Journal of Theoretical Accounting Research
ISSN: 1556-5106
Volume 21 Issue 2 Year 2025 Page 268-279

Governance Quality, Sustainability Accounting and Environmental Accountability: A Panel Data Analysis of Environmental Degradation in Developing Economies

Dr. Ashmita Kesar[1*], Dr. Syed Kumail Sajjad[2]

[1*]Assistant Professor, Department of Economics, GITAM School of Humanities and Social Sciences, Vishakhapatnam-530045, India Email: akesar@gitam.edu
[2]Assistant Professor (Economics), School of Humanities and Social Sciences, IILM University, Greater Noida Email: syedkumailsajjad@gmail.com

Abstract
This study examines the impact of governance quality on environmental degradation using panel data from 75 developing countries (1996-2020). It finds that stronger governance significantly reduces carbon dioxide emissions through enhanced accountability, disclosure credibility, and enforcement of sustainability reporting standards. The study advances sustainability accounting and governance theory by articulating accountability and disclosure assurance as mechanisms linking governance quality to environmental outcomes, with implications for both theory and practice in environmental and sustainability reporting.
Keywords: Sustainability accounting; Environmental accountability; ESG reporting credibility; Governance and disclosure; Assurance and enforcement; Environmental degradation

I. Introduction

Environmental degradation has become a severe and detrimental trend in recent times. The term "environment" is generally defined as the repercussions of human behaviour and activities on the biosphere and natural systems. This scenario sets it apart from the term "ecology", which is defined as a concept of interconnectedness within an ecosystem (Abbas et al., 2020). Environmental deterioration is a major concern for the world and the depletion of the environment due to exhaustive usage of environmental resources. It is demarcated as an adverse and undesirable change or disorder to the environment. Environmental degradation is the primary reason behind global warming, which has impacted wind and sea level circulation patterns, as well as local climatic conditions, including changes in precipitation levels and temperature. The increase in the global temperature leads to the increase in the Arctic Ice, which melts very fast leading to the elevation of the sea level (Samimi et al., 2012; Bumpus & Liverman, 2008; Larrinaga, 2014; Karim et al., 2021; Haseeb et al., 2018; and Hussain et al., 2021). The Intergovernmental Panel on Climate Change (IPCC, 2019) has stated that global warming due to anthropogenic activities is expected to reach 1.5°C between 2030 and 2052, which may lead to the permanent loss of some ecosystems. Furthermore, a temperature increase of 1.1°C to 6.4°C is also expected globally, accompanied by a rise of 16.5 cm to 53.8 cm in ocean water levels, which is likely to result in droughts and heatwaves. The five specific indicators of environmental degradation that are directly caused by human activity are: Greenhouse gas emissions, air pollution, water pollution, desertification, and soil degradation. Environmental degradation is often said to be the consequence of underprivileged governance and deficiency of enforcement of the rules and regulations (Samimi et al., 2012). From an accountability perspective, weak governance also undermines sustainability accounting systems by limiting credible environmental disclosure, monitoring, and enforcement of reporting standards. The cumulative danger of global warming and climate change has called for more attention and discussion to identify the factors behind the swift intensification in carbon emanations, institutional failure and bad governance (Lovell, 2010 and Sethi et al, 2022). It is generally observed that countries with better governance can better manage their environment and ecosystem. In the Paris Agreement 2015 countries committed to formulate "Nationally Determined Goals" to keep global warming to below 2 degrees Celsius while following attempts to keep it to a safer 1.5 degrees. The Paris agreement was further approved at the historic COP21 meeting with countries agreeing to make collective efforts to achieve the targets of keeping global warming "well below 2 degrees Celsius". These targets cannot be achieved without the audacious commitments of the government of the respective countries. Such commitments require not only policy intent but also credible sustainability accounting frameworks that ensure transparent environmental disclosure and institutional accountability. Thus, environmental policies are influenced by government policies, which are usually guided by the organisation and efficiency of the government. According to Milledge et al., (2007) poor methods, feeble institutional patterns and incompetent administration made it difficult to observe and control environmental activities.

Governance is defined by different scholars in different ways. According to Jordan et al. (2003), Governance is defined as the governmental activities performed by state agencies at the national level, and it also involves the contributions made by the private sector alongside the public sector. According to the United Nations Development Programme (UNDP), good governance is characterised by reasonable and democratic governance, where people have the means, rights, and capabilities to participate in and contribute to decisions that affect their lives, and the government is accountable for its actions. The European Commission defines governance as the combination of five indicators: trade openness, public participation, accountable actions by state agencies, predictability, and transparency (Bosselmann et al., 2008). While Costa et al. (2010) defined governance in the corporate sector as the way business organisations are directed and controlled. According to Walker (2011), governance consists of several actors across multiple scales performing a collaborative function to achieve the targets of reducing global climate change, taking responsibility within collaborative networks to achieve carbon reduction outcomes. In terms of accounting theory, sustainability accounting is the extension of conventional accountability models to include environmental performance measurement, credibility of disclosure, and enforcement. The quality of governance is what distinguishes the ability of such sustainability reporting systems to operate as the decision-useful accountability systems or mere symbolic systems (Larrinaga, 2014; Lovell, 2010). Also, Kaufman et al. (2006) revealed that Governance is a plural and comprehensive concept comprising shared efforts by various segments of society, non-profit organisations, corporations, and government institutions at different levels towards achieving a quality of life and a sustainable society. The World Governance Indicators has identified six indicators of governance: political stability and democracy, voice and accountability, regulatory quality, government effectiveness, the rule of law, and corruption control (Haseeb et al., 2018). These areas of governance are core components of environmental accountability, as they determine the credibility of sustainability reporting, policies and measures, and confidence in reported environmental data.

In the environmental accounting of sustainability, the quality of the accountability and reporting systems is closely associated with environmental degradation. Accounting theory focuses on the significance of disclosure credibility, enforcement, and assurance to generate decision-useful information. Applying the same reasoning to the environmental context, the quality of governance is a supporting mechanism that facilitates efficient sustainability accounting, enhances environmental accountability, and adherence to environmental standards (Larrinaga, 2014; Lovell, 2010). Therefore, governance is not only a direct factor in environmental results but it functions by institutionalized sustainability reporting and accountability systems.

