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Transitioning towards Low Carbon Economy: Role of Renewable Energy, Economic Growth and FDI in Achieving SDGs

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ABSTRACT

As global concerns about environmental degradation continue to rise alongside rapid economic development, the United Nations introduced the sustainable development goals (SDGs) to address these challenges by 2030. This study examines the interconnections between economic growth, foreign direct investment (FDI), renewable energy, and environmental degradation, focusing specifically on SDGs 7, 8, 10, and 13. Using the generalized method of moments (GMM) technique, we analyze panel data from the G-10 countries for the period 2012-2020. The findings reveal that renewable energy contributes to reducing CO_2 emissions, thereby supporting the achievement of SDG 7 (affordable and clean energy) and SDG 13 (climate action). However, increases in FDI and economic growth are associated with higher CO_2 emissions. These results suggest that G-10 countries need to reassess their policies related to FDI and economic growth to ensure alignment with SDGs 8 (decent work and economic growth), 10 (reduced inequalities), and 13. Based on these findings, the study recommends policy adjustments for G-10 countries to better integrate sustainability into their economic strategies and contribute to global SDG targets.

Keywords: Environmental Sustainability, Financial Development, CO_2 Emissions, Economic Growth, Renewable Energy Use, Sustainable Development Goals

JEL Classifications: F0, O1, Q4

1. INTRODUCTION

Ahmed et al. (2022), Nawaz et al., (2025) and Zhao et al. (2022) highlight that the United Nations has established 17 global sustainable development goals (SDGs) to eradicate poverty, promote socio-economic well-being, and preserve the environment by 2030. Since our reliance on fossil fuels and other non-renewable energy sources is a primary driver of climate change, environmental degradation, and greenhouse gas emissions, a fundamental shift in energy generation and consumption is essential to achieving these goals (Arora and Mishra, 2019). Without transitioning to a low-carbon economy, achieving the SDGs will be challenging. While both developing and developed countries are committed to these goals, this research focuses specifically on the G-10 nations. As some of the world's most economically powerful countries, the G-10 significantly influences global environmental policies, economic trends, and financial frameworks. By analyzing how these countries have adapted to the SDGs, this study provides insights into their contributions toward achieving these goals by 2030.

This research concentrates on SDGs 7, 8, 10, and 13 due to their interconnected nature. SDG 7 focuses on affordable and clean energy, forming the foundation for examining the adoption and evolution of renewable energy in G-10 countries. SDG 8 emphasizes decent work and economic growth, allowing an exploration of the relationship between economic progress and environmental sustainability. SDG 10 aims to reduce inequalities within and between countries, highlighting the importance of equitable financial sector development. Finally, SDG 13 addresses climate action, with G-10 countries playing a pivotal role due to their substantial CO_2 emissions. The achievement of SDG 10 is closely linked to SDG 13, as reducing inequalities is essential for effective climate action. Similarly, progress toward SDG 8, which focuses on sustainable economic development, depends on minimizing environmental damage to support a low-carbon economy (Murshed and Dao, 2022). Naqvi et al. (2023) emphasize that renewable energy sources—such as solar, wind, hydro, and biomass—can significantly reduce pollution. Foreign direct investment (FDI) is also crucial for achieving SDG 13, as it can accelerate the transition to a low-carbon economy. The impact of FDI on SDG attainment depends on factors such as investment quality, origin, destination, and type (Kisswani and Zaitouni, 2023).

FDI offers several potential benefits, including the expansion of renewable energy, enhanced energy efficiency and productivity, job creation, increased revenue, and stimulation of innovation and competitiveness. However, it can also have negative effects, such as exacerbating environmental degradation, displacing local businesses and populations, increasing inequality and social conflict, and undermining local governance and sovereignty. Transitioning to a low-carbon economy involves substantial investments, technological advancements, policy reforms, and behavioral changes, all of which come with significant costs and trade-offs. Therefore, understanding the factors that influence the feasibility and attractiveness of this transition, as well as its implications for the SDGs, is crucial. This study aims to evaluate the progress of G-10 nations toward SDGs 7, 8, 10, and 13 through the lenses of renewable energy, economic growth, and FDI. Its uniqueness lies in a detailed examination of G-10 countries, exploring how these factors interact to support SDG achievement and reduce CO_2 emissions. While existing research often focuses on emerging or developing countries, there is insufficient data on how these elements interplay in industrialized economies. By addressing this knowledge gap, this paper contributes fresh perspectives and policy recommendations to help G-10 nations achieve the SDGs and transition to a sustainable, low-carbon future.

2. LITERATURE REVIEW

According to stakeholder theory (Freeman et al., 1984), society as a whole is also a key stakeholder. Therefore, while neoclassical theories emphasize labor and capital endowments for economic growth, their broader societal impacts cannot be overlooked. Previous research on reducing CO_2 emissions has investigated various factors across different timeframes and methodologies. Regarding the relationship between CO_2 emissions and economic growth, extensive research has established that economic expansion often exacerbates environmental degradation (Suleman, S., 2024; Schell and Rousham, 2022). Many studies exploring this relationship rely on the Environmental Kuznets Curve (EKC) hypothesis, which suggests a U-shaped relationship between economic growth and environmental degradation. However, the findings remain inconclusive. For instance, Ozturk et al. (2023) validated the U-shaped EKC for South Asia using FMOLS and DOLS methods, whereas Tabash et al. (2023) found no evidence supporting the EKC hypothesis for GCC countries. A notable limitation of the EKC framework is its tendency to overlook the potential causal effects that CO_2 emissions may exert on economic growth (Guang-Wen et al., 2023).

