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The Governance-Environment Nexus: A Key to Environmental Sustainability in Asian Nations

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Abstract

Governance is a crucial determinant of environmental sustainability, encompassing property rights, a robust judicial system, and effective regulatory frameworks. Inadequate governance characterized by weak law enforcement and political difficulties contributes to environmental deterioration. This study explores the impact of good governance on environmental sustainability in 39 Asian countries from 1996 to 2022. By considering governance indicators such as political instability, regulatory quality, and corruption control, as well as controlling for renewable energy, inbound FDI, and economic growth, the study employs the Generalized Method of Moments (GMM) approach and Dumitrescu-Hurlin Panel Causality Tests to assess causal relationships among variables. Findings reveal that political stability and renewable energy demand contribute to decreased carbon emissions. Conversely, inadequate enforcement of environmental regulations, regulatory loopholes, leniency, corruption, and bribery lead to increased carbon emissions. The study confirms the hump-shaped relationship between income and emissions, supporting the environmental Kuznets curve hypothesis. Moreover, the direct relationship between industrialization and carbon emissions supports the 'environmental transition theory,' highlighting the initial increase in environmental degradation during the transition to industrialized economies. The causality results partially support the governance-led carbon emissions hypothesis in Asian economies. Additionally, the study verifies the existence of the pollution haven hypothesis through the growth-led and FDI-led emissions hypotheses. Green energy and economic growth stimulate inbound FDI across countries. The impulse response function suggests that, except for political stability,

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other governance factors and controlled variables are likely to decrease carbon emissions in the next decade. A variance decomposition analysis indicates that inbound FDI is expected to cause significant variance shocks in carbon emissions, followed by political stability and industrialization over time. The study underlines the role of good governance in environmental sustainability by highlighting democracy's role in raising awareness and demanding stronger ecological standards.

Keywords: Carbon emissions; Governance; Renewable energy; Industrialization; Inbound FDI; Asian economies.

JEL: C26, Q58

1. Introduction

The importance of institutions and governance on environmental sustainability in Asia is an important area of investigation for moving towards regional development (Gaur et al., 2022). Fighting global environmental change and monitoring institutions' impact on environmental management are vital for shared prosperity (Kumar et al., 2022). Political instability and corruption harm the environment. Thus, public officials must encourage sustainable development policies for long-term growth (Khezri et al., 2022). Population growth in Asia, where environmentally friendly technology is scarce, makes natural resource conservation harder (Boubellouta et al., 2021). A balanced energy-induced CO- emission model is needed to promote human happiness due to rising fossil fuel emissions in Asian countries (Khoshnevis et al., 2019). The Environmental Kuznets Curve (EKC) model studies how economic growth influences environmental degradation (Li et al., 2022; Bibi, 2021). Global pollution from rising GHG emissions threatens human health and mortality (Bildiciri, 2021). Environmental conditions change as nations grow increasingly economically, politically, and socially intertwined. Law and order, bureaucratic efficiency, and corruption affect environmental management (Xue et al., 2021). Institutional quality indicators in environmental research highlight the relevance of institutions, democracy, political stability, law, and corruption in CO2 emissions and environmental deterioration (Uzar, 2022). Political stability and regulatory quality are essential for economic growth to benefit the environment (Mrabet et al., 2021).

The worldwide population explosion increasingly threatens environmental protection. Green technology applications are lacking in Asia, resulting in low environmental quality (Koilo et al., 2019). Many Asian countries face environmental issues since they base their economies on manufacturing and services. This has dramatically increased Asian fossil fuel-related carbon emissions. CO_2 emissions in Asian countries are projected to surpass 2018 levels by 2050, hitting 23.7 billion metric tons. Due to Asia's expected rapid energy consumption rise, Khoshnevis et al. (2019) recommend a balanced model of energy-induced CO2 emissions that improves human welfare. The EKC model is used by environmental economics to examine GDP growth and ecological deterioration (Bibi et al., 2021). Greenhouse gas emissions—CO2, NOx, and GHG—have caused global pollution. Bildirici (2022) reports that 2018 CO- emissions were 33.1 billion metric tons more than pre-industrial levels, emphasizing the need to address climate change and environmental degradation.Numerous institutions' effects on CO- emissions and other pollutants have been studied (Li et al., 2021). These include democracies, political harmony,

legality, dishonesty, government efficiency, and bureaucratic excellence. In response to environmental concerns, governments worldwide have taken political action. Various economies at different stages of development pollute, requiring complex policies. Trade-offs between environmental performance and economic development reveal that growth rates cause environmental degradation. Quality organizations are needed to reduce carbon emissions and improve environmental control. Unfortunately, inadequate financial management, bureaucracy, red tape, and corruption may impair environmental control. High-quality institutions are needed to solve these challenges and improve environmental management (Sohail et al., 2022). For economic growth to help the environment, political stability, corruption control, and quality laws are essential for development. Political corruption and instability often delay socioeconomic welfare goals by diverting legislators from environmental challenges (Mrabet et al., 2021). Lowering political risk, which decreases pollution, helps understand how political factors affect ecosystems and environmental deterioration. Ashraf et al. (2022) concluded that benign political situations increase environmental standards and accelerate economic growth. Understanding institutions, governance, and political stability is crucial to Asian environmental sustainability. Effective environmental management requires high-quality rules, less corruption, and stable administration.

The study discussed several environmental sustainability research issues in Asian countries. Thus, it has the following research questions:

1. ***What are the responsibilities of institutions and governance in achieving environmental sustainability?*** The study suggests that institutions and governance decisions directly impact reducing environmental sustainability. It highlights the need to strengthen institutions to overcome environmental issues.
2. ***Do the government's political stability, regulatory quality, and control of corruption play a vital role in reducing environmental quality in Asian countries and increasing economic growth?*** This study intends to analyze how democracy factors affect ecological sustainability. Atmosphere quality and economic development may be affected by the political climate, the quality of regulations, and the suppression of misconduct.
3. ***Do renewable energy consumption (REC) and sustainable production enhance environmental quality in Asia?*** The issue highlights the connection between green energy use, manufacturing, and ecological longevity. It underlines the potential for flourishing economies in Asian nations and hints that the industry's value contributed is crucial to ensuring the planet's long-term viability.
4. ***Does the environmental Kuznets curve hypothesis exist in selected Asian countries?*** The EKC hypothesis, which this study seeks to examine, states that pollution increases with economic expansion at first but decreases as wealth grows. To test whether or not this idea is correct in a few different Asian nations.

The study recommends more extensive empirical testing to address these research topics. The study's evaluation of these subjects is meant to aid in creating long-term foreign strategies for Asian nations. This research aims to examine the complex link between administration indices and ecological sustainability in several selected Asian nations.

In addition, it aims to investigate how factoring in the pace of economic expansion affects the environment's welfare. The research also hopes to illuminate the role of industry and energy use in threatening long-term terrestrial viability. Finally, it aims to examine the impact of FDI on financial growth and its potential consequences on the state of the planet. This research contributes significantly to the current literature since it considers the importance of governance indicators and economic uplift in tackling the intricate relationship between institutional strength, environmental protection, and wealth creation.

2. Literature Review

There has been a significant increase in research on the root causes of carbon emissions and damage since the 1990s. Grossman and Krueger (1991) published seminal research showing that expanding economies are one of the main causes of environmental damage. Economic growth and pollution were shown to have an inverted U-shaped connection, which they dubbed the EKC. This paradigm has greatly aided the assessment of carbon emissions and ecological damage. In order to better understand how CO2 emissions have evolved throughout time, several studies have been done that factor in financial, social, ecologic, and sectoral aspects. This large body of work has made important contributions to our knowledge of carbon emissions. Xue et al. (2021) look at how economies and societies in South Asia have been affected by globalization and resource extraction. NOx emissions correlate positively with organizational efficiency, whereas carbon emissions, methane emissions, and ecological footprint have negative correlations. The research concludes that the key to environmental sustainability is a combination of measures, including reducing GHG emissions, efficient use of natural resources, promoting globalization, and enhancing institutional performance. Fiscal development, energy saving, anti-corruption measures, and ecological imprint are all topics Yao et al. (2021) investigate in the Next-11 economies. They conclude that openness and honesty in administration contribute to better environmental conditions and greater energy productivity. The effects of corruption on resource utilization and carbon footprint are also highlighted. The impact of China's anti-corruption and environmental initiatives on green manufacturing is investigated by Zhou & Li (2021). Their findings indicate that these policies significantly enhance green industrial development, but their impact needs to be revised and depends on the level of anti-corruption. When anti-corruption efforts surpass a certain threshold, the impact of these policies increases. Yameogo et al. (2021) investigate the connection between economic globalization and environmental quality in Sub-Saharan Africa. They find that regulatory quality positively impacts environmental degradation, while economic globalization and anti-corruption efforts have a negative impact. The study emphasizes the negative effects of the combination of institutions and economic globalization on environmental contamination. Adekunle (2021) looks at Africa, analyzing the connection between effective leadership, solid institutions, and a greener future. The findings suggest a strong correlation between the rule of law, good regulation, and sustainable environmental practices. However, government efficiency is found to be in opposition to environmental sustainability. The effects of executive power, power use, and demographic on the ecology in Sub-Saharan Africa are examined

by Agabo et al. (2021). They discover that having more people living in cities increases emissions, but this effect may be tempered by good policymaking. The population as a whole has a negligible effect on pollution levels. Research by Bulus and Koc (2021) examines how Korean state spending and FDI have influenced the environmental condition. Increases in FDI, income, energy intake, and imports are all associated with higher carbon emissions, whereas increases in fiscal expenditure, REC, and exports are associated with lower emissions. Monetary progress, business expansion, fuel advances, and pollution in OECD countries are investigated by Baloch et al. (2021). Their research demonstrates how development leads to improved energy technology and more environmental regulations. Long-term GHG emissions are lowered due to globalization's impact on energy innovation. Abid et al. (2021) investigate the relationships between Pakistan's governance measures, ISO 14001, and green growth. Their findings highlight the importance of sound governance in achieving environmental sustainability goals. Political stability, regulatory quality, government effectiveness, and ISO 14001 are strongly correlated with green growth. Different governance measures have varying impacts on green growth. Omri et al. (2021) assess Saudi Arabia's excellent governance's ability to mitigate economic growth's environmental impacts. According to their study, political leadership, institutional leaders, and financial sector developers collaborate to reduce CO2 emissions. Table 1 lists the relevant literature as a ready reference.