It is based on this that the current research paper is seeking to investigate the interdependences between governance and its impacts on environmental degradation, of a panel of data of 75 countries with specific focus on sustainability accounting accountability, disclosure environments and institutional reporting conditions. The present study makes the following contribution to the existing literature: First, the study is considered one of the scorching topics of today, concerned with global health, although much explored, it has still not reached its peak. Secondly, previous studies have used small samples related to a particular region, whereas the current paper utilises a large sample of 75 developing countries to analyse the influence of governance on environmental degradation worldwide. Thirdly, the past research works have mainly focused on the impact of governance on sustainable development using the entire concept of governance rather than taking its various dimensions into account. Therefore, in the current study, six dimensions of governance based on WGI indicators, namely- Control of corruption, political stability, government effectiveness, rule of law, Voice and accountability and regulating quality have been included to make governance index. Finally, the present research will provide a reminder of the importance of environmental degradation and will help the regulators to develop effective environment-friendly policies. Another aim of the research is to define governance quality as the institutional framework that facilitates sustainability accountability and reportable environmental practices in the developing economies.

The remaining paper is organized as follows: The section II contains a review of the past studies. The III section provides the data and the empirical methodology. Section IV presents the empirical findings followed by the concluding remarks in section V. By doing so, the study provides conceptual and empirical evidence on how governance-driven accountability and sustainability accounting mechanisms influence environmental outcomes in developing economies.

II. Review of literature

Environmental degradation and resulting global warming are primary concerns not only for countries with widespread contamination but for the entire world today. The pursuit of high development has led to the high usage of non-renewable resources, increased energy consumption, desertification, and pollution, resulting in environmental degradation as well as biological degradation (Wang & Zhang, 2014). Environmental degradation is likely to have adverse effects on humanity in various ways. Many scholars and academicians have examined the issue of environmental degradation. In this context, Jordan et al. (2003) analysed the relevance and broad trends and adoption of various newly developed tools, such as eco-taxes and intended arrangements. Mineur (2007) analysed the various indicators of sustainable development in the context of Sweden and found that the scope of homegrown sustainability indicators varies largely, signifying that different

homegrown contexts would interpret sustainability differently. Furthermore, Samimi et al. (2012) examined the impact of governance on environmental degradation from 2002 to 2007 and found that it has an adverse effect on environmental degradation in the MENA region. Gani (2012) observed the association between five measures of governance and carbon emissions in a sample of emerging nations and found an adverse impact of good governance on per capita carbon emissions. Using qualitative estimation methods, Halkos et al. (2013) examined the relationship between carbon emissions and governance for the period 1996 -2010 across 20 developed countries, finding a non-monotonic relationship between carbon emissions and governance. Furthermore, they also found that there are significant variations in governance measures and carbon emission levels, depending on regional development differences. Wang et al. (2014) examined the development of policy measures supporting the reduction of carbon emissions in China, considering five aspects: energy conservation, development of new energy sources, reforestation, creation of a circular economy, and corporate restructuring, and found that existing laws should be made stricter. Furthermore, they contended that a more stringent administrative system should be adopted to ensure the efficient implementation of carbon-reduction strategies, methods, and policies. Liu et al., (2018) performed a case-study analysis over the Suzhou Industry Park to analyse the role played by governance in reducing carbon emanations and found that policy implementation and assigning responsibility and accountability are the key to attain reducing carbon emission objectives. Further, the optimistic attitude of the resident government is also necessary to improve the quality of environmental health. Haseeb et al., (2018) empirically investigated the association between bribery, democracy, tourism, and carbon emanations for the panel data from 1995 to 2015 and using the FMOLS technique. They found the corruption along with increased tourism optimistically contribute to carbon emissions. While the repercussions of democracy are negative for carbon emissions in advanced countries, they are not in developing countries. Using the GMM methodology, Asangu and Odhiambo (2019) investigated the importance of governance and its measures in reducing environmental degradation in 44 countries of the Sub-Saharan African region from 2000 to 2012. They found the optimistic moderating impact of regulation quality, economic governance and general governance on carbon emissions in African countries. Using the AMG algorithm, annual data for 1990-2015 for BRICS countries, Baloch et al. (2019) analysed the relationship between natural resources and carbon emissions and found that the abundance of natural resources has adverse repercussions on carbon emissions in Russia, while it adds to contamination in South Africa. Further, they found evidence of the Environmental Kuznets Curve (EKC) hypothesis in BRICS countries. Abbas et al. (2020) examined the nexus between socioeconomic variables on various measures of environmental degradation in Pakistan for the period of 1984 to 2017 using the ARDL test and found an adverse relation between socioeconomic factors and environmental dimensions, with foreign inflows, economic growth, industrialisation and the total population having enhancing effects on environmental degradation. Further, governance also has moderating effects on environmental degradation. Kouser et al. (2020) investigated the association between inexhaustible energy consumption, water accessibility, and environmental degradation, considering the controlling repercussions of governance in the South Asian region, using data for the period 1988 -2018 and the dynamic common correlation effect. They found that foreign inflows, although optimistic, contribute to increased environmental degradation, while renewable energy and water accessibility reduce environmental degradation. Furthermore, governance also strengthens the positive nexus between foreign inflows and environmental degradation, as well as the adverse relationship between renewable energy and water accessibility and carbon emissions.

Okudo (2021) analysed the nexus between corporate governance and carbon disclosure procedures in industrial firms in Nigeria for the period 2011-2020 using Pearson correlation and Panel Least Squares (PLS) regression. They found that the proportion of ownership, gender diversity on the board and the sustainability committee have a considerable optimistic impact on carbon emission disclosure in the selected manufacturing firms. Karim et al. (2021) examined the measurement of carbon emissions disclosure in the UK for the period 2013-2019, applying various methods to assess validity and reliability. They also examined the nexus between capital expenditure, corporate governance and the extent of carbon emission disclosure. They found an optimistic relation between capital expenditure and carbon emission disclosure. Hussain et al. (2021) examined the impact of ecological taxes and green energy (non-exhaustible energy sources) on carbon emissions in the ten most polluted countries from 2012 to 2020 using panel regression analysis. They found that environmental governance and green energy considerably reduce environmental degradation in the sample countries. Sarwar et al., (2021) applied quantile regression to intensely analyse the relationship between good governance and carbon emissions by using the annual data of Saudi Arabia from 1970 to 2018 and found that good governance can considerably reduce the carbon emissions in Saudi Arabia, where governance efficacy and regulatory quality lead to a decrease in carbon emissions. Yang et al. (2021) examined the repercussions of financial development, natural resources, and governance on environmental degradation in the SAARC over the period 1996–2018 using a panel cointegration and heterogeneous causality test. They found that financial development and governance optimistically contribute to enhancing the environmental quality in SAARC countries. Furthermore, they found that the natural resources curse theory made a significant contribution to environmental emissions. Further, the one-way causal