Beyond the EKC framework, several studies have examined the CO_2-emissions-economic growth relationship using alternative approaches. For example, Jebabli et al. (2023) applied the Quantile-Vector Autoregression (Q-VAR) method to G-7 countries, analyzing asymmetric connections over a 202 years from 1820-2021. They found that CO_2 emissions initially acted as net receivers but later became net transmitters. Similarly, Schroder and Storm (2020) used a fixed-effects model across 58 countries and concluded that higher GDP leads to increased consumption-based CO_2 emissions. Other studies also confirm a positive correlation between economic growth and harmful emissions, including research on 39 developing countries (Haldar et al., 2021), Southeastern Europe (Mitić et al., 2024), South Africa (Saba, 2023), and the United States (Salari et al., 2021).

Numerous studies have also investigated the role of renewable energy in promoting environmental sustainability. For instance, Xu et al. (2022) employed non-linear Autoregressive Distributed Lag (NARDL) and two-stage least squares (2SLS) methods for G-7 countries (1986-2019), offering policy insights into renewable energy consumption. Suki et al. (2022) analyzed the relationship between CO_2 emissions, renewable energy, and technological innovation in Malaysia, confirming the significant role of renewable energy in reducing emissions. Similar findings have been reported for MINT economies (Li et al., 2022), G20 countries (Zhang et al., 2022), the MENA region (Charfeddine and Kahia, 2019), and South Asia (Rahman and Velayutham, 2020). The relationship between foreign direct investment (FDI) and CO_2 emissions has also received considerable attention. For example, Saidi et al. (2020), Xue et al., 2021, Muhammad and Khan (2019), and Ekwueme and Zoaka (2020) explored this linkage extensively. Luo et al. (2022) examined the dynamic impact of FDI on emissions in China, India, and Singapore, finding that FDI fosters economic growth but increases pollution. Similarly, Huang et al. (2022) used panel data from G-20 countries and applied the feasible generalized least squares (FGLS) method, concluding that FDI inflows are positively associated with higher CO_2 emissions.

Despite the extensive body of research, the causal relationships among these variables—particularly within the context of SDG goals in G-10 countries—remain underexplored. To develop effective policies for the G-10 nations, it is essential to understand the interplay between renewable energy, economic growth, and FDI, and their impact on CO_2 emissions, while aligning with specific SDGs. Table 1 summarizes recent studies that investigate these variables using various statistical techniques and datasets, highlighting key insights and knowledge gaps that this research aims to address.

Table 1: Summary of recent related studies

Authors	Time period	Methodology	Sample countries	Findings
Economic growth and CO_2 emissions				
(Ahmad et al., 2023)	1990-2018	DOLS	E-7	EG→ (+) CO_2
(Liu et al., 2023)	1990-2018	AMG, CCMEG	South Eastern European countries	EG→ (+) CO_2
(Adebayo, 2023)	1970-2020	WLMC	China	EG→ (+) CO_2
(Li et al., 2023)	1977-2021	ARDL	Pakistan	EG→ (+) CO_2
(Umair et al., 2023)	1991-2018	PMG-ARDL, FOMLS, DOLS	50 countries	EG→ (+) CO_2
(Khan et al., 2023)	1985-2013	GMM	Belt and Road countries	EG→ (+) CO_2
(Naseem et al., 2023)	2000-2019	DOLS, Quantile Regression	BRICS	EG→ (+) CO_2
(Huang and Ren, 2024)	2001-2022	DHG causality test	160 countries	EG→ (+) CO_2
Renewable energy and CO_2 emissions				
(Rehman et al., 2023)	1985-2022	NARDL	global	RE→ (−) CO_2
(He et al., 2023)	1990-2020	AMG/CCMG	China	RE→ (−) CO_2
(Zhang et al., 2023)	1975-2020	AMGH	Asian emerging economies	RE→ (−) CO_2
(Raihan, 2023)	1990-2020	DOLS	Chile	RE→ (−) CO_2
(Sharif et al., 2023)	1995-2018	CS-ARDLA	ASEAN countries	RE→ (−) CO_2
(Usman et al., 2023)	1990-2017	MM-QR	OECD	RE→ (−) CO_2
(Apergis et al., 2023)	1985-2020	ARDL	Uzbekistan	RE→ (−) CO_2
(AlNemer et al., 2023)	1963-2020	Wavelet coherence analysis	KSA	RE→ (−) CO_2
(Adebayo and Ullah, 2024)	1990-2020	WTC, WC, WTC	Sweden	RE→ (−) CO_2
(Alam et al., 2023)	1990-2018	Regression	India	RE→ (−) CO_2
Financial development and CO_2 emissions				
(Hasni et al., 2023)	2000-2019	PMG-ARDL	APEC countries	FDI → (+) CO_2
(Khan et al., 2023)	2000-2016	P-VECM	108 developing countries	FDI → (+) CO_2
(Mahmood et al., 2023)	1995-2020	SAR	MENA	FDI → (+) CO_2
(Iqbal et al., 2023)	2000-2018	ARDL, PMG	MENA	FDI → (+) CO_2
(Abbas et al., 2023)	2006-2020	SAR model	45 South Saharan African (SSA)	FDI → (+) CO_2
(Chi and Meng, 2023)	2003-2017	China	POLS	FDI → (+) CO_2
(Guo and Yin, 2024)	1990-2022	China	NARDL	FDI → (+) CO_2
(Boubacar et al., 2024)	2004-2020	54 African countries	GMM	FDI → (+) CO_2
(Akhtar et al., 2023)	1980-2019	Malaysia	NARDL	FDI → (+) CO_2
(Apergis et al., 2023)	1993-2012	BRICS OECD	GMM	FDI → (+) CO_2