Table 1. Literature Review on Governance-Environment Nexus

Authors	Country	Time Period	Results
Zhang et al., (2022)	BRICS Economies	1996-2019	Lower CO2 emissions are linked to stable governments, less corruption, and better law enforcement. Unstable governments make environmental rules and regulations harder to implement. Insufficient environmental enforcement may increase CO2 emissions and environmental degradation.
Jianguo et al., (2022)	OECD Nations	1998-2018	Carbon emissions increase with a firm's income and electricity usage as it grows. However, technical and administrative developments, backed by strong legislation and monitoring, stimulate more ecologically friendly processes and equipment and reduce CO2 emissions.
Uzar (2022)	Emerging-7 Countries	1993-2016	Carbon dioxide emissions are lower in countries with greater press freedom. This link explains the free press's role in raising environmental awareness and fostering accountability. Conversely, increased CO_2 emissions correlate with increased commerce and primary energy consumption due to transportation and energy resource intensification.
Sulaiman & Abdul-Rahim (2022)	Sub-Saharan African countries	2005-013	Competent administrations with strong anti-corruption programs must prevent forest degradation. Using less wood fuel may help maintain forest resources and mitigate environmental impacts.

Authors	Country	Time Period	Results
Tian & Li (2022)	G20 Nations	2005-2018,	More economically engaged, financially inclusive communities and linked global markets boost energy consumption and industrial output, which raises carbon emissions. Corruption may worsen these effects by encouraging unsustainable behaviour and undermining environmental laws.
Usman (2022)	Nigeria	1990-2016	Renewable energy may assist the environment by reducing fossil fuel use and GHG emissions. However, political instability and corruption may prevent environmental legislation from protecting ecosystems and natural resources.
Sohail et al., (2022)	Pakistan	1999-2019	Political upheaval hurts clean energy and the environment. During political uncertainty, stability and environmental problems are prioritized, reducing renewable energy investment and sustainable practices. This may increase dependency on harmful energy sources and ecological deterioration.
Shobande & Ogbeifun (2022).	OECD countries	1980-2019	ICTs may dramatically reduce CO2 emissions and improve environmental sustainability. Many businesses may use ICT solutions to enhance energy efficiency, resource utilization, and carbon footprint.
Bletsas et al., (2022)	95 countries	1998-2019	Industrialization and production increase CO2 emissions. As economies grow, energy, transportation, and infrastructure demand increase carbon dioxide and other GHG emissions.
Yasmeen et al., (2022)	BRICS countries	1996-2018	R&D funding increases may result in greener and more efficient products, processes, and procedures.
Appiah et al., (2023)	30 Sub-Saharan African countries	2000-2021	Efforts to control corruption, improve regulatory quality, and strengthen the rule of law have been found to have a substantial impact on reducing CO2 emissions. These factors play a crucial role in shaping environmental outcomes and promoting sustainability.
Hargrove et al., (2022)	136 Nations	1995–2013	To reduce trade-related CO_2 emissions, countries should resist corruption, strengthen the rule of law, and promote good governance. Global efforts to mitigate climate change and rescue the earth make business more sustainable.
Hadj & Ghodbane (2022).	Golf-Cooperation Council countries	2002-2004	The link between energy consumption, FDI, population density, and governance systems emphasizes the need for sustainable energy and governance practices to reduce CO2 emissions and improve environmental sustainability.
Opoku et al., (2022)	103 developing countries	1970-2019	Higher CO2 emissions may deter FDI due to environmental and reputational risks. In low- and lower-middle-income nations with rising foreign direct investment, fewer ecological regulations may cause environmental degradation. Environmental rules and effective governance are needed to prevent environmental damage and promote sustainable investments.

Authors	Country	Time Period	Results
Kakar et al., (2023)	SAARC nations	2000-2018	Inadequate governance practices contribute to environmental deterioration, highlighting the negative impact of governance on the environment. On the other hand, technological advancements and innovations have shown the potential to improve environmental quality, emphasizing the positive role of technology in promoting sustainable development and environmental well-being.
Baba Ali et al., (2023)	EU countries	1996-2018	For development to be ecologically sound, it is essential to reduce ecological harm while fostering investment and technological breakthroughs.
Hasni et al., (2023)	18 countries	2000-2019	Growing economies and REC are both associated with higher carbon emissions. However, less pollutant occurs when business growth and malfeasance are well managed.

Drawing upon existing literature, this study formulates the following hypotheses:

H1: Asian environmental sustainability and goodgovernance are significantly connected.

H2: Sustainable manufacturing and renewable energy will benefit Asia's environment.

H3: The inverted U-shaped EKC hypothesis is expected between income and emissions, further leading to the pollution haven/halo hypothesis, accounting for an increase inbound FDI in Asian economies.

These hypotheses will be empirically tested to explore the relationships between governance, political factors, economic indicators, and environmental quality in Asia.

Several scholarly studies have extensively explored the impact of governance on economic growth and FDI at the country level and through time series analysis. Notable research contributions include studies by Qureshi et al. (2021), Nadeem et al. (2020), and Farooq (2022). Building upon this existing body of research, our study extends the examination of governance indicators, specifically political stability, regulatory quality, and control of corruption. Moreover, our study significantly advances the research by investigating the dynamic interactions between CO2 emissions, the utilization of REC sources, industrial-added value, and service-added value. We validate the pollution haven/halo hypothesis and conduct an EKC analysis. This study is one of the pioneering attempts to concurrently explore both theories considering their enhanced relevance in the context of 39 Asian countries. Asian nations currently hold the highest CO2 emissions worldwide, ranking first among all countries. These nations have committed to the United Nations Climate Change Conference and have undertaken significant efforts to reduce CO2 emissions. Furthermore, their economies are experiencing rapid expansion. Our study aims to provide insights into effective strategies for reducing carbon emissions, such as investing in cutting-edge ICT projects, enhancing institutional quality, and implementing REC initiatives. By thoroughly evaluating the existing literature, our research is among the first to examine the dynamic relationship

between carbon emissions and economic indicators.

In the context of renewable power use, our study considers the anticipated effects of increased use of green energy sources. We hypothesize that such an increase can deter carbon emissions, while higher energy consumption is expected to fuel these emissions. Consequently, as the REC rises, we anticipate a corresponding decrease in carbon emissions. It is worth noting that the REC is considered neutral regarding its impact on carbon emissions, unlike other energy sources. Furthermore, our study explores the assertion that FDI flows into countries with weak environmental protection regulations, thereby depleting ecosystems. Numerous studies have debated whether financing environmental projects in highly financially developed nations improve environmental quality, particularly in cases where population growth is believed to be a major contributor to carbon emissions. Based on these considerations, as mentioned earlier, our study stands apart from prior research endeavors. Existing literature primarily investigates the one-way relationship between variables using panel regression and ordinary least squares methods. Moreover, most research studies have focused solely on the relationship between FDI, economic development, and corruption within the context of developing nations. Interestingly, the literature has overlooked the examination of whether FDI inflows contribute to corruption, an endogenous variable (Son et al., 2020; Nam et al., 2020; Gründler & Potrafke, 2019). Given that FDI can provide resources that enable regions to combat corruption effectively, it is crucial to assess the impact of FDI inflows on corruption levels. Rising FDI inflows also exacerbate corruption. The study examines causal links between variables using the Dumitrescu-Hurlin model to fill this research vacuum. Given prior empirical studies' mixed findings, the study tries to better understand the complicated linkages between anti-corruption initiatives, GDP growth, and FDI.

3. Data and Methodology

This study examined the relationship between environmental quality and three predictor variables, i.e., political stability (PSTAB), regulatory quality (RQ), and corruption control (CC). Metric tons per capita of CO2 emissions determined environmental quality. These factors had index values between -2.5 and 2.5. The research used FDI as a percentage of GDP, GDP per capita adjusted for inflation to constant 2015 US dollars (GDPPC), square of GDP per capita (SQGDPPC), the ratio of renewable energy consumption to total power use, and industry value added (IVA) as a percentage of GDP as control variables. Several parameters were used to evaluate their ecological impact. The objective of this study was to investigate the correlation between the autonomous variables and the variable of interest to gain a deeper understanding of the factors that influence environmental quality. The research employed panel data encompassing 39 Asian countries, spanning the time frame of 1996 to 2022. The data utilized in this study was obtained from credible sources, including the World Development Indicator (WDI, 2022) and the World Governance Indicator (WGI, 2022). The study utilized panel data to examine temporal and cross-national trends and patterns in Asia to comprehensively comprehend the association between the variables being studied and the environmental state in the region. Table 2 displays the roster of countries that were included in the sample.