relation between environment and governance, economic growth and natural resources and the two-way relation between financial development and environmental degradation. Solikhah et al. (2021) observed various elements, such as environmental outcomes, company life, administrative proprietorship, official proprietorship, and autonomous officers, that influence the disclosure of carbon emissions. They considered data for 40 engineering-indexed corporates for the period 2012-2015, using panel regression analysis. They found that the carbon emissions revelation level was the lowest due to a lack of awareness about environmental reporting problems. Furthermore, they also argued that the repercussions of company tenure, institutional proprietorship, and autonomous representatives are positive in enhancing the revelation of carbon emissions, while environmental outcomes and administrative proprietorship do not influence the revelation of carbon emissions. Using a fixed panel of 21 countries in the Asia-Pacific Economic Cooperation (APEC) region, Sethi and Dash (2022) considered the implications of energy-led development, predominance of life, and organisational factors on the amount of carbon emissions and discovered that the optimistic effects of energy-led growth on carbon emission are positive. They also proved that the greater the transparency, the less pollution and that the human development and the employment increase directly influence the reduction of the pollution.

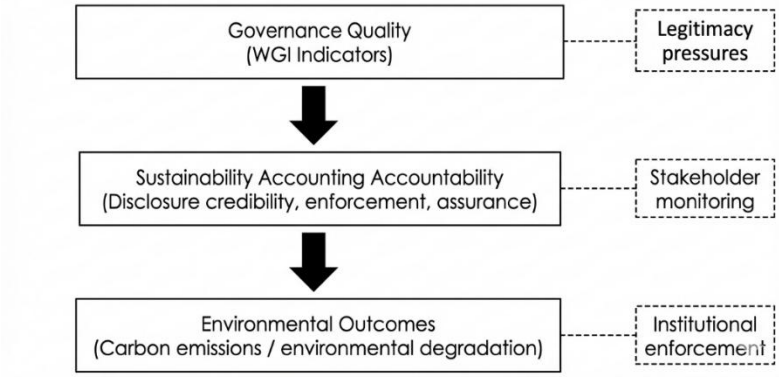
Governance, Sustainability Reporting & Environmental Accountability

An emerging body of literature has indicated that the quality of governance is a significant factor that determines the success of sustainability reporting and environmental accountability systems. Effective governance structures lead to transparency, increase the credibility of environmental reporting, as well as less asymmetry of information between companies, their regulators, and stakeholders. In terms of sustainability accounting, good governance enhances institutional environment within which environmental information is quantified, reported, and monitored, which reduces the quality and comparability of reporting (Larrinaga, 2014; Lovell, 2010). The level of governance is also higher in countries and thus, they are in a better position to execute credible ESG reporting systems and adherence to environmental regulations.

The importance of enforcement and institutional control in reducing the greenwashing and symbolic environmental disclosure is also highlighted by previous studies. The absence of strong governance conditions can also permit the firms and governmental institutions to practice selective or misleading sustainability reporting because there are no strict regulations and assurance measures. Conversely, more powerful governance mitigates the risks of greenwashing by increasing regulatory oversight, legalization, and responsibility of reported environmental data (Walker, 2011; Karim et al., 2021). According to this literature, the quality of governance is an institutional protection mechanism which makes sure that sustainability reporting is a real accountability instrument and not a reputational instrument.

III. Conceptual Framework

This paper conceptualizes the quality of governance as an institutional process that determines the results of the environment by the accountability of sustainability of the environment and enforcement of disclosure. Good governance will lead to better regulatory controls, transparency and enforcement of the environmental reporting, which will increase the credibility of disclosure and accountability. By lowering the risk of opportunistic behavior and greenwashing, these mechanisms result in a better environmental performance and minimized carbon emissions. On the other hand, poor governance erodes sustainability reporting mechanisms, restricts enforcement and accountability thus leading to worse environmental results. Conceptually, this direction is in line with the legitimacy theory, which postulates the need of credible environmental disclosure to ensure social legitimacy by organizations and governments. It is also consistent with the stakeholder theory because through reporting clear sustainability, the stakeholders can assess the performance of the institutions in relation to the environment and hold institutions accountable. Also, institutional theory describes the influence of the reporting practices by the governance structures by establishing the formal rules, enforcement mechanisms, and norms underpinning the sustainability accounting systems. The following is the conceptual model of this research:



IV. Data and methodology

The study utilises panel data spanning from 1990 to 2020, sourced from the BP Statistical Review of World

Energy and the World Governance Indicators from the World Bank. The magnitudes of governance provided by Kaufman et al., 2004 are as follows:

1) Voice and Accountability (VA): A country's residents contribute to choosing the government, and further, they have the right to express their views and opinions, as well as the freedom to associate.

2) Political Stability (POL): beliefs about the possibility that the state will be replaced through ferocious or illegal means, such as political massacre and terrorism.

3) Rule of Law (RUL): The extent to which residents and administrators trust and uphold social norms, particularly in enforcing the contracts, protection of property rights, the role played by courts and police in providing justice and the possibility of delinquency and viciousness.

4) Control of Corruption (COC): the degree to which the state controls bribery and other practices adopted by various segments of society for private benefits, and also involves the implementation of anti-corruption strategies adopted by the state.

Thus, governance has a considerable influence on a country's environmental policies, which are usually guided by the organisation and efficiency of the government, depending on the level of governance. In this study, the governance index is interpreted as a proxy for the institutional environment that shapes sustainability accounting accountability, disclosure credibility, and the enforcement of environmental reporting practices.The study seeks to observe the effects of governance on environmental

Methodology

The study seeks to observe the effects of governance on environmental degradation and to verify the long-run association between governance quality and carbon emissions, recognizing governance as a mechanism that enhances environmental accountability and disclosure credibility, thereby reducing environmental degradation. The use of panel data techniques allows the study to capture institutional heterogeneity across countries, which is central to governance and accounting theory. Fixed effects, FMOLS, and DOLS estimations are particularly suitable for examining how persistent institutional conditions, such as accountability and enforcement frameworks, influence environmental outcomes over time. Thus, our proposed model on the association between governance and environmental degradation takes the following form:

$$Env = f(GI, COC, POL, RUL, VA) \quad (1)$$

Where GI, COC, POL, RUL and VA indicate governance index, Control of corruption, political stability, rule of law and voice and accountability respectively. Control of corruption enhances environmental accountability by limiting opportunistic behavior and improving the credibility of sustainability disclosures. Political stability facilitates consistent enforcement of environmental regulations and reporting requirements over time. Rule of law strengthens sustainability accounting by ensuring compliance with disclosure standards and legal accountability for environmental misconduct. Voice and accountability improve transparency by enabling public scrutiny and stakeholder monitoring of environmental reporting practices. Further, we have considered a panel data study, therefore, Equation (1) can be articulated as follows:

$$Envir = \alpha + \beta_1 COC_{it} + \beta_2 COC_{it} + \beta_3 POL_{it} + \beta_4 RUL_{it} + \beta_5 VAR_{it} + \varepsilon_{it} \quad (2)$$

where environmental degradation is the dependent variable while GI, COC, POL, RUL and VA are independent variables, ε is the error term which is normally dispersed with mean zero and variance σ^2. The subscript "i" and "t" signify country and time correspondingly. These governance dimensions are expected to influence environmental outcomes by shaping sustainability accounting accountability, disclosure environments, and the enforcement of environmental reporting standards. Accordingly, the study hypothesizes that stronger governance quality enhances environmental accountability and disclosure credibility, leading to lower levels of environmental degradation.