(+) and (−) sign indicate the direction of effect
FDI: Foreign direct investment, GMM: Generalized method of moments

3. DATA AND METHODOLOGY

3.1. Samples

In this study, environmental quality is the dependent variable, measured by CO_2 emissions (metric tons per capita). The independent variables include renewable energy (RE), economic growth (GDP per capita), and foreign direct investment (FDI). The analysis uses panel data from G-10 countries covering the period from 2012 to 2020. The choice of G-10 countries is significant because these nations are among the world's leading economies, with substantial impacts on global economic and environmental policies. Notably, the United States is the second-largest CO_2 emitter after China, while the other G-10 countries also play crucial roles in the global economy and contribute significantly to greenhouse gas emissions. Table 2 provides a detailed summary of all variables and data sources used in this study. Figures 1-4 illustrate the trends of these variables over the sample period, showing a general increase in economic development, CO_2 emissions, and renewable energy usage. In contrast, foreign direct investment exhibits fluctuations across some G-10 countries during the same period. Additionally, Figure 5 visually represents the geographical distribution of G-10 countries on a world map.

Table 3 presents the descriptive statistics for the panel data. The mean values of the variables are as follows: LnEQ (1.92), RE (2.65), GDP growth (0.684), and FDI growth (6.202). The

Table 2: Variable description

Variable	Indicators	Source
Environmental quality	CO_2 emissions (mt per capita)	World development indicators
Renewable energy	%age of total final energy consumption	World development indicators
Economic growth	GDP per capita	World development indicators
Foreign direct investment	FDI	World development indicators

FDI: Foreign direct investment

Figure 1: Trend of CO_2 emissions in the G-10 countries

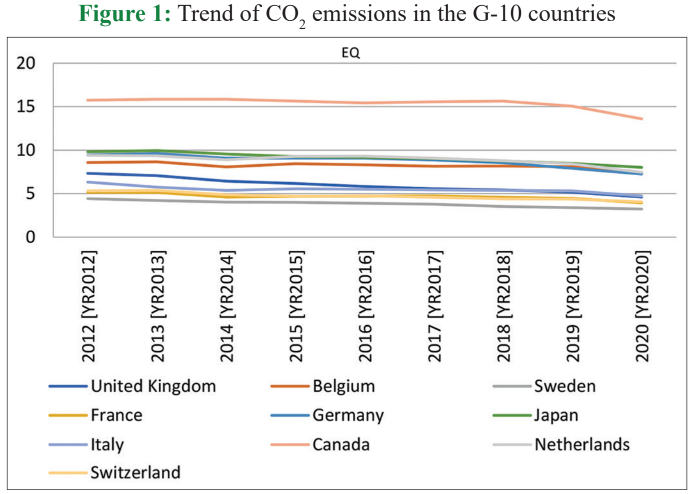


Figure 2: Trend of economic development in the G-10 countries

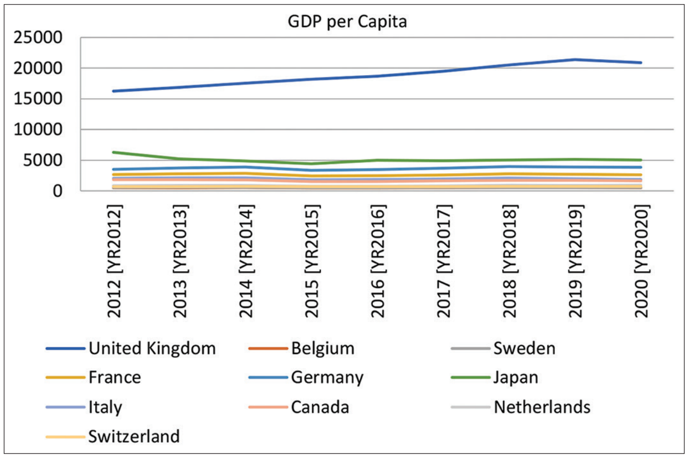


Figure 3: Trend of renewable energy consumption in the G-10 countries

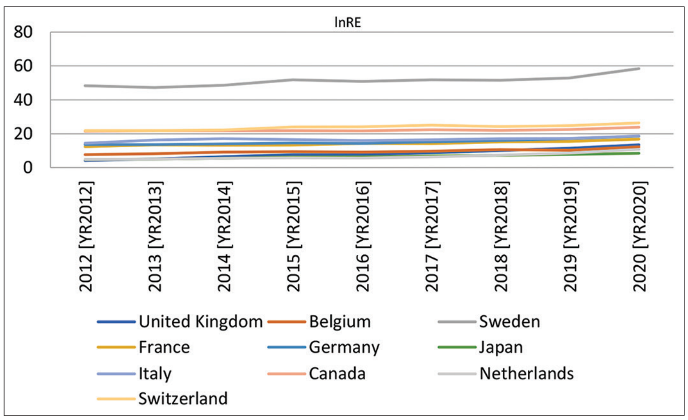
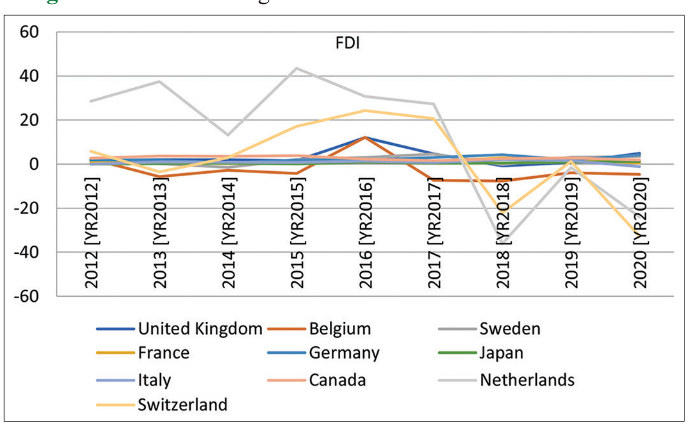