Table 2. List of Countries

Regions	Countries
Eastern Asia	China, Japan, Mongolia, South Korea.
Southern Asia	Afghanistan, Bangladesh, Bhutan, India, Iran, Maldives, Nepal, Pakistan, Sri Lanka.
South-Eastern Asia	BruneiDarussalam, Cambodia, Indonesia, Laos, Myanmar, Malaysia, Philippines, Singapore, Thailand, Vietnam.
Western Asia	Armenia, ,Cyprus, Georgia, Jordan, Iraq, Israel, Kuwait, Lebanon, Oman, Saudi Arabia, Turkey.
Central Asia	Azerbaijan, Kyrgyzstan, Kazakhstan, Tajikistan, Uzbekistan.

Source: WDI (2022).

Multiple factors drive the rationale behind choosing Asian countries for this study. First, it is worth noting that many Asian nations are categorized as developing economies, thereby encountering significant ecological and governmental obstacles that necessitate the implementation of effective policies for resolution. Hence, the utilization of R&D techniques is imperative in addressing these challenges. The issue of climate change has emerged as a significant and urgent matter, as the escalating levels of carbon emissions have been identified as a key driver behind the observed global rise in temperatures. CO2 emissions cause global warming and environmental deterioration, alarming developing countries. Thus, Asian countries prioritize pollution reduction. Ecological problems, unstable regimes, limited commerce and transportation, catastrophic disasters, and wars hinder Asian economic progress and ecological protection. These reasons have caused environmental and social issues that have harmed developing nations' temperatures, carbon emissions, and health. The region's economic expansion has increased energy use, especially fossil fuel. Fossil resources are running depleted, and their prices are fluctuating, hurting low-income countries hardest. Inadequate institutional quality complicates energy use and economic growth in many developing countries. Examining Asian countries' environmental performance over time may assist stakeholders and governments in establishing sustainable ecological plans.

Environmental governance theory suggests that a well-functioning government may improve the environment. Environmental governance claims that efficient government enhances the environment (Ahmad et al., 2020). They argue that separating economic growth from negative externalities would help the government protect the environment (Bhutta et al., 2022). Environmental governance theory links institutional quality, environmental deterioration, and sustainability. Environmental preservation requires stringent management. Environmental governance theorists believe sustainability and strong institutions are intertwined (Pickering et al., 2020). The premise is that a nation's governance is vital to environmental management, including sustainability, quality, and activist organization (Usman et al., 2022). The ecological management hypothesis predicts a substantial association between institution quality, pollution, and environmental longevity. The EKC theory, proposed by Grossman & Krueger (1991), shows its economic success,

environmental degradation, and conservation. According to the theory, industrial activity peaks early in economic development, increasing carbon emissions and worsening ecological conditions. This is due to economic expansion above environmental protection. Later in development, feasible conservation trumps economic growth, improving the environment (Wen et al., 2021).

3.1. Econometric Framework

This study empirically tests using GMM. There are several reasons to employ GMM. First, the cross-sections relative to time must be larger (Rodman, 2009). The study used 39 cross-sectional units with a 25-year temporal dimension for GMM regression. Second, unobserved heterogeneity and simultaneity biases may occur from having the lagged dependent variable in the model. Thus, the use of GMM is appropriate to minimize these issues effectively. Dagar et al. (2022) suggest utilizing first-order (important lagged difference) differentiation and assuming the error term and lag value are orthogonal to reduce explanatory factor endogeneity. Third, regressions include controlled cross-country reliance. This allows the estimate process to incorporate cross-national consequences and interdependencies (Nchofoung et al., 2022).Finally, the study uses GMM to manage endogeneity and cross-country dependence for robust and efficient estimates. This method tests research hypotheses empirically and assures study reliability.

Based on the theoretical linkages and previous research by Asongu (2018) and Nchofoung & Asongu (2022), the empirical model specified in Equation (1) is as follows:

$$\ln CO2_{t} = \alpha_0 + \alpha_1 PSTAB_{t} + \alpha_2 RQ_{t} + \alpha_3 CCx_{t} + \alpha_4 \ln FDI_{t} + \alpha_5 \ln GDPPC_{t} + \alpha_6 \ln SQGDPPC_{t} + \alpha_7 \ln IVA_{t} + \alpha_8 \ln REC_{t} + \mu_{t} \quad (1)$$

After involving cross sections in model equation (1) can be written as follows:

$$\ln CO2_{i,t} = \alpha_0 + \alpha_1 PSTAB_{i,t} + \alpha_2 RQ_{i,t} + \alpha_3 xCC_{i,t} + \alpha_4 \ln FDI_{i,t} + \alpha_5 \ln GDPPC_{i,t} + \alpha_6 \ln SQGDPPC_{i,t} + \alpha_7 \ln IVA_{i,t} + \alpha_8 \ln REC_{i,t} + \mu_{i,t} \quad (2)$$

$$\ln CO2_{i,t} = \alpha_0 + \alpha_1 PSTAB_{i,t} + \alpha_2 RQ_{i,t} + \alpha_3 xCC_{i,t} + \alpha_j X_{i,t} + v_i + \gamma_t + \mu_{i,t} \quad (3)$$

To include the effect of the interactive effect, equation (3) can be specified as:

$$\ln CO2_{i,t} = \alpha_0 + \alpha_1 PSTAB_{i,t} + \alpha_2 RQ_{i,t} + \alpha_3 xCC_{i,t} + \alpha_j X_{i,t} + \pi_1(CC_{it} \times PSTAB_{i,t}) + \pi_2(RQ_{i,t} \times PSTAB_{i,t}) + \mu_{it} \quad (4)$$

Where α = direct effect coefficient and π= indirect effect coefficient

Differentiating equation (4)

$$\frac{\partial CO2_{i,t}}{\partial PSTAB_{i,t}} = \alpha_1 + \pi_1 CC_{i,t} + \pi_2 RQ_{i,t} \quad (5)$$

Where ∂ = Partial derivative operator. By examining the magnitude and significance of the direct and indirect coefficients, we can determine the net effect. This can be further defined using Equation (6):

$$\ln CO2_{i,t} = \alpha_0 + \alpha_1 PSTAB_{i,t} + \alpha_2 \ln RQ_{i,t} + \alpha_3 \ln CC_{i,t} + \alpha_j X_{i,t} + \pi_1(CC_{i,t} \times PSTAB_{i,t}) + \pi_2(RQ_{i,t} \times PSTAB_{i,t}) + (\alpha_1 + (\Omega \times \pi)) + \mu_{i,t} \quad (6)$$

Equation (6) can only be true if variables α1 and π are substantial and opposite in sign. In this case, the average of the modulating variable is used to determine if there is a threshold effect that cancels out the net effect when certain conditions are met. By setting Equation (6) equal to zero, we can specify the threshold level in this case:

$$\text{Threshold} \xrightarrow{\text{yields}} \begin{cases} \text{Controlofcoruption} = {}^{\alpha 1}/_{\pi 1} \\ \text{RegulatoryQuality} = {}^{\alpha 1}/_{\pi 2} \end{cases} \quad (7)$$

If the values estimated in Equation (7) fall outside the range of values for the modulating variables, the determination of the threshold

becomes irrelevant and unnecessary. This implies that no values within the observed range of the modulating variables would result in a neutral or null effect on the net relationship between political instability, corruption control, and CO2 emissions.

Incorporating the lagged dependent variable within the model may introduce an adaptive panel bias, as it correlates with the fixed effects present in an oversight period. This bias is addressed by employing the GMM estimation approach, which accounts for the dynamic panel bias and adjusts for cross-country dependence across panels. An excessive number of instruments might hinder GMM estimates. Even though there is no threshold, Roodman (2009) suggested the forward orthogonal deviation strategy to address excessive instrument count. This method comes from Arellano and Bover (1995). The approach maximizes sample size using a few instruments. Instead of reentering data, the anticipatory orthogonal deviation strategy subtracts the average of all future variable measurements. This strategy may confine lags as instrumental variables in regression analysis while retaining orthogonality with the error term. This study uses the forward orthogonal deviation technique for a less instrumented and more efficient approach. This method decreases measuring instrument use and improves validity and reliability. Equations (8) and (9), indicating level and difference, define the GMM process, i.e.,

$$\ln CO2_{i,t} = \propto_0 + \propto_1 \ln CO2_{i(t-\tau)} + \propto_2 PTAB_{i,t} + + \sum_{k=j}^{k} \delta_k W_{h,i(t-\tau)} + v_t + \gamma_t + \mu_{it} \quad (8)$$

$$\ln CO2_{i,t} - \ln CO2_{i(t-\tau)} = \propto_1 (\ln CO2_{i(t-\tau)} - -\ln CO2_{i(t-\tau)}) + \propto_2 \left(\ln PSTAB_{i,t} - -PSTAB_{i(t-\tau)}\right) + \sum_{k=j}^{k} \delta_k (W_{h,i(t-\tau)} - -W_{h,i(t-2\tau)}) (v_t - v_{t-\tau}) + \mu_{i(t-\tau)} \quad (9)$$

The impulse response function (IRF) analyses system dynamics after a disruption. If no additional shocks occur, the IRF can predict the system's future state at time t + n after a big shock. The amplitude and direction of temporal fluctuations of numerous variables were examined using a VAR model. Impulse response analysis studies how parameters change in response to external and internal forces. This tool lets you study dynamic reactions and changeable interdependencies to better understand the system's temporal behavior. The study applies the IRF technique to the system to understand its dynamic interactions and impacts. This will explain variable shifts.