The study proceeds with the estimation of cross-sectional dependence in the panel data. Cross-sectional dependence is a very common problem found in cross-sections. Usual procedures that do not take into consideration the presence of spatial correlations result in unreliable estimates of the standard errors of these parameters (Barbieri, 2009). Therefore, to consider spatial correlation, the Pesaran Lagrange multiplier cross-section dependency test is applied, which is estimated as:

$$CD_{lm} = \sqrt{\frac{2}{N(N-1)}} \sum_{i=1}^{n-1} \sum_{J=i+1}^{N} \left(\frac{(T-K)\rho_{ij}^2 - u_{Tij}}{v_{Tij}^2} \right) \vec{d}(N,0) \quad (3)$$

where k signifies the number of independent variables, $u_{Tij}$and v_{Tij}^2 are the first and second moments of $(T-K)\rho_{ij}^2$ correspondingly. Further, the series was also investigated for the presence of the unit root problem. The traditional methods such as Levin-Lin-Chu (LLC) and Im-Pesaran-Shin unit root (IPS) tests do not consider the spatial correlations in the panel data. Moreover, they are tests that cannot be used when spatial effects are at play as they result in least power (Sharif et al., 2019; Barbieri, 2009; Hurlin& Mignon, 2007). Accordingly, we employ Pesaran's (2007) CIPS unit root testis applied which takes into consideration the cross-sectional dependence and is estimated as follows:

Journal of Theoretical Accounting Research
ISSN: 1556-5106
Volume 21 Issue 2 Year 2025 Page 268-279

$$\Delta y_{it} = \alpha_i + \rho_i y_{i,t-1} + c_i \bar{y}_{i,t-1} + \sum_{j=0}^{k} d_{ij}\, \Delta \bar{y}_{t-j} + \sum_{j=0}^{k} \beta_{ij} \Delta y_{i,t-j} + \varepsilon_{it} \quad (4)$$

CIPS statistic is based on the average of individual CADF statistics:

$$CIPS = \frac{1}{N} \sum_{i=1}^{N} t_i(N,T) \quad (5)$$

Where $t_i(N,T)$ is the teststatistic of the estimated ρ_i.

In the next step, the study proceeds with the estimation of the long-run relationship between various dimensions of governance and environmental degradation. For this purpose, the cointegrating regression technique of fully modified ordinary least squares (FMOLS) proposed by Pedroni is used. The FMOLS technique was introduced by Phillips and Hansen (1990) and was later refined by Pedroni (2000).

Generally, the panel cointegration tests such as Pooled Mean Group and Mean Group do not provide for long-run estimations. For example, Pooled Mean Group method and Dynamic Fixed Effect method only provid eshort-run coefficients while the long-run coefficients are assumed to be homogenous across panels. Further, the Dynamic Fixed Effect method restricts the speed of adjustment coefficients and is also prone to simultaneous bias in the case of endogenic variables. Likewise, the Mean Group method although provide short and long-run estimates but is sensitive to outliers and small model permutations (Samargandi et al., 2015). Thus, to overcome these drawbacks, the technique of fully modified (FMOLS) is applied. This technique provides reliable estimates even in the presence of endogenic variables. From a sustainability accounting perspective, identifying long-run relationships is essential, as accountability and reporting systems operate through stable institutional arrangements rather than short-term adjustments. The FMOLS model is estimated as follows:

$$\hat{\beta}_{FMOLS} = [N^{-1} \textstyle\sum_{i=1}^{N} (\sum_{t=1}^{T} (p_{it} - \bar{p}_i)^2)]^{-1} \times [(\sum_{t=1}^{T} (p_{it} - \bar{p}_i)) \hat{S}_{it} - T\hat{\Delta}_{eu} \quad (6)$$

where p denotes the independent variables and S is the dependent variable.

However, the estimated values of FMOLS are not able to address the problem of the autocorrelation across the cross-sections that may result in inefficient estimates (Kao and Chiang, 2001). Thus, to over this drawback, we additionally used Driscoll-Kraay standard errors estimation in addition to the FMOLS technique to determine the long-run coefficients. Driscoll and Kraay's (1998) method are a non-parametric procedure that can be applied in micro panels (N > T). It does not only consider spatial correlations but also addresses the issue of heteroscedasticity (Baloch et al., 2019) by assuming the residuals to be heteroskedastic and autocorrelated up to delays correlated between the groups in the panel. Therefore, the study employs a panel data regression with Driscoll-Kraay standard errors for coefficients estimated by the fixed-effects estimator.The parameters of the Driscoll-Kraay standard errors are calculated as "square roots ($\widehat{S_T}$) of the diagonal elements ofthe asymptotic covariance matrix" (Driscoll and Kraay,1998):

$$V(\hat{\beta}) = (X'X)^{-1} \widehat{S_T} (X'X)^{-1} \quad (7)$$

Further, the number of panels is not a constraint while using this method.