Figure 4: Trend of foreign direct investment in the G-10 countries



standard deviation values indicate that FDI growth exhibits the highest variability, which is also reflected in Figure 4, where an inconsistent pattern is observed across the sample period. To ensure reliable analysis, it is crucial to check the stationarity of the data and avoid issues related to variable amalgamation. Unit root tests, specifically the Augmented Dickey-Fuller (ADF) and Levin-Lin-Chu (LLC) tests, were applied to assess stationarity. The results, summarized in Table 4, confirm that all the data series are stationary at the first difference level, with significance at the 5% level.

Table 3: Descriptives statistics

Variables	Mean	Minimum	Maximum	Standard deviation
LnEQ	1.928388	1.176495	2.763307	0.412622
REg	2.654703	1.543298	4.067316	0.640975
GDPgr	0.684580	−11.03086	4.489282	2.614082
FDIg	6.202079	−27.90604	4.489282	57.90419

Table 4: Unit root tests

Variables	LLC-test	ADF-test
LnEQ	0.0000***	0.0292***
REg	0.0001***	0.0350***
GDPgr	0.0000***	0.0042***
FDIg	0.0000***	0.0000***

LLC: Levin-Lin-Chu, ADF: Augmented Dickey-Fuller

3.2. Methodology

The variables used in this study such as CO_2 emissions, renewable energy, economic growth and foreign direct investment are country specific variables. Hence the use of time-series or cross-sectional analysis will not give effective results and may obscure the actual effect among the variables. On the other hand, panel data reduces the chances of collinearity among variables and degree of freedom, thereby improving the validity of estimation (Sun and Chen, 2022). Therefore, this study uses panel dataset for analysis. The generalized method of moments (GMM) technique is used to deal with the problem of endogeneity. The GMM model proposed by Arellano and Bond (1991) could be mathematically expressed as:

$$Y_{i,t} = \alpha Y_{i,t\text{-}1} + \beta \sum X_{i,t} + \mu_i + \varepsilon_{i,t} \tag{1}$$

In the above equation, $Y_{i,t}$ is the explained variable, whereas, $Y_{i,t\text{-}1}$ is the lagged term of explained variable which is being used as explanatory variable, $\sum X_{i,t}$ represents other explanatory variables. μ_i represents unobservable individual effect and $\epsilon_{i,t}$ denotes the random error term. This study uses renewable energy, economic development and foreign direct investment as predictors of examining environmental quality in G-10 countries. The GMM equation is as follows:

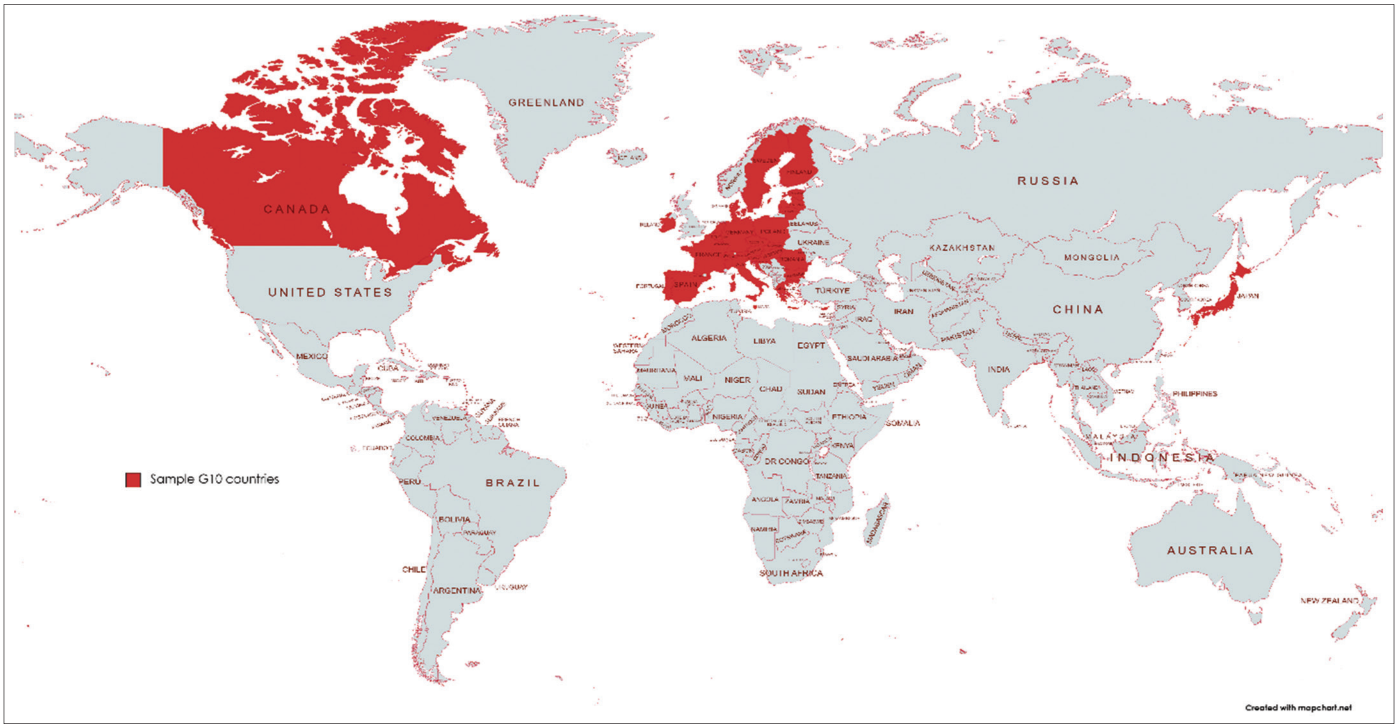
$$lnEQ_{i,t} = \beta_1\, lnEQ_{i,t\text{-}1} + \beta_2\, REg_{i,t} + \beta_3\, GDPg_{i,t} + \beta_3\, FDIg_{i,t} + \epsilon_{i,t} \tag{2}$$