This research uses VDA for predicting. Economics and strategy use the VDA. This study determines how much variance is due to unobserved variables like time, industry, company characteristics, etc. This study uses VDA to estimate how much variance in predicted error across variables is attributable to external shocks produced by other variables in a VAR system. This method illuminates the relative impact of various shocks in altering the examined variables. This study measures the short- and long-term effects of various exogenous shocks to understand the variables of interest better. VDA helps this study forecast future findings. By analyzing their effects, we establish which shocks had the biggest influence on the variables. This method aids economic evaluation and decision-making.

This research requires applying Granger's causality test, which has drawbacks.

The limitations encompass challenges related to model specification, the determination of lag lengths, and the potential occurrence of spurious regression when cointegration and non-stationarity are present. The present study employs the methodology Dumitrescu and Hurlin (2012) proposed to establish panel causality relationships among the variables. This methodology enables the examination of causality in panel data, regardless of whether the data is balanced or unbalanced. It also accounts for heterogeneity across panels, providing adequate time periods relative to cross-sections (TD>CS or TDCS).

Additionally, it solves the panel data cross-sectional dependence issue. Compared to the Granger causality test, the DH causality test has several advantages. This method allows us to relax the homogeneity assumption and offer test statistics with robust Monte Carlo simulation validation. This assessment is more beneficial with spatial dependencies and short datasets. It uses the DH causality test to increase the validity and trustworthiness of its results on variable relationships to overcome the limitations of the traditional technique.

$$y_{i,t} = \alpha_i + \sum_{i=1}^{k} \gamma_i^{(k)} y_{i,k-t} + + \sum_{i=1}^{k} \beta_i^{(K)} x_{i,t-k} + \varepsilon_{i,t} \quad (10)$$

where k denotes optimal lag length

$x_{i,t}$ and $y_{i,k}$ denotes the variables for individual country i in time t

α_i denotes the intercept

$\gamma_i^{(k)}$ denotes Auto regressive parameter

$\beta_i^{(K)}$ denotes regression coefficient.

It is important to note that panel settings should be balanced, meaning that all individuals in the dataset have the same lag order (k). The present study examines a distinct theory suggesting a Granger causal link within the panel dataset. This differing concept challenges the null hypothesis, which assumes the absence of any consistent Granger causality among the chosen Asian countries. The null hypothesis and alternative hypothesis can be defined as follows:

$$H_0 : \beta_{i1} = \ldots = \beta_{ik} = 0 \; \forall_i = 1,2,\ldots\ldots CS$$
$$H_1 : \beta_{i1} \neq \ldots \neq \beta_{ik} \neq 0 \; \forall_i = 1,2,\ldots\ldots CS_1$$

Where $CS_1 \in$ [0, CS-1] is an unknown. There is causality for every person in the panel if $CS_1 = 0$. If CS_1 is not precisely less than CS, then H_1 decreases to H_0 and there is no causality for any of the individuals (Appiah et al., 2023).

4. Result and Discussion

The factors' characteristics are shown in Table 3. According to the data, the average CO2 output is about 4.929 kt, with a high output of 19.622 kt and the lowest output of 0.088 kt. The standard deviation is calculated to be 5.228 kt, indicating a moderate level of dispersion around the mean. The skewness of 1.801 suggests a positively skewed distribution, indicating that a few countries may have high carbon emission levels. The kurtosis value of 6.586 indicates that the distribution has heavy tails and leptokurtic, suggesting outliers or extreme values.

Table 3. Descriptive Statistics

Methods	CO2	PSTAB	RQ	CC	FDI	GDPPC	IVA	REC
Mean	4.929	-0.418	-0.113	-0.251	5.675	9362.16	32.930	25.269
Maximum	29.622	1.615	2.260	2.325	280.131	61173.90	84.795	96.041
Minimum	0.088	-3.180	-2.344	-1.680	-37.172	238.215	6.861	0.0005
Std. Dev.	5.288	0.984	0.878	0.894	18.140	12322.04	14.506	29.720
Skewness	1.801	-0.115	0.121	0.792	10.079	1.698	0.893	1.017
Kurtosis	6.586	2.365	2.946	2.936	125.403	5.056	3.374	2.671

Source: Author's estimate.

Regarding GDP per capita, the statistics show the highest mean value of 61173.90, ranging from 238.215 to 61173.90. This indicates a wide variation in GDP per capita among the selected Asian countries. The PSTAB exhibits the lowest minimum value of -3.180, suggesting deviations from stability in some countries. Analyzing the dispersion of the variables, we find that GDPPC shows the highest dispersion with a value of 12322.04, indicating a wide range of values. On the other hand, CC exhibits the lowest dispersion with a value of 0.894, suggesting a relatively narrow range of variation. We find that the distributions of PSTAB, RQ, CC, FDI, GDPPC, IVA, and REC are positively skewed when we analyze the skewness of these variables. This indicates that most nations fall on the low end of the distribution, while a select few show high numbers. On the other hand, a positively skewed distribution of carbon emissions suggests the existence of nations with very high emission rates. Understanding the economic and ecological trends in the chosen Asian nations is aided by these data, which provide light on the distribution and features of the variables. The correlation matrix is shown in Table 4.

First, increasing CO2 emissions tends to increase GDP per capita. This indicates that as nations become more prosperous, they also produce more carbon emissions. This is because when economies grow, so do their transportation, energy, and manufacturing demands. As a second point, CO2 is correlated positively with PSTAB, RQ, and CC. This suggests that nations with greater governance stability, regulatory excellence, and control of corruption also produce more carbon emissions. Prosperous economies and flourishing political systems may encourage greater carbon-intensive economic activity and investment. Additionally, CO2 and FDI have a favorable association. Higher levels of FDI are associated with more industrial activity and economic development, both of which contribute to higher levels of carbon emissions in the host country. The positive association between CO2 and the SQGDPPC further supports the non-linearity between carbon emissions and economic output. The effect on carbon emissions is more noticeable when GDP per capita grows faster. Possible causes include skyrocketing energy use and industrial output owing to brisk economic growth. Conversely, CO2 and REC have a negative association. This implies that countries with higher levels of REC tend to have lower carbon emissions. This highlights the importance of transitioning towards REC sources to mitigate the environmental impact of carbon emissions. Overall, these

Table 4. Correlation Matrix

Variables	CO2	PSTAB	RQ	CC	FDI	GDPPC	IVA	SQGDPPC	REC
CO2	1								
PTAB	0.454	1							
	(0.000)	-----							
RQ	0.407	0.594	1						
	(0.000)	(0.000)	-----						
CC	0.455	0.668	0.833	1					
	(0.000)	(0.000)	(0.000)	-----					
FDI	0.037	0.159	0.202	0.172	1				
	(0.249)	(0.000)	(0.000)	(0.000)	-----				
GDPPC	0.588	0.478	0.698	0.763	0.186	1			
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	-----			
IVA	0.345	-0.001	-0.037	-0.006	-0.163	-0.061	1		
	(0.000)	(0.973)	(0.243)	(0.845)	(0.000)	(0.056)	-----		
SQGDPPC	0.478	0.441	0.640	0.716	0.165	0.947	-0.079	1	
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.012)	-----	
REC	-0.348	-0.112	-0.282	-0.194	-0.110	-0.480	-0.036	-0.342	1
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.260)	(0.000)	-----

Source: Author's estimate.Note: Small bracket shows probability value.

correlations suggest that economic factors, governance indicators, and REC significantly influence carbon emissions. Policymakers and stakeholders can utilize these findings to develop strategies that promote sustainable economic growth, enhance governance practices, and encourage the adoption of REC sources to address environmental challenges associated with carbon emissions. Table 5 shows the panel GMM estimates.

Starting with the lagged CO2 variable (CO2(-1)), the coefficient estimate of 0.640 is highly significant (t-value = 183.192, $p < 0.001$), indicating a positive relationship between past carbon emissions and current emissions. This suggests that CO2 emissions tend to persist over time. Among the governance indicators included as explanatory variables, PSTAB exhibits a negative coefficient (-0.280) with a high level of significance (t-value = -11.407, $p < 0.001$). This suggests that greater political stability is associated with lower carbon emissions. This finding aligns with the notion that political stability can create an enabling environment for effective environmental policies and sustainable practices. Several ecological and economic reasons might explain this association. Stable political systems make environmental laws easier to write and enact. Stable administration improves a nation's policy stability and longevity. This will enable carbon-reducing ecological policies and activities (Uddin et al., 2023). Governments can finance green policies and technology better without political uncertainty. Government

Table 5. Panel Generalized Method of Moments

Variables	Coefficient	Standard Error	t-Value	Probability
CO2(-1)	0.640	0.003	183.192	0.000
Governance Indicators (Use as Explanatory Variables)				
PSTAB	-0.280	0.024	-11.407	0.000
RQ	0.193	0.032	5.984	0.000
CC	0.185	0.013	14.085	0.000
Macroeconomic Variables (Use as Controlled Variables)				
FDI	-0.000	0.001	-0.287	0.773
GDPPC	6.455	8.966	7.197	0.000
SQGDPPC	-3.010	1.430	-2.105	0.035
IVA	0.018	0.001	12.641	0.000
REC	-0.016	0.002	-5.512	0.000
Instrument	39	Observations		893
SE of Regression	0.560	Mean dependent variable		0.0388
Sum Squared Resid	278.073	S.D dependent variable		0.464
J-statistic	31.730	Prob (J-statistic)		0.380
Arellano-Bond Serial Correlation Test Estimates				
Test order	**m-Statistic**	**Rho**	**SE(rho)**	**Probability**
AR(1)	-0.843	-126.732	150.235	0.398
AR(2)	NA	-13.397	NA	NA

Note: Dependent variable :CO2.

stability enhances investor confidence and investment. Foreign and local investors want efficient governments for permanent bases. With such financial requirements, sustainable and ecologically friendly activities frequently prevail. Thus, stable governments encourage enterprises to employ environmentally friendly tools, lower their carbon footprint, and adopt sustainable manufacturing practices (Ofori et al., 2023). When political stability is high, governments, companies, civic society, and international organizations cooperate more. In politically stable governments, these organizations interact more on environmental issues. This may encourage collaboration, information sharing, and resource mobilization to support sustainable development and minimize carbon emissions. A country's political stability is often attributed to its strong institutions and leadership. Sun et al. (2023) found that politically stable settings have more institutions that can enforce environmental legislation. Good leadership ensures everyone follows the rules, reducing pollution. Political stability also helps develop regulatory frameworks encouraging cleaner technology, REC investments, and carbon emission reductions (Chhabra et al., 2023).