V. Results and Analysis

Descriptive Statistics

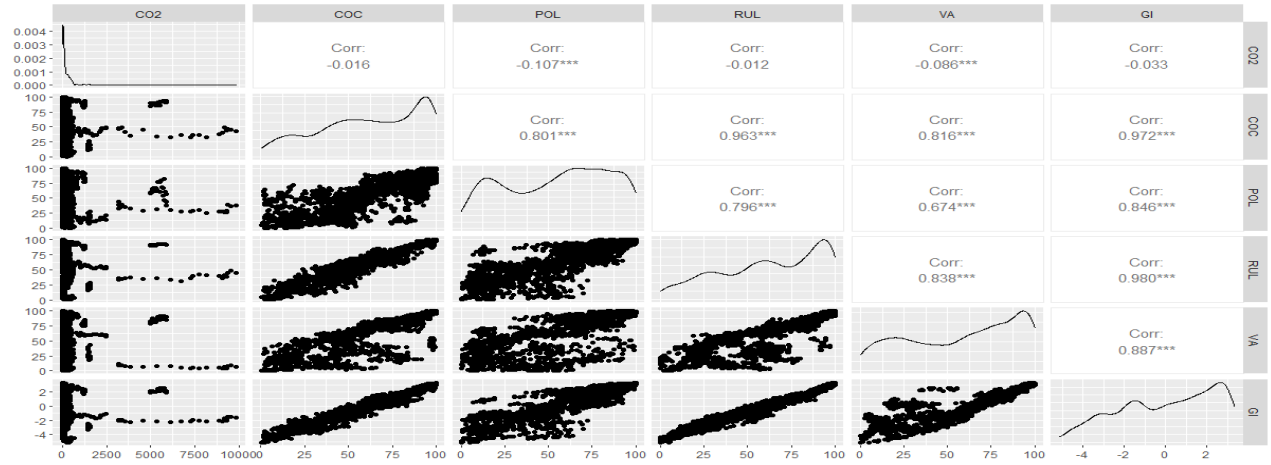
Table 1 explains the descriptive statistics and the results indicate the mean of carbon dioxide (366.57) is the maximum among all the mentioned variables with standard deviation (1036.60) followed by the value of rule of law (RUL) mean 62.434 with the standard deviation 28.522. The control of corruption (COC) has a mean 61.913 with the standard deviation 28.482, the voice and accountability (VA) mean 58.726 and standard deviation value 31.00, the political stability (POL) mean is 55.077 with standard deviation 29.165. The lowest value of mean is that of governance index (GI) 0.057 with standard deviation 2.294. The value and skewness and kurtosis ranges between "zero" and "three" for the series to have normal distribution and symmetric. The variable carbon dioxide is positively skewed whereas all other variables are inclining left and shows variables are skewed negatively. For the kurtosis all variables are mesokurtic as the values of all the variables are approaching near three. The results of skewness along with kurtosis prove that the variables refuse to be normally distributed and further the test of normality of Jarque-Bera confirms this by rejecting the null hypothesis for normally distributed.

Table 1: Summary of Descriptive Statistics

	CO_2	COC	POL	RUL	VA	GI
Mean	366.57	61.913	55.077	62.434	58.726	0.0570
Median	94.502	64.539	59.047	65.497	64.179	0.3573
Maximum	9825.80	100.00	100.00	100.00	100.000	3.3287
Minimum	2.5091	0.5376	0.000	0.469	0.0000	-5.1150
Std. Dev.	1036.60	28.482	29.165	28.522	31.0023	2.294
Skewness	5.969	-0.3929	-0.2200	-0.4250	-0.3419	-0.3537
Kurtosis	2.53	2.0114	1.8044	2.0080	1.7623	1.9544
Jarque-Bera	127946.1	119.59	121.733	127.99	149.964	119.54
Probability	0.000	0.000	0.000	0.000	0.0000	0.000
Sum	659835.6	111443.6	99139.58	112381.3	105712.3	102.712
Sum Sq. Dev.	1.93E+09	145943	1530240	1463564	1729106	9471.88
Observations	1800	1800	1800	1800	1800	1800

Source: Author's own Calculation

Figure 1 shows the distribution pattern of the variables and the pair-wise correlation midst variables. The highest positive correlation is shown by GI and RUL (0.980) followed by GI and COC (0.972), GI and VA (0.887) and GI and POL (0.846). Also, the positive correlation is shown by VA and COC (0.816), VA and POL (0.674), VA and RUL (0.838), POL and COC (0.801), RUL and COC (0.963) and RUL and POL (0.795) whereas POL along with VA doses not show strong positive correlation with the carbon dioxide emission.



Author's own representation

Principal Component Analysis Results

The Principal Component Analysis technique (PCA) is used to create governance index (GI) which remains the summative of six world governance indicators (COC, GE, POL, RQ, RUL and VA). The calculated variables are scaled from 0-1 where 0 is an indicator of the worse and 1 indicates the best. Table 1 represents the results of PCA where Comp1shows the highest Eigen value represent ting the correlation matrix value (5.26) and the value of variance proportion (0.878) explaining 87% of the overall variance. Similarly, Comp2 has the Eigen value (0.347) with the variance proportion (0.05) which shows 5% of the total variance. Further the comp (3, 4, 5, 6) has the Eigen value (0.22, 0.07, 0.04, 0.33) and explaining (3%, 1% 0.7% and 0.5%) of the total variance. Components 1 & 2 explain 93% of the overall variance, as per PCA results. Table 2 clearly explains the correlation amid components and the variables and the formed governance index (GI) once the analysis rotates its factors.

Table1: Principal Component Analysis

Components	Eigenvalue	Difference	Proportion	Cumulative
1	5.268	4.920	0.878	0.878
2	0.347	0.119	0.058	0.936
3	0.228	0.152	0.038	0.974
4	0.076	0.031	0.012	0.986
5	0.045	0.011	0.007	0.994

6	0.335		0.005	1.000

Author's own representation

Table 6: PCA Correlation amid Components and Variables:

Variables	Components						
	1	2	3	4	5	6	Unexplained
COC	0.423	0.008	-0.260	-0.549	-0.369	0.560	0
GE	0.422	-0.106	-0.324	-0.014	0.836	0.068	0
POL	0.368	0.868	0.299	0.136	0.042	0.008	0
RQ	0.418	-0.216	-0.203	0.783	-0.316	0.152	0
RUL	0.426	-0.052	-0.210	-0.236	-0.241	-0.810	0
VA	0.386	-0.429	0.807	-0.097	0.059	0.059	0

Author's own representation

Test for Panel Unit Root

The study has applied second generation unit root test to test for the cross-sectional dependency of the panel data to take advantage of prospective veiled features with and without trend. The results are shown in Table 3 that clearly gives us evidence that the variables convert into stationarity after the first difference with 1% significance level.