In the above equation, Ln$EQ_{i,}$ depicts environmental quality, $EQ_{i,t-1}$ shows the lagged term of environmental quality, $\beta_i(i = 1,...., 3)$ shows the coefficient of each variable, $REg_{i,t}$ denotes renewable energy, $GDPg_{i,t}$ represents the gross domestic product finance whereas $FDIg_{i,t}$ measures foreign direct investment in the model.

4. RESULTS AND DISCUSSION

The results of empirical analysis align with the SDG7 (affordable and clean energy), SDG8 (economic growth), SDG10 (reduced inequalities) and SDG13 (climate action). The findings of the study indicate that all the explanatory variables have significant effect on environmental quality. The results for GMM estimation are shown in Table 3. Sargan test has a P = 0.154078 (>0.05) indicating that null hypothesis of Sargan test cannot be rejected. Furthermore, the coefficients of all the explanatory variables are significant. For

Figure 5: Map of G-10 countries



Source: Author's own representation

renewable energy, $\beta_{reg} = -0.233041$. Here the negative sign indicates that with 1% increase in renewable energy there is 0.233% decrease in CO_2 emissions hence helping in environmental sustainability. These results are consistent with prior studies on various datasets such as (Osman et al., 2023; Pata and Kartal, 2023; Bei and Wang, 2023). The results confirm that G-10 countries are playing a vital part in achieving SDG7 goal of affordable and clean energy.

The economic growth and foreign direct investment on the other hand show positive coefficients ($\beta_{gdp} = 0.00953$ and $\beta_{fdi} = 0.00147$) indicating that with 1% increase in GDP there is 0.00953% increase in CO_2 emissions, similarly, 1% increase in FDI causes 0.0014% increase in CO_2 emissions. It shows that as the economic development increases in the form of higher GDP and increased FDI, the environmental pollution also increases. These results are consistent with (Rauf et al., 2023; Ren et al., 2023; Djellouli et al., 2022) and show the role of G-10 countries in achieving SDG8 and SDG10 where the focus is sustainable economic growth and improved regulation of financial markets.

The results confirm the importance of renewable energy in achieving SDG13 by creating resilience again climate related disasters, as the negative sign indicates a reduction in CO_2 emissions in the G-10 countries with the usage of renewable energy resources. These results are consistent with theory and prior literature (Tariq and Hassan, 2023; Raihan and Tuspekova, 2022; Djellouli et al., 2022; Mujtaba et al., 2022). The robustness of GMM methodology was further cross checked by applying Dynamic OLS (DOLS) and the corresponding results are shown in Table 5. The estimation results of DOLS also show the same results as GMM (Table 6). Renewable energy shows significant and negative relation with CO_2 emissions showing that increase in RE causes decrease in emissions. Whereas economic growth and FDI show a positive and significant relationship with CO_2 emissions.

Table 5: GMM estimation results

Variables	Results
LnEQ(−1)	0.748151***
REg	−0.233041***
GDPgr	0.009535***
FDIg	0.001472***
Sargan test	0.154078
AR (1)	0.0043
AR (2)	0.3655

***P<0.001, **P<0.05, ***P<0.01

Compiled by author, based on EViews 12 software

GMM: Generalized method of moments

Table 6: DOLS estimation results

Variables	Results
LnEQ(−1)	1.012395***
REg	−0.006160**
GDPgr	0.008661***
FDIg	0.000063***
Sargan test	0.190574
C	−0.004870

***P<0.001, **P<0.05, ***P<0.01

Compiled by author, based on EViews 12 software

5. CONCLUSION

Amid growing concerns over environmental degradation caused by rapid economic growth, the United Nations has introduced 17 sustainable development goals (SDGs) to address these challenges. This study examines the impact of renewable energy, economic growth, and foreign direct investment (FDI) on environmental sustainability within the framework of the SDGs in G-10 countries. These nations, as leading global economies and signatories to the SDG agreement, hold a pivotal role in achieving these goals. The findings highlight that achieving sustainable economic growth (SDG8) necessitates integrating environmental sustainability into growth-enhancing policies. Specifically, greater emphasis must be placed on renewable energy transition projects. While G-10 countries are transitioning toward renewable energy sources, the trends illustrated in Figure 3 show that the increase in renewable energy consumption remains modest. Instead, non-renewable energy sources continue to dominate, contributing significantly to greenhouse gas emissions. This contrasts with the study's findings, which underscore the critical role of renewable energy in reducing CO_2 emissions. These findings align with SDG7, emphasizing the need for G-10 countries to accelerate their shift to renewable energy while reducing reliance on fossil fuels.

