that favourable economic arrangements benefit both the private and social sectors. Most research findings suggest that optimizing the institutional environment can significantly promote high-quality economic development (Zhao, 2024). Glawe and Wagner (2020) also concluded that institutional improvements enhance China's economic growth. Recently, Kassouri and Altıntaş (2020) found that economic institutions support human well-being targets and aid in environmental protection. The highly negative relationship between FND and SEG is consistent

**Table 4***The Impact of Environmental Quality, Financial Development, and Institutional Quality on Sustainable Economic Growth*

Variable	Model 1 [GMM]		Model 1 [OLS]		Model 2	
	Coeff. (1)	t-Stat. (2)	Coeff. (3)	t-Stat. (4)	Coeff. (5)	t-Stat. (6)
C	5.801*	2.736	16.996	6.514	17.365	8.379
ENV	2.712*	3.2	0.213*	2.7	0.334*	3.875
ENV2	-0.825*	-3.051				
FND	-1.209*	-2.857	-1.908*	-7.81	-1.538*	-5.514
INQ	0.018	0.208	0.057**	2.419	-0.343**	-2.013
DTE	-0.043	-0.578	-0.237**	-2.404	-0.332*	-3.944
GEI	0.079*	3.675	0.043*	7.364	0.035*	5.04
IQ*ENV					0.195**	2.409
R2	0.929		0.935		0.948	
Adjusted R <sup>2</sup>	0.923		0.93		0.943	
Prob (F-statistic)			0		0	

Note. SEG, ENV, FND, INQ, DTE and GEI indicate sustainable economic growth, environmental quality, institutional quality, external debt stock and global equity index. For further details, see Table 1.

**Table 4***The Impact of Environmental Quality, Financial Development, and Institutional Quality on Sustainable Economic Growth (Continued)*

Variable	Model 3		Model 4		Model 5	
	Coeff. (7)	t-Stat. (8)	Coeff. (9)	t-Stat. (10)	Coeff. (11)	t-Stat. (12)
C	16.741	9.893	19.54	10.988	17.273	6.482
ENV	0.199*	3.663	0.296*	5.968	0.214*	2.757
FND	-1.115*	-4.234	-1.071*	-3.698	-1.838*	-8.526
INQ	-1.669*	-4.078	-3.135*	-4.568	0.153*	3.348
DTE	-0.378*	-4.662	-0.503*	-5.723	-0.260**	-2.437
GEI	0.029*	5.491	0.028*	4.171	0.029*	3.929
IQ*FD	0.342*	4.226				
IQ*DE			0.123*	4.654		
IQ*GI					-0.024*	-2.736
R2	0.961		0.968		0.941	
Adjusted R <sup>2</sup>	0.958		0.965		0.936	
Prob (F-statistic)	0.000		0.000		0.000	

Note. The ENV2 is used in Model 1 while applying GMM to test the evidence of EKC. For GMM estimates, standard errors and covariance are computed using the HAC weighting matrix (Bartlett kernel, Newey-West fixed bandwidth = 4.0000). The constant was added to the instrumental list. The first lags of the independent variables are added in the instrument specification. White has used the estimation weighting matrix. \*p<.01, \*\*p < 0.5, \*\*\*p < 0.10.

with Wang et al. (2015), who concluded that financial development negatively impacts China's economic growth. Therefore, further development of China's capital market is needed to observe its potential positive effects on economic growth. Conversely, the interaction with INQ transforms the negative coefficient into a positive one, suggesting that strong national-level governance fosters financial development, promoting higher economic growth.

The direct relationship between DTE and SEG is found to be negative. These results are consistent with Zhao et al. (2019), who observed a non-linear relationship between local government debt and China's economic growth. However, the interaction with INQ transforms this relationship into a positive one. This phenomenon emphasizes the role of good governance in enhancing SEG through better debt management. Zhao et al. (2019) highlighted the controversy in the existing literature regarding the relationship between debt and sustainable economic growth, and the introduction of the INQ interaction helps. In the case of GEI, a significant positive relationship with SEG is found, but the interaction with INQ reverses this relationship, making it negative. One possible explanation for the direct relationship between GEI and SEG is the strong nexus between the Chinese stock market and its trading partner countries (Hung, 2019). The increasing financial spillovers from China to global markets (Arslanalp et al., 2016) further contribute to this dynamic.