Table 3: Second Generation Panel Unit Root

CIPS					
Variables	Without Trend	With Trend		Without Trend	With Trend
Level	Zt-bar	Zt-bar	First Difference	Zt-bar	Zt-bar
CO_2	-0.318(0.37)	0.775(0.781)	ΔCO_2	-5.581*(0.000)	-8.419*(0.000)
COC	-1.293(0.098)	-1.025(0.153)	ΔCOC	-12.913*(0.000)	-9.098*(0.000)
POL	-0.412(0.340)	-0.141(0.444)	ΔPOL	-6.735*(0.000)	-2.799*(0.003)
RUL	0.112(0.545)	-1.099(0.136)	ΔRUL	-4.959*(0.000)	-9.916*(0.000)
VA	0.709(0.761)	3.215(0.999)	ΔVA	-5.995*(0.000)	-10.570*(0.000)
GI	0.657(0.744)	-1.055(0.146)	ΔGI	-5.540*(0.000)	-10.591*(0.000)

Note: *, **and *** imply significance levels at the 1, 5 and 10% levels, respectively

Panel Fixed Effect Analysis

The use of Hausman test is pragmatic to check if the fixed or random effect model is more to continue with the analysis. Table 4 confirms the results by testing the null hypothesis of the Hausman test states that the random effect model is more appropriate than the fixed effect model but the results of Table 4 confirms that the fixed effect model is more appropriate and thus rejecting the null-hypothesis as p-value being 0.009<0.05. Consequently, making FE model more appropriate for the regression analysis and the results are exhibited in Table 5. The study reveals that the variable control of corruption (COC), political stability (POL), rule of law (RUL) and voice and accountability (VA) performs a key role in prompting the developing economies and governance index (GI) formed using the six governance variables will impact the carbon emission of the developing economies. The result of Table 5 confirms that governance index (GI) has a negative and significant influence on the carbon emission (CO_2) at1% level of significance. In terms of sustainability accounting, the above finding implies that enhanced governance enhances environmental responsibility and disclosure reliability due to the strengthening of institutional monitoring and enforcement. Better governance minimises the opportunities of the symbolic environmental reporting and increases the credibility of the reported environmental information. Further the variable control of corruption (COC), political stability (POL) and rule of law (RUL) will have negative impact on the carbon emission (CO_2) of the developing economies. These findings suggest that the governance aspects enhance sustainability accounting accountability by curbing opportunism, enhancing identical implementation of environmental reporting guidelines, and augmenting regulatory compliance. The high rule of law and corruption control minimizes the chances of greenwashing as legal and reputational penalties of false environmental disclosure increase. The F-statistics value is significant and the rho value is 0.47 implying that 47% of the model variance is owing to diversity across the panel. The total value of R-square is 0.02, (p-value=0.02<0.05) which is significant.

Table 4: Hausman test

Test Summary	Chi-Square value	p-value	Result
Cross-section Random	9.37	0.0095	Accepting the fixed effect model

Source: Author's own presentation

Table 5: Fixed effect Model

Variables	Coefficient	Std. Error	P-value
GI	-23.435*	8.018	0.004
COC	-0.843*	0.273	0.002
POL	-0.305***	0.163	0.062
RUL	-0.728**	0.362	0.045
VA	0.001	0.232	0.995
Constant	121.491*	42.58	0.004
R^2within	0.66		
Between	0.14		
Overall	0.02		
F Statistic	17.04 (0.00)		
Corr (u_i, Xb)	-0.3049		
Sigma_u	36.226		
Sigma_e	37.772		
Rho	0.4791		

Note: *, **and *** imply significance levels at the 1, 5 and 10% levels, respectively

Diagnostic Test for the Fixed Effect Model

Table 6 presents the results of the diagnostic tests, which include the cross-sectional dependence test, heteroscedasticity, and autocorrelation tests. To check for group-wise heteroscedasticity, the Modified Wald Test is applied in the FE regression, along with the Pesaran CD test to check for cross-sectional dependencies. The results of both models confirm the presence of both cross-sectional dependence and heteroscedasticity, whereas the Wooldridge test confirms the absence of autocorrelation. Therefore, to overcome heteroskedasticity as well as cross-sectional dependence, the Driscoll-Kraay (1998) standard error technique is used.

Table 6: Diagnostic Test

Test	**Statistic**	**p-value**	**Results**
Wald Test to test group-wise Heteroskedasticity	$Wald_x{}^2$=3.2e+07	0.000	Existence of Heteroskedasticity
Cross-sectional dependence	Pesaran CD =13.308 The average absolute value = 0.223	0.000	Existence of cross-sectional dependence
Wooldridge test for autocorrelation in panel data	F(1, 74) = 57.917	0.000	No autocorrelation

Source: Author's own depiction and *, **and *** imply significance at the 1, 5 and 10% levels, respectively.

Table 7: Driscoll-Kraay standard error with fixed effect

Variables	Coefficient	Driscoll/Kraay Std. Error	P-value
GI	-23.583**	10.626	0.037
COC	-0.863**	0.334	0.017
POL	-0.320***	0.173	0.078
RUL	-0.728***	0.380	0.068
VA	0.001	0.264	0.995
Constant	121.491**	52.684	0.031
Within R-Square	0.66		
F-Statistics	2.36		
P-Value	0.07		

Note: *, **and *** imply significance levels at the 1, 5 and 10% levels, respectively

The Driscoll-Kraay method is used as a remedy and is considered suitable for studies with a large time period. Furthermore, this method is elastic and exclusive of any assumptions. Table 7 presents the results of Driscoll-Kraay (1998) with the standard error and fixed effect. The results confirm that the governance index has a negative and significant impact on carbon dioxide emissions at the 5% level of significance. The robustness of this result

supports the view that governance-driven accountability and disclosure enforcement mechanisms play a stable and persistent role in improving environmental reporting quality and outcomes. The results show that the variables COC, POL, and RUL will have a negative and significant impact on the carbon dioxide emission. The control of corruption, along with political stability, will have a vital influence on economic activity, which will have both direct and indirect impacts on developing economies. Beyond policy outcomes, this finding highlights the role of governance in strengthening environmental accountability and sustainability reporting credibility by improving regulatory oversight and enforcement.

Robustness analysis: FMOLS and DOLS Model

The study uses FMOLS as well as DOLS techniques to confirm the stability of variables (taking into consideration the signs), with the point of inference along with the robust analysis results which includes the degree of the fixed effect model (Christopoulou &Tsionas, 2004). Table 8 depicts the findings of both the FMOLS and the DOLS models.