Additionally, the results regarding FDI open a discussion on reshaping foreign investment strategies and financial markets to support SDG10. Policies must ensure that FDI mechanisms and financial systems benefit broader populations and do not contribute to the production or trade of environmentally harmful commodities. Based on these findings, several policy recommendations are proposed to help G-10 countries achieve their SDG targets by 2030: Achieving SDG8: Future economic growth strategies must address environmental concerns alongside economic and financial development. As most G-10 countries rely heavily on non-renewable energy sources, both domestically and internationally, it is essential to adopt a more environmentally sustainable growth model.

Addressing SDG10: FDI frameworks and financial markets must be restructured to ensure inclusive benefits for the majority of the population. It is equally crucial to monitor FDI and financial market activities to prevent investments that exacerbate environmental degradation through the production or trade of unclean commodities. Attaining SDG13: Environmental sustainability can be achieved by integrating green policies into current and future economic growth strategies. Transitioning to renewable energy poses challenges for G-10 countries due to their traditional dependence on non-renewable resources. To overcome these challenges and achieve SDG13, SDG10, SDG7, and SDG8, the following steps are recommended: (1) Liberalize interest rates for innovative green energy projects to encourage development in the renewable energy sector. (2) Subsidize green energy initiatives to attract more investments in renewable energy projects. (3) These measures will not only increase demand for renewable energy but also improve per capita income in G-10 countries. (4) Strengthen financial sectors by introducing green credit policies and providing low-interest loans for clean energy projects. (5) Implement clear and actionable policies aimed at reducing CO_2 emissions and combating environmental degradation. By adopting these strategies, G-10 countries can make significant progress toward achieving their SDG targets while fostering sustainable economic and environmental growth.

REFERENCES

Abbas, S.J., Iqbal, A., Hussain, M.M., Anwar, A. (2023), The environmental cost of FDI and spatial implications of CO2 emissions in Sub-Saharan Africa. Environmental Science and Pollution Research, 30(29), 74441-74451.

Adebayo, T.S. (2023), Trade-off between environmental sustainability and economic growth through coal consumption and natural resources exploitation in China: New policy insights from wavelet local multiple correlation. Geological Journal, 58(4), 1384-1400.

Adebayo, T.S., Ullah, S. (2024), Towards a sustainable future: The role of energy efficiency, renewable energy, and urbanization in limiting CO_2 emissions in Sweden. Sustainable Development, 32(1), 244-259.

Ahmed, Z., Ahmad, M., Murshed, M., Shah, M.I., Mahmood, H., Abbas, S. (2022), How do green energy technology investments, technological innovation, and trade globalization enhance green energy supply and stimulate environmental sustainability in the G7 countries? Gondwana Research, 112, 105-115.

Ahmad, M., Ahmed, Z., Khan, S.A., Alvarado, R. (2023), Towards environmental sustainability in E-7 countries: Assessing the roles of natural resources, economic growth, country risk, and energy transition. Resources Policy, 82, 103486.

Akhtar, R., Masud, M.M., Al-Mamun, A., Saif, A.N.M. (2023), Energy consumption, CO_2 emissions, foreign direct investment, and economic growth in Malaysia: An NARDL technique. Environmental Science and Pollution Research, 30(22), 63096-63108.

Alam, M.S., Duraisamy, P., Siddik, A.B., Murshed, M., Mahmood, H., Palanisamy, M., Kirikkaleli, D. (2023), The impacts of globalization, renewable energy, and agriculture on CO_2 emissions in India: Contextual evidence using a novel composite carbon emission-related atmospheric quality index. Gondwana Research, 119, 384-401.

AlNemer, H.A., Hkiri, B., Tissaoui, K. (2023), Dynamic impact of renewable and non-renewable energy consumption on CO_2 emission and economic growth in Saudi Arabia: Fresh evidence from wavelet coherence analysis. Renewable Energy, 209, 340-356.

Apergis, N., Kuziboev, B., Abdullaev, I., Rajabov, A. (2023), Investigating the association among CO_2 emissions, renewable and non-renewable energy consumption in Uzbekistan: An ARDL approach. Environmental Science and Pollution Research, 30(14), 39666-39679.

Apergis, N., Pinar, M., Unlu, E. (2023), How do foreign direct investment flows affect carbon emissions in BRICS countries? Revisiting the pollution haven hypothesis using bilateral FDI flows from OECD to BRICS countries. Environmental Science and Pollution Research, 30(6), 14680-14692.

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.

Arora, N.K., Mishra, I. (2019), United nations sustainable development goals 2030 and environmental sustainability: Race against time. Environmental Sustainability, 2(4), 339-342.

Bei, J., Wang, C. (2023), Renewable energy resources and sustainable development goals: Evidence based on green finance, clean energy and environmentally friendly investment. Resources Policy, 80, 103194.

Boubacar, S., Sarpong, F.A., Nyantakyi, G. (2024), Shades of sustainability: Decoding the impact of foreign direct investment on CO_2 emissions in Africa's growth trajectory. Environment, Development and Sustainability. Germany: Springer. p1-34

Chi, F., Meng, Z. (2023), The effects of ICT and FDI on CO_2 emissions in China. Environmental Science and Pollution Research, 30(2), 3133-3145.

Djellouli, N., Abdelli, L., Elheddad, M., Ahmed, R., Mahmood, H. (2022), The effects of non-renewable energy, renewable energy, economic growth, and foreign direct investment on the sustainability of African countries. Renewable Energy, 183, 676-686.

Ekwueme, D.C., Zoaka, J.D. (2020), Effusions of carbon dioxide in MENA countries: Inference of financial development, trade receptivity, and energy utilization. Environmental Science and Pollution Research, 27(11), 12449-12460.