Regulatory Quality (RQ) shows a significant positive coefficient of 0.193 (t-value = 5.984, p 0.001). This shows that nations with strong regulatory and governance systems emit more

carbon. Better regulatory circumstances may boost industrial activity and GDP. Higher-quality regulations improve governance and business conditions. Strong regulation and governance attract investment and grow economies. Higher industrial activity and economic production in these nations may increase carbon emissions (Adedeji & Ogunfalu, 2023). Polluting industries like manufacturing, electricity, and transportation thrive in nations with lax environmental regulations. Countries with stronger regulations may also allow more manufacturing. Well-crafted environmental rules are important, yet nations with stronger regulations may have less strict criteria or enforcement. Long-term carbon emissions may rise if environmental rules are slack and corporations are deregulated (Ben Othman et al., 2023). Without tight regulations, businesses may put profit and development above environmental protection. The quality of regulations rises with economic growth. According to Medase et al. (2023), nations with better regulatory frameworks attract investors and foster business growth. Rising carbon emissions are caused by energy usage, infrastructure construction, and urbanization, which generally accompany economic growth. Economically developed nations have greater carbon emissions due to energy-intensive activities and fossil fuel consumption (Dincer & Aydin, 2023).

A positive coefficient of 0.185 (t-value = 14.085, p 0.001) is found for corruption control (CC). Corruption may hamper environmental governance and law enforcement, explaining the relationship. Good governance relies on the rule of law, openness, and accountability, but corruption undermines all. Bribery, embezzlement, or favouritism by public officials in corrupt countries may harm environmental decision-making (Momot et al., 2023). Environmental regulations are inconsistently and inadequately implemented, which may enhance monitoring, lessen fines, or both. If enterprises and individuals are given more freedom to operate without limitations and with less environmental concern, carbon emissions may rise (Cong et al., 2023). Corruption may also skew allocation, favouring private gain above public well-being. Corruption in environmental management may divert conservation funds to less important initiatives. Renewable energy infrastructure and carbon-cutting programs may lose financing (Olumuyiwa & Isaiah, 2023). Corruption may lead to natural resource mismanagement, environmental deterioration, and carbon emissions (Ampaw et al., 2023). This involves illegal logging, mining, and environmental destruction. Corruption reduces citizen participation in environmental decisions. It may damage public trust in environmental policy and institutions. According to Pinazo-Dallenbach and Castelló-Sirvent (2023), this may discourage individuals from participating in environmental initiatives, slowing the adoption of sustainable practices and carbon emission reduction.

GDP per capita shows a significant positive coefficient of 6.455 (t-value = 7.197, $p < 0.001$). Thus, more GDP per capita increases CO2 emissions. The negative coefficient of the GDP per capita square of -3.010 is statistically significant (t-value = -2.105, $p = 0.035$). Carbon emissions look nonlinear with GDP per capita. Growth in GDP per capita squared reduces carbon emissions. New policies and technologies may strive to decouple economic development from carbon emissions. Based on these data, the EKC hypothesis appears to apply to Asian economies. The EKC hypothesis proposes an inverted U-shaped link between environmental

deterioration and economic progress. When a country's economy expands, carbon emissions often rise at first. However, beyond a certain point in its economic success, GDP per capita diminishes carbon emissions. The square root of a country's GDP is negative; therefore, as economies improve, the pace at which they produce more carbon emissions decreases. There might be several causes for this. First, nations with higher incomes and levels of development are often better able to invest in energy efficiency and clean technology. The carbon footprint of business operations may be lowered as a result of these developments (Caporale et al., 2023) thanks to the more environmentally conscious and sustainable industrial process that results. Second, when nations develop economically, they are more likely to shift their focus to the service sector, which produces less carbon dioxide than factories and industries (Destek et al., 2023).

There is a positive relationship between industry value added and carbon emissions. This indicates that industrial processes are responsible for increased carbon emissions. Energy-intensive manufacturing methods and a dependence on fossil fuels are to blame for this positive correlation. Extraction, production, and manufacturing in industries often demand high levels of energy inputs. Burning fossil fuels for this purpose is a major contributor to GHG emissions (Chung et al., 2023) since these fuels contain carbon. Carbon emissions are not the only ones caused by industry; additional GHGs may be released as a byproduct of certain chemical reactions. Consequently, industrial activities straightforwardly affect carbon emissions (Xiao et al., 2023). Cleaner manufacturing processes, promotion of REC sources, and adoption of sustainable practices may help regulators and industry actors lessen the environmental effect of industrial operations and cut carbon emissions. The carbon intensity of manufacturing operations may be lowered by encouraging the shift to low-carbon and efficient resource technologies, increasing energy efficiency, and creating a circular economy (Almulhim & Al-Saidi, 2023). Industries may be incentivized to adopt greener practices and decrease carbon emissions by implementing tighter environmental legislation, emission reduction objectives, and sustainable practice incentives (Najam, 2023).

There is a statistically significant negative coefficient of -0.016 for REC (t-value = -5.512, p 0.001). This evidence points to an inverse relationship between carbon emissions and REC levels. To reduce carbon emissions and advance sustainable energy practices, our discovery emphasizes the need to switch to REC sources. The power produced by alternative energy sources has the added benefit of not directly emitting GHGs. Green power methods tap on non-depletable and renewable resources to generate electricity, unlike fossil fuels, which contribute to GHG emissions when burnt. Carbon emissions are mostly caused by the combustion of fossil fuels, which may be mitigated by switching to clean energy sources.

A country switching from fossil fuels to renewable energy may reduce its environmental impact. According to Folio et al. (2023), renewable energy solutions frequently improve energy efficiency. Renewable energy systems effectively transform natural resources into usable energy, reducing energy waste and carbon emissions per unit of electricity. Raihan et al. (2023) suggest that the REC may enhance innovation, employment, and economic growth in the REC sector. This move from imported fossil fuels to domestic renewable resources may

help governments attain energy security. Feed-in tariffs, tax incentives, and subsidies may accelerate the transition to REC and reduce carbon emissions. Kuma et al. (2023) further suggested that grid integration, energy storage, and robust REC infrastructure may increase REC technology scalability and reliability.

GMM uses Arellano-Bond autocorrelation tests AR (1) and AR (2) to demonstrate serial correlation. These tests assume no autocorrelation in the model. The study's results show that the AR (1) test probability is 0.398. AR (1) does not reject the no-autocorrelation null hypothesis at 5%, showing that the model does not exhibit first-order autocorrelation. The serial correlation may compromise GMM findings due to the irregular temporal connection of the model's error terms. The GMM estimate is inconsistent if the AR (1) test does not reject the null hypothesis of no autocorrelation, according to Arellano and Bond (1991). Since the AR do not reject the null hypothesis (1) test, GMM findings may be strong and unaffected by first-order autocorrelation. The results show no second-order autocorrelation. This means there is no evidence of a systematic correlation between the error terms at a lag of two periods in the model. The J-statistic is another test used to assess the overall validity of the GMM model. The value of the J-statistic is reported as 31.730, p<0.380. A low probability value (less than 0.05) suggests that the over-identifying restrictions are invalid, indicating potential issues with the instrumental variables used in the model. Table 6 represents the estimated results of the Dumitrescu-Hurlin Panel Causality test.