The results indicate that the variable governance index (GI) will reduce the carbon dioxide emission (CO_2) which is significant (p-value<0.05). The implication of this finding in the long run would be that the quality of governance, which is sustained would reinforce the institutional reporting conditions to support credible sustainability accounting and environmental accountability. Stable governance reduces incentives for short-term symbolic compliance and supports substantive environmental disclosure practices. Furthermore, the results confirm that there is no variation in the extent of the coefficients, stability of variables, or in the significance level. The results confirm that COC negatively and significantly (p-value<0.05) impacts the carbon dioxide emission (CO_2). This implies that the better the corruption is controlled, the greater the credibility of the sustainability disclosures made because rent-seeking behaviour is limited and the effectiveness of the regulation is increased meaning that in the event that there is better control of corruption, there will be less carbon dioxide emissions and this will eventually lead to the quality of the environment as the rules and other environmental regulations have to be followed by the industries meaning that the environment will be less pressured. The results are consistent with those of Lui et al. (2020), and are also consistent with sustainability accounting literature emphasizing that credible environmental disclosure depends on governance quality, enforcement, and institutional accountability (Larrinaga, 2014; Lovell, 2010; Karim et al., 2021). The political stability showed a significant and negative impact on carbon dioxide emission (CO_2) which were consistent with the results of (Lui et al.,2020). The stability in the political environment will help in bringing the dioxide emission (CO_2) down but making polices that will favour the environment and reduce environmental degradation. The variable rule of law again will help in reducing the carbon dioxide emission (CO_2). Similarly, the results showed that the consistency is not considerable in the extent of the coefficients, stability of variables and their significance.

Governance Strengthening through Sustainability Reporting Credibility

Good governance increases the credibility of sustainability reporting through strengthening accountability, transparency and enforcement action in institutional reporting settings. Corruption and good rule of law are effective in mitigating the possibilities of symbolic compliance and greenwashing by ensuring that legal and reputational outcomes of deceptive environmental disclosures are higher. Political stability facilitates a steady implementation of the reporting standards over the years whereas voice and accountability allow the stakeholders to examine the environmental information. All these mechanisms combined are made to make sure that sustainability reporting is a substantive accountability tool and not a symbolic or reputational practice.

Table 8: FMOLS and DOLS Results

	FMOLS			DOLS		
Variables	Coefficient	Std. Error	P-value	Coefficient	Std. Error	P-value
GI	-.648**	1.175	0.024	-5.036***	1.529	0.001
COC	-0.991***	0.370	0.007	-0.148***	0.051	0.004
POL	-0.300**	0.225	0.018	-0.060**	0.027	0.030
RUL	-0.835*	0.479	0.081	-0.156***	0.058	0.008
VA	0.026	0.306	0.930	0.012	0.040	0.759
R-squared	0.464			0.462		
Adjusted R-Square	0.438			0.436		

Note: *, **and *** show the significance levels at the 1, 5 and 10% levels, respectively.

Implications for Sustainability Accounting and Environmental Accountability

These results have significant implications to sustainability accounting, environmental disclosure regulation, and assurance practices. The findings suggest that the quality of governance acts as a key institutional credential to successful sustainability reporting through enhancing accountability, transparency, and enforcement systems. Within a governance context where there is high institutional quality, sustainability accounting systems

will tend to generate credible and decision useful environmental information as opposed to symbolic or compliance motivated disclosures.

With better governance, the implementation of the ESG and environmental disclosure standards may be better enforced through greater regulatory control and institutional capacity. Proper management of corruption minimizes the incentives of opportunistic behavior and greenwashing, and enhances the reliability and credibility of reported environmental information. By limiting corruption, the accountability aspect of sustainability reporting is strengthened as the cost of misleading or selective environmental disclosure of the firms or the public institutions is increased by legal and reputational cost.

The effectiveness of the sustainability assurance and verification mechanisms is also enhanced by the rule of law that provides the disclosure violations to be enforced and punished. Assurance practices in this type of institutional setting have a greater likelihood to serve as substantive monitoring mechanisms, but not as symbolic legitimization mechanisms. Political stability helps in the consistent application of disclosure regulations over time whereas voice and accountability mechanisms help in transparency whereby stakeholders can scrutinize the environmental reporting.

VI. Conclusion

Governance plays a crucial role in the sustainable development of economies, not only at national levels but also internationally and globally. Sustainable development is a complex combination of various macroeconomic variables; however, the present study focuses on four governance variables and the governance index for the period 1996-2020.

The study begins by using the Pesaran (2007) test to check for stationarity, and it is found that stationarity is detected after the first difference. Furthermore, considering the Hausman test results, the fixed effects technique is considered more relevant than the random effects model. The study further uses the diagnostic to test the cross-sectional dependency and heteroskedasticity. After running the appropriate diagnostic test, the study employs Driscoll-Kraay's (1998) standard error method with fixed effects to address the issues of dependency and heteroskedasticity. In addition, the results of the FMOLS, along with the DOLS techniques, are used to test the magnitude and degree of the parameters in the model. The results confirm that governance indices, control of corruption, rule of law, and political stability will reduce carbon dioxide emissions and contribute to sustainable development. From a theoretical accounting perspective, this study contributes by conceptualizing governance quality as an institutional foundation for sustainability accounting accountability and credible environmental disclosure. The findings demonstrate that governance influences environmental outcomes not only through policy intent but through its role in shaping accountability structures, disclosure environments, and enforcement mechanisms that underpin sustainability reporting systems.

The environment plays a crucial role, and to achieve a sustainable environment, everyone must work together, which will help reduce carbon dioxide levels and protect the environment. The study has highlighted the significance of governance indicators and the importance of a sustainable environment for governance, control over corruption, stability in the political economy, and improved law and order. Future research may extend this line of inquiry by examining ESG disclosure quality, carbon reporting practices, and the adoption of sustainability assurance mechanisms at firm or sectoral levels. Further studies could also explore how variations in governance quality influence the credibility, comparability, and enforcement of environmental disclosures across institutional settings. All this will enhance growth.

References

1. Abbas, S., Kousar, S., Yaseen, M., Mayo, Z. A., Zainab, M., Mahmood, M. J., & Raza, H. (2020). Impact assessment of socioeconomic factors on dimensions of environmental degradation in Pakistan. *SN Applied Sciences*, *2*(3), 1-16.
2. Asongu, S. A., & Odhiambo, N. M. (2019). Inclusive development in environmental sustainability in sub-Saharan Africa: Insights from governance mechanisms. *Sustainable Development*, *27*(4), 713-724.
3. Baloch, M. A., Mahmood, N., & Zhang, J. W. (2019). Effect of natural resources, renewable energy and economic development on CO2 emissions in BRICS countries. *Science of the Total Environment*, *678*, 632-638.
4. Barbieri, L. (2009). Panel unit root tests under cross-sectional dependence: An overview. *Journal of Statistics: Advances in Theory and Applications*, *1*(2), 117-158.
5. Bumpus, A. G., & Liverman, D. M. (2008). Accumulation by decarbonization and the governance of carbon offsets. *Economic geography*, *84*(2), 127-155.
6. Driscoll, J. C., & Kraay, A. C. (1998). Consistent covariance matrix estimation with spatially dependent panel data. *Review of economics and statistics*, *80*(4), 549-560.
7. Gani, A. (2012). The relationship between good governance and carbon dioxide emissions: evidence from developing economies. *Journal of Economic Development*, *37*(1), 77.
8. Halkos, G. E., & Tzeremes, N. G. (2013). Carbon dioxide emissions and governance: a nonparametric analysis for the G-20. *Energy Economics*, *40*, 110-118.
9. Haseeb, M., Hassan, S., Azam, M., & Suryanto, T. (2018). The dynamics of governance, tourism and environmental degradation: the world evidence. *International Journal of Global Environmental Issues*, *17*(4), 340-363.
10. Hurlin, C., & Mignon, V. (2007). Second generation panel unit root tests.