Moreover, the Chinese economy is also linked with the global economy through various channels, such as international trade, financial flows, price effects on tradable goods, and general market sentiment. The relationship between GEI and SEG is negatively moderated by the interaction with INQ, indicating that the national-level governance structure needs to be modified to leverage the global environment and enhance China's sustainable economic growth. The significant relationship between ENV and SEG underscores the importance of China's energy structure in its development process (Jian et al., 2019). The direct relationship between ENV and SEG is positive, suggesting that CO<sub>2</sub> emissions have contributed to China's economic growth. However, the introduction of INQ reduces the intensity of this relationship, as the coefficient decreases from 0.213

to 0.195. This indicates that the governance strategies of the Chinese government have weakened the direct link between CO<sub>2</sub> emission and economic growth. An important development in the Chinese government's shift from fossil fuels to non-fossil fuels. From 2005 to 2007, the proportion of non-fossil energy increased to 13.8%, while the share of natural gas rose to 7.0%. In contrast, the proportion of coal in the energy mix dropped to 60.4%. According to the results, the INQ variable positively supports China's economic growth. Thus, China enhancing governance quality will enable China to achieve higher sustainable economic growth.

### 5.1. Quantile Regression Results for Robustness

To further enhance the robustness of the OLS results, the output of quantile regression is reported in Table V. Angrist and Pischke (2008) argue that quantile regression is a powerful tool for understanding the distributional characteristics of the model, particularly when the underlying relationships are multi-dimensional and complex. Contemporary literature continues to regard this technique as robust (Mehmood et al., 2020). The positive impact of GEI on SEG is observed across the selected quantiles, and this relationship is also confirmed by the 50th quantile. The relationship between ENV and SEG is insignificant at the 50th and 75th percentiles, respectively, but becomes significant at the 90th percentile. The coefficient is positive, indicating that an increase in CO<sub>2</sub> emissions positively contributes to China's economic growth. While the greenhouse effect caused by CO<sub>2</sub> is a global concern, the results suggest that, at higher levels of economic performance, the growth benefits from CO<sub>2</sub> emissions are more pronounced. According to quantile regression, FND and GEI are strong predictors of China's economic growth.

### 6.2. Conclusions and Policy Implications

This study examines the impact of financial development, environmental factors, institutional quality, and global index performance on China's economic growth, highlighting the critical role of institutional quality in driving sustainable development. While environmental factors and institutional quality positively influence growth, financial development negatively affects it, reflecting inefficiencies in resource

allocation. Policymakers should prioritize institutional reforms, enhance financial inclusion, adopt green technologies, and promote energy efficiency to achieve balanced and sustainable growth. This research contributes to the literature by integrating key determinants into a multivariate framework and providing actionable insights for decision-makers. However, the study is limited by its scope of variables and data timeframe. Future research should incorporate additional macroeconomic factors, such as economic policy uncertainty and industry-specific dynamics, to offer a more comprehensive understanding of sustainable growth drivers.

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**Table 5**  
*Quantile Regression Results (Robustness)*

Variable	50thquantile Coefficient	75thquantile Coefficient	90thquantile Coefficient
ENV	0.250	0.183	0.299**
FND	1.524	1.468	2.310
	-1.983*	-2.016*	-1.632*
	-8.257	-8.616	-6.520
INQ	0.048*	0.050*	0.047*
	5.805	7.305	8.427
DTE	-0.348**	-0.157	-0.270
	-2.132	-1.018	-1.626
GEI	0.048*	0.050*	0.047*
	5.805	7.305	8.427
Adjusted R2	0.747	0.762	0.793
Pseudo R2	0.765	0.779	0.807

Note. The above table is based on the author's computation. \* $p < .01$ , \*\* $p < 0.5$ , \*\*\* $p < 0.10$ .

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