The findings indicate a Granger causal link between PSTAB, RQ, and CO2 emissions. This shows that adjustments in carbon emissions are possible due to improvements in political stability and regulatory frameworks. Lower carbon emissions may result from improved political stability and more effective laws making adopting environmental policies and sustainable practices easier. Carbon emissions seem to be a function of both economic expansion and FDI. These results

Table 6. Dumitrescu-Hurlin Panel Causality Tests Results

Null Hypothesis	W-Statistics	Zbar-Statistics	P- Value	Decision
PSTAB⇎CO2	3.327*	2.628	0.008	PSTAB→ CO2
RQ ⇎CO2	3.784**	3.74442	0.0002	RQ → CO2
FDI⇎ CO2	3.798**	3.77955	0.0002	FDI → CO2
GDPPC⇎ CO2	5.895**	8.90245	0.0000	GDPPC→ CO2
IVA⇎ RQ	3.341*	2.66796	0.0076	IVA →RQ
CC ⇎REC	3.305*	2.58008	0.0099	CC → REC
GDPPC ⇎FDI	5.988**	9.13946	0.0000	GDPPC → FDI
REC⇎ FDI	3.609**	3.32211	0.0009	REC → FDI
IVA⇎ GDPPC	3.586*	3.26692	0.0011	IVA ↔ GDPPC
GDPPC⇎ IVA	5.996**	9.15982	0.0000	GDPPC ↔ IVA

Note: ***, **, and * demonstrate the significance levels of 10%, 5%, and 1%, respectively. The symbols ⇎, ↔, and → indicate no causality, bidirectional causality, and unidirectional causality, respectively.

support the idea that emission trends in Asia are driven by economic expansion and capital expenditures. Increases in GDP and FDI often lead to increased industrial activity and power use, which may impact carbon emissions. Economic activity and FDI flows have repercussions for the environment; hence efforts to reduce carbon emissions should take steps to uncouple revenue growth from carbon-intensive sectors. The data also suggest a link between REC and economic development on incoming FDI, which is interesting. This indicates that a country's use of clean electricity may promote FDI. Sustainable financial expansion and lower carbon emissions are both possible thanks to the development of green electricity, which is shown by this conclusion. Additionally, the results reveal bidirectional causality between economic growth and industry value added. This implies that economic growth drives industrial activities, which, in turn, contribute to economic expansion. This relationship underscores the importance of industrial sectors in driving economic growth and their potential impact on carbon emissions. It suggests that strategies promoting sustainable industrial practices and transitioning to cleaner technologies can help mitigate carbon emissions while supporting economic development. Table 7 shows the IRF estimates.

The "CO2" variable indicates a decrease in projected CO_2 emissions. Asian countries may reduce CO2 emissions and promote environmental sustainability in the following years. Explanatory factors' IRF estimations, i.e., "PSTAB" that predicts CO2 emissions' response to political stability, are shown. Due to political instability, CO2 emissions may be reduced temporarily. Improved political stability should increase emissions relatively. These findings demonstrate the need for political stability for long-term environmental goals. Better regulation and less corruption are expected to reduce CO_2 emissions, as shown by the "RQ" and "CC" variables. According to the results, reduced corruption and better laws would cut CO2 emissions, encourage eco-friendly policies and behavior, and improve the environment. The "FDI" variables indicate the predicted reaction time of CO_2 emissions to FDI changes. Based on these projections, an increase in FDI seems to lead to lower

Table 7. Impulse Response Function Estimates of CO2 Emissions

Period	CO2	PSTAB	RQ	CC	FDI	GDPPC	IVA	REC
2023	0.4621	0	0	0	0	0	0	0
2024	0.444	-0.010	-0.006	-0.013	-0.019	0.023	0.016	-0.013
2025	0.444	0.002	-0.008	-0.009	-0.024	0.026	0.023	-0.013
2026	0.442	0.013	-0.013	-0.007	-0.034	0.023	0.027	-0.014
2027	0.440	0.024	-0.017	-0.005	-0.039	0.017	0.030	-0.014
2028	0.437	0.034	-0.022	-0.004	-0.045	0.010	0.033	-0.014
2029	0.435	0.044	-0.026	-0.003	-0.049	0.003	0.036	-0.014
2030	0.433	0.053	-0.030	-0.002	-0.052	-0.003	0.038	-0.014
2031	0.431	0.062	-0.034	-0.001	-0.055	-0.010	0.041	-0.014
2032	0.429	0.071	-0.038	-0.001	-0.057	-0.017	0.043	-0.014

Source: Authors' estimation.

CO2 emissions. As a result, it seems likely that FDI will help reduce carbon emissions by encouraging the use of environmentally conscious technology and methods. The "GDPPC" and "IVA" charts demonstrate the anticipated response of CO2 emissions to Income and commercial value-added changes, respectively. At first, growth-driven emissions, such as those caused by a rise in GDP per capita, are expected to increase CO2 emissions. The relationship between economic activity and carbon emissions is predicted to decline over time, indicating a possible decoupling between the two. On the other side, rising manufacturing valuable is likely to lead to more carbon emissions, calling for more eco-friendly production methods. Finally, the "REC" stands for the anticipated change in CO2 emissions due to shifts in the use of green power. According to projections, increasing green electricity usage will be linked to lower CO2 emissions. That is why it's crucial that we switch to green electricity as soon as possible to reduce our carbon footprint. The results of the VDA for CO2 emissions are shown in Table 8.

According to the VDA estimates, the projected variance shocks on CO2 emissions over the next ten years show that inbound FDI is expected to have the highest impact, accounting for 0.871% of the variance in CO2 emissions. This implies that changes in inbound FDI are likely to influence carbon emissions in Asian countries during this period significantly. Following inbound FDI, the variable of political stability is projected to contribute to 0.803% of the variance in CO2 emissions. This indicates that changes in political stability will also play a substantial role in shaping future carbon emissions in the region. Additionally, the impulse response function estimates indicate that IVA will account for 0.504% of CO_2 emissions volatility in the next decade. Changing economic activity and value creation will moderate the region's carbon emissions. Regulatory compliance accounts for 0.270% of CO2 emissions variation in the future, but legal frameworks and accountability mechanisms account for less. Decreasing corruption will have the least influence on carbon emissions in the coming decade. This implies that Asian

Table 8. VDA Estimates of CO2 Emissions

Period	S.E.	CO2	PSTAB	RQ	CC	FDI	GDPPC	IVA	REC
2023	0.462	100	0	0	0	0	0	0	0
2024	0.642	99.572	0.0270	0.009	0.041	0.096	0.135	0.065	0.042
2025	0.782	99.338	0.019	0.017	0.044	0.166	0.207	0.135	0.060
2026	0.901	99.114	0.0375	0.036	0.040	0.274	0.224	0.194	0.070
2027	1.004	98.887	0.088	0.061	0.036	0.377	0.211	0.248	0.077
2028	1.098	98.615	0.174	0.092	0.032	0.487	0.186	0.300	0.082
2029	1.184	98.295	0.290	0.129	0.028	0.592	0.161	0.351	0.086
2030	1.265	97.920	0.436	0.172	0.025	0.693	0.142	0.402	0.088
2031	1.341	97.494	0.608	0.219	0.022	0.786	0.132	0.453	0.090
2032	1.413	97.019	0.803	0.270	0.020	0.871	0.134	0.504	0.091

Source: Authors' estimation.

corruption will not significantly affect carbon emissions at this period. Using this data, stakeholders and governments may prioritize areas to decrease carbon emissions and promote equitable development.

5. Conclusions

This research emphasizes the importance of good governance in Asian sustainability goals. Efficient ecological monitoring needs "good governance," including democratic stability, high-quality regulations, and no nepotism. This research suggests reducing carbon emissions, having politically stable surroundings, and using renewable energy to improve sustainability. Environmental regulation enforcement lowers carbon emissions, but regulatory loopholes, apathy, corruption, and bribery increase them. These results emphasize the necessity of anti-corruption legislation, strict regulations, and law enforcement mechanisms in addressing environmental challenges and poor leadership. The EKC shows an inverted U-shaped relationship between income and carbon emissions. Early economic growth may increase ecological degradation. Beyond a certain income level, sustainable practices and policies may separate economic progress from carbon emissions. Carbon emissions are directly linked to industrialization, supporting the "environmental transition theory," which holds that technological progress and eco-friendly practices may worsen environmental degradation in the early stages of industrialization. Good governance reduces carbon emissions in Asian nations, according to the causality test. Sustainable regional development requires effective ecological governance, strengthened governance structures, and more openness. The study supports the pollution haven hypothesis by showing positive relationships between GDP growth, FDI, and carbon emissions. It proposes implementing environmental rules and sustainability initiatives alongside increasing economies and foreign direct investment to prevent emerging nations from becoming pollution havens. IRF predictions for the next decade incorporate several carbon emission factors. Governance, controllable variables, and political stability may assist in cutting carbon emissions.This underscores the need for focused policies and initiatives to improve governance standards, limit nepotism, and increase the usage of alternative energies to accomplish a sustainable future. The VDA shows that FDI is the most likely to create large variation shocks in carbon emissions, then stable governance and industrialization. These findings show that to reduce carbon emissions, sustainable industrial development and FDI environmental impacts must be prioritized.

Institutional changes, policy enforcement, and international participation are needed to improve Asian environmental governance and political stability. To cut red tape, strengthen democracy, and maintain political stability. Governments should fight corruption, promote open policymaking, and engage the public. Political instability may harm environmental policy, but the rule of law and independent regulatory institutions may help. Governments should finance projects to assist public authorities in implementing and executing environmental legislation. Monitoring and regulatory framework improvements are also needed to enforce environmental laws. Governments should pay lawbreakers heavily to encourage compliance and provide tax advantages to enterprises investing in green technologies. Regional cooperation through environmental accords and cross-

border pollution management may improve laws. Environmental democracy may enforce environmental laws more strictly. Corporations, NGOs, and civil society may promote responsible environmental decision-making. Governments should encourage education sustainability to empower citizens to demand higher environmental standards. These measures may make Asian countries more ecologically sustainable, improving governance, environmental enforcement, and carbon emissions.

Despite the key findings of the study on the relationship between environmental sustainability and Asian nations' governance, it is crucial to acknowledge the study's limitations and provide the framework for future research. Potential bias in selecting governance indicators may arise, as the study used political stability, regulatory quality, and corruption control; they may not be adequate to account for different countries' systems. Due to measurement inconsistencies caused by country governance definitions, data collection methods, and institutional frameworks, our findings may not be as dependable. Future research may employ qualitative and governance metrics to augment the study's quantitative technique. Secondary data sources may include estimation errors, reporting biases, or missing figures, even if they are reliable. Since this study only examined 39 countries, the findings may not apply beyond Asia. Governance-environment nexuses may vary in locations with distinct political systems, economic frameworks, or industrialization levels.