11. Hussain, M. S., Nawaz, M. A., Ahmad, T. I., & Bhatti, M. A. (2021). Environmental Governance and Green Energy: An Administrative Toolkit to Reduce Environmental Degradation. *iRASD Journal of Management*, *3*(3), 329-338.
12. Intergovernmental Panel on Climate Change (Report on October 18, 2018; September, 2019)
13. Jordan, A., Wurzel, R. K., & Zito, A. R. (2003). 'New' instruments of environmental governance: Patterns and pathways of change.
14. Kao, C., & Chiang, M. H. (2001). On the estimation and inference of a cointegrated regression in panel data. In *Nonstationary panels, panel cointegration, and dynamic panels*. Emerald Group Publishing Limited. Bingley. Vol. 15, pp. 179-222. https://doi.org/10.1016/S0731-9053(00)15007-8
15. Karim, A. E., Albitar, K., &Elmarzouky, M. (2021). A novel measure of corporate carbon emission disclosure, the effect of capital expenditures and corporate governance. *Journal of Environmental Management*, *290*, 112581.
16. Kousar, S., Ahmed, F., López García, M. D. L. N., & Ashraf, N. (2020). Renewable energy consumption, water crises, and environmental degradation with moderating role of governance: Dynamic panel analysis under cross-sectional dependence. *Sustainability*, *12*(24), 10308.
17. Larrinaga, C. (2014). Carbon accounting and carbon governance. *Social and Environmental Accountability Journal*, *34*(1), 1-5.
18. Liu, T., Wang, Y., Song, Q., & Qi, Y. (2018). Low-carbon governance in China–Case study of low carbon industry park pilot. *Journal of Cleaner Production*, *174*, 837-846.
19. Lovell, H. C. (2010). Governing the carbon offset market. *Wiley Interdisciplinary Reviews: Climate Change*, *1*(3), 353-362.
20. Milledge, S., Gelvas, I. & Ahrends, A. (2007). Forestry, governance and national development: lessons learned from a logging boom in Southern Tanzania, *IUCN: International Union for Conservation of Nature*. Retrieved from https://policycommons.net/artifacts/1375933/forestry-governance-and-national-development/1990194/ on 18 Aug 2022. CID: 20.500.12592/bs965j.
21. Mineur, E. (2007). *Towards Sustainable Development: Indicators as a tool of local governance* (Doctoral dissertation, Statsvetenskap).
22. Okudo, A. G. (2021). Corporate governance and carbon disclosure practices of quoted manufacturing firms in Nigeria. *International Journal of Contemporary Research and Review*, *12*(07), 20409-20419.
23. Samargandi, N., Fidrmuc, J., & Ghosh, S. (2015). Is the relationship between financial development and economic growth monotonic? Evidence from a sample of middle-income countries. *World development*, *68*, 66-81.
24. Samimi, A. J., Ahmadpour, M., & Ghaderi, S. (2012). Governance and environmental degradation in MENA region. *Procedia-Social and Behavioral Sciences*, *62*, 503-507.
25. Sarwar, S., & Alsaggaf, M. I. (2021). The role of governance indicators to minimize the carbon emission: a study of Saudi Arabia. *Management of Environmental Quality: An International Journal*.
26. Sethi, N., & Dash, D. P. (2022). A Perspective on Energy Consumption Balance: Quality of Life, Governance, and Carbon Emissions in APEC. *Energy RESEARCH LETTERS*, *3*(Early View), 32621.
27. Sharif, A., Raza, S. A., Ozturk, I., & Afshan, S. (2019). The dynamic relationship of renewable and nonrenewable energy consumption with carbon emission: a global study with the application of heterogeneous panel estimations. *Renewable energy*, *133*, 685-691.
28. Solikhah, B., Wahyuningrum, I. F. S., Yulianto, A., Sarwono, E., &Widiatami, A. K. (2021). Carbon emission report: a review based on environmental performance, company age and corporate governance. In *IOP Conference Series: Earth and Environmental Science* (Vol. 623, No. 1, p. 012042). IOP Publishing.
29. Walker, G. (2011). The role for 'community'in carbon governance. *Wiley interdisciplinary reviews: climate change*, *2*(5), 777-782.
30. Wang, N., & Chang, Y. C. (2014). The development of policy instruments in supporting low-carbon governance in China. *Renewable and Sustainable Energy Reviews*, *35*, 126-135.
31. Yang, Y., & Khan, A. (2021). Exploring the role of finance, natural resources, and governance on the environment and economic growth in South Asian countries. *Environmental Science and Pollution Research*, *28*(36), 50447-50461.
32. Liu, X., Latif, K., Latif, Z., & Li, N. (2020). Relationship between economic growth and CO2 emissions: does governance matter? *Environmental Science and Pollution Research*, *27*(14), 17221-17228.
33. Pesaran, M. H. (2007). A simple panel unit root test in the presence of cross-section dependence. *Journal of applied econometrics*, *22*(2), 265-312.
34. Christopoulos, D. K., & Tsionas, E. G. (2004). Financial development and economic growth: evidence from panel unit root and cointegration tests. *Journal of development Economics*, *73*(1), 55-74.
35. Kazmi, R., Sajjad, S. K., Askari, S. F., & Rizvi, A. A. (2025). An analytical study of the non-performing asset (NPA) issue in Punjab National Bank: A pre-pandemic study. South Asian Journal of Social Studies and Economics, 22(6), 158–169. https://doi.org/10.9734/sajsse/2025/v22i61045
36. (HAL-05100435)
37. Kazmi, R., Sajjad, S. K., Askari Afser Rizvi, S. F., & Sajjad, S. K. (2025). Impact of shadow economy on Indian economy: Unraveling the problems and pitfalls. Empirical Economics Letters, 24(August Special Issue 2), 233–251. https://doi.org/10.5281/zenodo.16951109