Freeman, R.E., Harrison, J.S., Wicks, A.C., Parmar, B.L., De Colle, S. (2010), Stakeholder theory: The state of the art. The Academy of Management Annals, 4(1), 403-445.

Guang-Wen, Z., Murshed, M., Siddik, A.B., Alam, M.S., Balsalobre-Lorente, D., Mahmood, H. (2023), Achieving the objectives of the 2030 sustainable development goals agenda: Causalities between economic growth, environmental sustainability, financial development, and renewable energy consumption. Sustainable Development, 31(2), 680-697.

Guo, Q., Yin, C. (2024), Fintech, green imports, technology, and FDI inflow: Their role in CO_2 emissions reduction and the path to COP26: A comparative analysis of China. Environmental Science and Pollution Research, 31(7), 10508-10520.

Haldar, A., Sethi, N. (2021), Effect of institutional quality and renewable energy consumption on CO2 emissions-an empirical investigation for developing countries. Environmental Science and Pollution Research, 28(12), 15485-15503.

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, 30(35), 83198-83213.

He, J., Iqbal, W., Su, F. (2023), Nexus between renewable energy investment, green finance, and sustainable development: Role of industrial structure and technical innovations. Renewable Energy, 210, 715-724.

Huang, Y., Chen, F., Wei, H., Xiang, J., Xu, Z., Akram, R. (2022), The impacts of FDI inflows on carbon emissions: Economic development and regulatory quality as moderators. Frontiers in Energy Research, 9, 820596.

Huang, Z., Ren, X. (2024), Impact of natural resources, resilient economic growth, and energy consumption on CO_2 emissions. Resources Policy, 90, 104714.

Iqbal, A., Tang, X., Rasool, S.F. (2023), Investigating the nexus between CO_2 emissions, renewable energy consumption, FDI, exports and economic growth: Evidence from BRICS countries. Environment, Development and Sustainability, 25(3), 2234-2263.

Jebabli, I., Lahiani, A., Mefteh-Wali, S. (2023), Quantile connectedness between CO2 emissions and economic growth in G7 countries. Resources Policy, 81, 103348.

Khan, I., Zhong, R., Khan, H., Dong, Y., Nuţă, F.M. (2023), Examining the relationship between technological innovation, economic growth and carbon dioxide emission: Dynamic panel data evidence. In: Environment, Development and Sustainability. Germany: Springer. p1-20.

Khan, M., Rana, A.T., Ghardallou, W. (2023), FDI and CO_2 emissions in developing countries: The role of human capital. Natural Hazards (Dordrecht), 117(1), 1125-1155.

Kisswani, K.M., Zaitouni, M. (2023), Does FDI affect environmental degradation? Examining pollution haven and pollution halo hypotheses using ARDL modelling. Journal of the Asia Pacific Economy, 28(4), 1406-1432.

Li, S., Yu, Y., Jahanger, A., Usman, M., Ning, Y. (2022), The impact of green investment, technological innovation, and globalization on CO2 emissions: Evidence from MINT countries. Frontiers in Environmental Science, 10, 868704.

Li, X., Wang, F., Al-Razgan, M., Awwad, E.M., Abduvaxitovna, S.Z., Li, Z., Li, J. (2023), Race to environmental sustainability: Can structural change, economic expansion and natural resource consumption affect environmental sustainability? A novel dynamic ARDL simulations approach. Resources Policy, 86, 104044.

Liu, M., Chen, Z., Sowah, J.K. Jr., Ahmed, Z., Kirikkaleli, D. (2023), The dynamic impact of energy productivity and economic growth on environmental sustainability in South European countries. Gondwana Research, 115, 116-127.

Luo, Y., Guo, C., Ali, A., Zhang, J. (2022), A dynamic analysis of the impact of FDI, on economic growth and carbon emission, evidence from China, India and Singapore. Environmental Science and Pollution Research, 29(54), 82256-82270.

Mahmood, H., Saqib, N., Adow, A.H., Abbas, M. (2023), FDI, exports, imports, and consumption-based CO_2 emissions in the MENA region: Spatial analysis. Environmental Science and Pollution Research, 30(25), 67634-67646.

Mitić, P., Fedajev, A., Radulescu, M., Hudea, O.S., Streimikiene, D. (2024), Fostering green transition in Central and Eastern Europe: Carbon dioxide emissions, industrialization, financial development, and electricity nexus. Technological and Economic Development of Economy, 30(4), 1009-1036.

Muhammad, B., Khan, S. (2019), Effect of bilateral FDI, energy consumption, CO2 emission and capital on economic growth of Asia countries. Energy Reports, 5, 1305-1315.

Mujtaba, A., Jena, P.K., Bekun, F.V., Sahu, P.K. (2022), Symmetric and asymmetric impact of economic growth, capital formation, renewable and non-renewable energy consumption on environment in OECD countries. Renewable and Sustainable Energy Reviews, 160, 112300.

Murshed, M., Dao, N.T.T. (2022), Revisiting the CO_2 emission-induced EKC hypothesis in South Asia: The role of export quality improvement. GeoJournal, 87(2), 535-563.

Naqvi, S.A.A., Hussain, M., Hussain, B., Shah, S.A.R., Nazir, J., Usman, M. (2023), Environmental sustainability and biomass energy consumption through the lens of pollution Haven hypothesis and renewable energy-environmental Kuznets curve. Renewable Energy, 212, 621-631.

Naseem, S., Hu, X., Shi, J., Mohsin, M., Jamil, K. (2023), Exploring the optical impact of information communication technology and economic growth on CO_2 emission in BRICS countries. Optik, 273, 170339.