More research should concentrate on specific nations or sub-regions to learn Asia's variety properly. This study covers the whole Asian continent, although political systems, economic frameworks, and regulatory powers vary substantially across countries, affecting environmental governance. Case studies like Japan, China, or India may help explain how governance regimes affect environmental consequences. Comparing rising and established Asian economies may reveal the best governance models and environmental standards. Future research should further expand datasets and improve methodological advancements.

References

Adedeji, A. A., & Ogunfalu, K. M. (2023). Investments, Governance Quality, and Industrial Development in Africa. Economic Alternatives, 2, 344-373.

Adekunle, I. A. (2021). On the search for environmental sustainability in Africa: the role of governance. Environmental Science and Pollution Research, 28(12), 14607-14620.

Agabo, T., Abubakar, I. F., & Adedoyin, F. F. (2021). The anthropogenic consequences of energy consumption and population expansion in Africa? Do governance factors make any difference? Environmental Science and Pollution Research, 28(21), 27109-27118.

Ahmad, S., Iqbal, N., Jamil, F., & Kim, D. (2020). Optimal policy-making for municipal waste management based on predictive model optimization. IEEE Access, 8, 218458-218469.

Almulhim, A. I., & Al-Saidi, M. (2023). Circular economy and the resource nexus: Realignment and progress towards sustainable development in Saudi Arabia. Environmental Development, 46, 100851.

Ampaw, E. M., Chai, J., Jiang, Y., Dumor, K., & Edem, A. K. (2023). Why is Ghana losing

the war against illegal gold mining (Galamsey)? An artificial neural network-based investigations. Environmental Science and Pollution Research, 30, 73730–73752.

Appiah, K., Appah, R., Barnes, W., & Darko, E. A. (2023). Testing the validity of disaggregated agricultural-induced growth–environmental pollution nexus in selected emerging economies. International Journal of Environmental Science and Technology, 20(4), 3687-3702.

Arellano, M., & Bond, S. (1991). Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. The review of economic studies, 58(2), 277-297.

Arellano, M., & Bover, O. (1995). Another look at the instrumental variable estimation of error-components models. Journal of econometrics, 68(1), 29-51.

Ashraf, J., Luo, L., & Anser, M. K. (2022). Do BRI policy and institutional quality influence economic growth and environmental quality? An empirical analysis from South Asian countries affiliated with the Belt and Road Initiative. Environmental Science and Pollution Research, 29(6), 8438–8451.

Asongu, S. A. (2018). ICT, openness and CO2 emissions in Africa. Environmental Science and Pollution Research, 25(10), 9351-9359.

Azam, M.; Abbassi, W.; Tayachi, T.; Azam, R.I. (2022). Impact of Socioeconomic Factors on Environmental Quality: A Panel Quintile Regression Method. Preprints.org 2022, 2022040164. https://doi.org/10.20944/preprints202204.0164.v1

Baba Ali, E., Radmehr, R., Shayanmehr, S., Gyamfi, B. A., & P. Anufriev, V. (2023). The role of technology innovation, R&D, and quality governance in pollution mitigation for EU economies: fresh evidence from method of moment quantile regression. International Journal of Sustainable Development & World Ecology, 30(3), 244-261.

Baloch, M. A., Ozturk, I., Bekun, F. V., & Khan, D. (2021). Modeling the dynamic linkage between financial development, energy innovation, and environmental quality: does globalization matter? Business Strategy and the Environment, 30(1), 176-184.

Ben Othman, H., Hussainey, K., & Moumen, N. (2023). The influence of cultural tightness–looseness, religiosity, and the institutional environment on tax evasion behaviour: A cross-country study. European Financial Management, https://doi.org/10.1111/eufm.12420

Bhutta, A. I., Ullah, M. R., Sultan, J., Riaz, A., & Sheikh, M. F. (2022). Impact of green energy production, green innovation, financial development on environment quality: a role of country governance in Pakistan. International Journal of Energy Economics and Policy, 12, 316-326.

Bibi, F., & Jamil, M. (2021). Testing environment Kuznets curve (EKC) hypothesis in different regions. Environmental Science and Pollution Research, 28, 13581-13594.

Bletsas, K., Oikonomou, G., Panagiotidis, M., & Spyromitros, E. (2022). Carbon Dioxide and Greenhouse Gas Emissions: The Role of Monetary Policy, Fiscal Policy, and Institutional Quality. Energies, 15(13), 4733.

Boubellouta, B., Kusch-Brandt, S. (2021). Cross-country evidence on Environmental

Kuznets Curve in Waste Electrical and Electronic Equipment for 174 Countries. Sustainable Production and Consumption 2021, 25, 136–151. https://doi.org/10.1016/j.spc.2020.08.006

Bulus, G. C., & Koc, S. (2021). The effects of FDI and government expenditures on environmental pollution in Korea: the pollution haven hypothesis revisited. Environmental Science and Pollution Research, 28(28), 38238-38253.

Caporale, G. M., Donati, C., & Spagnolo, N. (2023). Small and medium sized European firms and energy saving measures: The role of financing. Energy Policy, 179, 113613.

Chhabra, M., Giri, A. K., & Kumar, A. (2023). Do trade openness and institutional quality contribute to carbon emission reduction? Evidence from BRICS countries. Environmental Science and Pollution Research, 30(17), 50986-51002.

Chung, C., Kim, J., Sovacool, B. K., Griffiths, S., Bazilian, M., & Yang, M. (2023). Decarbonizing the chemical industry: A systematic review of sociotechnical systems, technological innovations, and policy options. Energy Research & Social Science, 96, 102955.

Cong, J., Xu, T., Zhang, W., Liang, D., & Zhao, Y. (2023). Creation or crowding out? A "two-eight split" phenomenon in the employment effects of the carbon trading policy in China. Journal of Cleaner Production, 415, 137722.

Dagar, V., Khan, M. K., Alvarado, R., Rehman, A., Irfan, M., Adekoya, O. B., & Fahad, S. (2022). Impact of renewable energy consumption, financial development and natural resources on environmental degradation in OECD countries with dynamic panel data. Environmental Science and Pollution Research, 29(12), 18202-18212.

Destek, M. A., Hossain, M. R., & Khan, Z. (2023). Premature Deindustrialization and Environmental Degradation. Gondwana Research, https://doi.org/10.1016/j.gr.2023.06.006

Dincer, I., & Aydin, M. I. (2023). New paradigms in sustainable energy systems with hydrogen. Energy Conversion and Management, 283, 116950.

Dumitrescu, E. I., & Hurlin, C. (2012). Testing for Granger non-causality in heterogeneous panels. Economic modelling, 29(4), 1450-1460.

Farooq, U. (2022). Foreign direct investment, foreign aid, and CO 2 emissions in Asian economies: does governance matter?. Environmental Science and Pollution Research, 29, 7532–7547.

Fotio, H. K., Adams, S., Nkengfack, H., & Poumie, B. (2023). Achieving sustainable development goal 7 in Africa: Does globalization matter for electricity access, renewable energy consumption, and energy efficiency?. Utilities Policy, 82, 101545.

Gaur, V. K., Gautam, K., Sharma, P., Gupta, S., Pandey, A., You, S., & Varjani, S. (2022). Carbon-based catalyst for environmental bioremediation and sustainability: Updates and perspectives on techno-economics and life cycle assessment. Environmental Research, 209, 112793.

Grossman, G. M., & Krueger, A. B. (1991). Environmental impacts of a North American free trade agreement. NBER working paper 3914, DOI 10.3386/w3914.

Online available at: https://www.nber.org/papers/w3914 (accessed on 4th July, 2023).

Gründler, K., & Potrafke, N. (2019). Corruption and economic growth: New empirical evidence. European Journal of Political Economy, 60, 101810.

Hadj, T. B., & Ghodbane, A. (2022). A moderated mediation model of the effect of foreign direct investments on CO2 emissions: Panel data evidence from GCC countries. Journal of the Knowledge Economy, 13(2), 904-925.

Hargrove, A., Hao, F., & Sommer, J. M. (2022). Governing trade: a cross-national study of governance, trade, and CO2 emissions. Journal of Environmental Studies and Sciences, 12(4), 727-738.

Hasni, R., Dridi, D., & Ben Jebli, M. (2023). Do financial development, financial stability and renewable energy disturb carbon emissions? Evidence from asia–pacific economic cooperation economics. Environmental Science and Pollution Research, https://doi.org/10.1007/s11356-023-28418-8.

Jianguo, D., Ali, K., Alnori, F., & Ullah, S. (2022). The nexus of financial development, technological innovation, institutional quality, and environmental quality: evidence from OECD economies. Environmental Science and Pollution Research, 29(38), 58179-58200.

Kakar, A., Khan, A., & Khan, A. (2023). Analyzing the Role of Governance, ICT, and Urbanization on Environment in South Asian Countries. Journal of the Knowledge Economy, https://doi.org/10.1007/s13132-023-01288-8.

Khezri, M., Heshmati, A., Khodaei, M. Environmental implications of economic complexity and its role in determining how renewable energies affect CO2 emissions. Applied Energy. 2022, 306, 117948.

Khoshnevis Yazdi, S., & Golestani Dariani, A. (2019). CO 2 emissions, urbanisation and economic growth: Evidence from Asian countries. Economic research-Ekonomska istraživanja, 32(1), 510-530.

Koilo, V. (2019). Evidence of the Environmental Kuznets Curve: Unleashing the opportunity of industry 4.0 in emerging economies. Journal of Risk and Financial Management, 12(3), 122.

Kumar, A., Khandelwal, S. G., & Gadhwal, N. (2022). Global Environmental Problems: A Nexus Between Climate, and COVID 19 and Evolving Mitigation Strategies. Innovations in Environmental Biotechnology, 65-110.

Kumar, P. P., Rahman, A., Nuvvula, R. S., Colak, I., Muyeen, S. M., Shezan, S. A., ... & Elavarasan, R. M. (2023). Using Energy Conservation-Based Demand-Side Management to Optimize an Off-Grid Integrated Renewable Energy System Using Different Battery Technologies. Sustainability, 15(13), 10137.

Li, H., Shahbaz, M., Jiang, H., & Dong, K. (2021). Is natural gas consumption mitigating air pollution? Fresh evidence from national and regional analysis in China. Sustainable Production and Consumption, 27, 325–336.

Medase, S. K., Ahali, A. Y., & Belitski, M. (2023). Natural resources, quality of institutions and entrepreneurship activity. Resources Policy, 83, 103592.

Bildirici, M. (2022). The impacts of governance on environmental pollution in some countries of Middle East and sub-Saharan Africa: the evidence from panel quantile regression and causality. Environmental Science and Pollution Research, 29(12), 17382-17393.

Momot, T., Chekh, N., Prylypko, S., Filonych, O., & Cherednychenko, O. (2023). Corruption in business: motives and influence on shadow economy. Business: Theory and Practice, 24(1), 206-215.

Mrabet, Z., Alsamara, M., Mimouni, K., & Mnasri, A. (2021). Can human development and political stability improve environmental quality? New evidence from the MENA region. Economic modelling, 94, 28-44.

Nadeem, M. A., Liu, Z., Xu, Y., Nawaz, K., Malik, M. Y., & Younis, A. (2020). Impacts of terrorism, governance structure, military expenditures and infrastructures upon tourism: Empirical evidence from an emerging economy. Eurasian Business Review, 10, 185-206.

Najam, H. (2023). Optimization of renewable energy supply for a carbon neutral society: Role of environmental regulations, sustainable finance, and financial innovation through the lens of game theory. Geological Journal, https://doi.org/10.1002/gj.4746

Nam, V. H., Nguyen, M. N., Nguyen, D. A., & Luu, H. N. (2020). The impact of corruption on the performance of newly established enterprises: Empirical evidence from a transition economy. Borsa Istanbul Review, 20(4), 383-395.

Nchofoung, T. N., & Asongu, S. A. (2022). Effects of infrastructures on environmental quality contingent on trade openness and governance dynamics in Africa. Renewable Energy, 189, 152-163.

Nchofoung, T. N., Asongu, S. A., Njamen Kengdo, A. A., & Achuo, E. D. (2022). Linear and non-linear effects of infrastructures on inclusive human development in Africa. African Development Review, 34(1), 81-96.

Ofori, E. K., Li, J., Radmehr, R., Zhang, J., & Shayanmehr, S. (2023). Environmental consequences of ISO 14001 in European economies amidst structural change and technology innovation: Insights from green governance dynamism. Journal of Cleaner Production, 411, 137301.

Olumuyiwa, A. T., & Isaiah, A. O. (2023). Political Leadership, Corruption, and Insecurity in Nigeria: Issues, Challenges, and Way Forward. African Renaissance, 20(2), 331-355.

Omri, A., Kahia, M., & Kahouli, B. (2021). Does good governance moderate the financial development-CO2 emissions relationship? Environmental Science and Pollution Research, 28(34), 47503-47516.

Opoku, E. E. O., Acheampong, A. O., Dzator, J., & Kufuor, N. K. (2022). Does environmental sustainability attract foreign investment? Evidence from developing countries. Business Strategy and the Environment, 31(7), 3542-3573.

Pickering, J., Bäckstrand, K., & Schlosberg, D. (2020). Between environmental and ecological democracy: theory and practice at the democracy-environment nexus. Journal of environmental policy & planning, 22(1), 1-15.

Pinazo-Dallenbach, P., & Castelló-Sirvent, F. (2023). Gender, Perceived Insecurity, Corruption Perception, Subjective Norm,

and Household Income: A Configurational Approach to Entrepreneurial Intention. Journal of the Knowledge Economy, https://doi.org/10.1007/s13132-023-01387-6.

Prasad, R. (2023). Sustainability and Sustainable Energy Options. In: Physics and Technology for Engineers. Springer, Cham. https://doi.org/10.1007/978-3-031-32084-2_10

Qureshi, M. A., Akbar, M., Akbar, A., & Poulova, P. (2021). Do ESG endeavors assist firms in achieving superior financial performance? A case of 100 best corporate citizens. Sage Open, 11(2), 21582440211021598.

Raihan, A., Pavel, M. I., Muhtasim, D. A., Farhana, S., Faruk, O., & Paul, A. (2023). The role of renewable energy use, technological innovation, and forest cover toward green development: Evidence from Indonesia. Innovation and Green Development, 2(1), 100035.

Roodman, D. (2009). How to do xtabond2: An introduction to difference and system GMM in Stata. The stata journal, 9(1), 86-136.

Shobande, O. A., & Ogbeifun, L. (2022). Has information and communication technology improved environmental quality in the OECD? a dynamic panel analysis. International Journal of Sustainable Development & World Ecology, 29(1), 39-49.

Sohail, M. T., Majeed, M. T., Shaikh, P. A., & Andlib, Z. (2022). Environmental costs of political instability in Pakistan: policy options for clean energy consumption and environment. Environmental Science and Pollution Research, 29(17), 25184-25193.

Son, T. H., Liem, N. T., & Khuong, N. V. (2020). Corruption, nonperforming loans, and economic growth: International evidence. Cogent Business & Management, 7(1), 1735691.

Sulaiman, C., & Abdul-Rahim, A. S. (2022). Relationship between wood fuel energy consumption and forest degradation at regional and sub-regional levels of sub-Saharan Africa: the role of control of corruption and government effectiveness. Environmental Science and Pollution Research, 29(49), 74512-74525.

Sun, Y., Gao, P., Raza, S. A., & Khan, K. A. (2023). The nonparametric causal effect of sustainable governance structure on energy efficiency and ecological footprint: A pathway to sustainable development. Gondwana Research, 121, 383-403.

Tian, Y., & Li, L. (2022). Impact of financial inclusion and globalization on environmental quality: evidence from G20 economies. Environmental Science and Pollution Research, 29(40), 61265-61276.

Uddin, I., Usman, M., Saqib, N., & Makhdum, M. S. A. (2023). The impact of geopolitical risk, governance, technological innovations, energy use, and foreign direct investment on CO2 emissions in the BRICS region. Environmental Science and Pollution Research, 30, 73714–73729.

Usman, M., Jahanger, A., Makhdum, M. S. A., Balsalobre-Lorente, D., & Bashir, A. (2022). How do financial development, energy consumption, natural resources, and globalization affect Arctic countries' economic growth and environmental quality? An advanced panel data simulation. Energy, 241, 122515.

Usman, O. (2022). Modelling the economic and social issues related to environmental quality in Nigeria: the role of economic growth and internal conflict. Environmental Science and Pollution Research, 29(26), 39209-39227.

Uzar, U. (2022). The connection between freedom of the press and environmental quality: an investigation on emerging market countries. In Natural Resources Forum (Vol. 46, No. 1, pp. 21-38). Oxford, UK: Blackwell Publishing Ltd.

WDI (2022). World development indicators, World Bank Washington D.C.

Wen, J., Mughal, N., Zhao, J., Shabbir, M. S., Niedbała, G., Jain, V., & Anwar, A. (2021). Does globalization matter for environmental degradation? Nexus among energy consumption, economic growth, and carbon dioxide emission. Energy Policy, 153, 112230.

WGI (2022). World governance indicators, World Bank, Washington D.C.

Xiao, F., Pang, Z., Yan, D., Kong, Y., & Yang, F. (2023). How does transportation infrastructure affect urban carbon emissions? an empirical study based on 286 cities in China. Environmental Science and Pollution Research, 30(4), 10624-10642.

Xue, J., Rasool, Z., Nazar, R., Khan, A. I., Bhatti, S. H., & Ali, S. (2021). Revisiting natural resources—globalization-environmental quality nexus: fresh insights from South Asia countries. Sustainability, 13(8), 4224.

Yameogo, C. E., Omojolaibi, J. A., & Dauda, R. O. (2021). Economic globalisation, institutions and environmental quality in Sub-Saharan Africa. Research in Globalization, 3, 100035.

Yao, X., Yasmeen, R., Hussain, J., & Shah, W. U. H. (2021). The repercussions of financial development and corruption on energy efficiency and ecological footprint: Evidence from BRICS and next 11 countries. Energy, 223, 120063.

Yasmeen, R., Tao, R., Shah, W. U. H., Padda, I. U. H., & Tang, C. (2022). The nexuses between carbon emissions, agriculture production efficiency, research and development, and government effectiveness: Evidence from major agriculture-producing countries. Environmental Science and Pollution Research, 29(34), 52133-52146.

Zhang, D., Ozturk, I., & Ullah, S. (2022). Institutional factors-environmental quality nexus in BRICS: a strategic pillar of governmental performance. Economic research-Ekonomska istraživanja, 35(1), 5777-5789.

Zhou, A., & Li, J. (2021). Impact of anti-corruption and environmental regulation on the green development of China's manufacturing industry. Sustainable Production and Consumption, 27, 1944-1960