Osman, A.I., Chen, L., Yang, M., Msigwa, G., Farghali, M., Fawzy, S., & Yap, P.S. (2023), Cost, environmental impact, and resilience of renewable energy under a changing climate: A review. Environmental Chemistry Letters, 21(2), 741-764.

Ozturk, I., Farooq, S., Majeed, M.T., Skare, M. (2023), An empirical investigation of financial development and ecological footprint in South Asia: Bridging the EKC and pollution haven hypotheses. Geoscience Frontiers, 15, 101588.

Pata, U.K., Kartal, M.T. (2023), Impact of nuclear and renewable energy sources on environment quality: Testing the EKC and LCC hypotheses for South Korea. Nuclear Engineering and Technology, 55(2), 587-594.

Rahman, M.M., Velayutham, E. (2020), Renewable and non-renewable energy consumption-economic growth nexus: New evidence from South Asia. Renewable Energy, 147, 399-408.

Raihan, A. (2023), Toward sustainable and green development in Chile: Dynamic influences of carbon emission reduction variables. Innovation and Green Development, 2(2), 100038.

Raihan, A., Tuspekova, A. (2022), Role of economic growth, renewable energy, and technological innovation to achieve environmental sustainability in Kazakhstan. Current Research in Environmental Sustainability, 4, 100165.

Rauf, A., Ali, N., Sadiq, M.N., Abid, S., Kayani, S.A., Hussain, A. (2023), Foreign direct investment, technological innovations, energy use, economic growth, and environmental sustainability nexus: New perspectives in BRICS economies. Sustainability, 15(18), 14013.

Rehman, A., Alam, M.M., Ozturk, I., Alvarado, R., Murshed, M., Işık, C., Ma, H. (2023), Globalization and renewable energy use: How are they contributing to upsurge the CO_2 emissions? A global perspective.

Environmental Science and Pollution Research, 30(4), 9699-9712.

Ren, S., Du, M., Bu, W., Lin, T. (2023), Assessing the impact of economic growth target constraints on environmental pollution: Does environmental decentralization matter? Journal of Environmental Management, 336, 117618.

Saba, C.S. (2023), Nexus between CO2 emissions, renewable energy consumption, militarisation, and economic growth in South Africa: Evidence from using novel dynamic ARDL simulations. Renewable Energy, 205, 349-365.

Saidi, S., Mani, V., Mefteh, H., Shahbaz, M., Akhtar, P. (2020), Dynamic linkages between transport, logistics, foreign direct Investment, and economic growth: Empirical evidence from developing countries. Transportation Research Part A: Policy and Practice, 141, 277-293.

Salari, M., Javid, R.J., Noghanibehambari, H. (2021), The nexus between CO2 emissions, energy consumption, and economic growth in the US. Economic Analysis and Policy, 69, 182-194.

Schell, L.M., Rousham, E.K. (2022), Environmental effects on growth. In: Human Growth and Development. United States: Academic Press. p261-315.

Schröder, E., Storm, S. (2020), Economic growth and carbon emissions: The road to "hothouse earth" is paved with good intentions. International Journal of Political Economy, 49(2), 153-173.

Sharif, A., Kartal, M.T., Bekun, F.V., Pata, U.K., Foon, C.L., Depren, S.K. (2023), Role of green technology, environmental taxes, and green energy towards sustainable environment: Insights from sovereign Nordic countries by CS-ARDL approach. Gondwana Research, 117, 194-206.

Suki, N.M., Suki, N.M., Sharif, A., Afshan, S., Jermsittiparsert, K. (2022), The role of technology innovation and renewable energy in reducing environmental degradation in Malaysia: A step towards sustainable environment. Renewable Energy, 182, 245-253.

Sun, H., Chen, F. (2022), The impact of green finance on China's regional energy consumption structure based on system GMM. Resources Policy, 76, 102588.

Tabash, M.I., Farooq, U., El Refae, G.A., Qasim, A. (2023), Exploring the carbon footprints of economic growth, foreign investment, energy dependency and financial development: Does EKC work in GCC region? Management of Environmental Quality: An International Journal, 34(2), 273-289.

Tariq, A., Hassan, A. (2023), Role of green finance, environmental regulations, and economic development in the transition towards a sustainable environment. Journal of Cleaner Production, 413, 137425.

Umair, M., Yousuf, M.U., Ul-Haq, J., Hussain, Z., Visas, H. (2023), Revisiting the environmental impact of renewable energy, non-renewable energy, remittances, and economic growth: CO_2 emissions versus ecological footprint for top remittance-receiving countries. Environmental Science and Pollution Research, 30(23), 63565-63579.

Usman, O. (2023), Renewable energy and CO_2 emissions in G7 countries: Does the level of expenditure on green energy technologies matter? Environmental Science and Pollution Research, 30(10), 26050-26062.

Xu, D., Sheraz, M., Hassan, A., Sinha, A., Ullah, S. (2022), Financial development, renewable energy and CO2 emission in G7 countries: New evidence from non-linear and asymmetric analysis. Energy Economics, 109, 105994.

Zhao, Z., Pan, Y., Zhu, J., Wu, J., Zhu, R. (2022), The impact of urbanization on the delivery of public service-related SDGs in China. Sustainable Cities and Society, 80, 103776.

Zhang, T., Yin, J., Li, Z., Jin, Y., Arshad, A., Jiang, B. (2023), A dynamic relationship between renewable energy consumption, non-renewable energy consumption, economic growth and CO_2 emissions: Evidence from Asian emerging economies. Frontiers in Environmental Science, 10, 1092196.