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(Review Article)

Urbanization, trade openness, and industrialization as a determent of clean energy consumption: Evidence from BRI nations

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Abstract

Energy and economic policies should include the intricate interconnections among urbanization, trade openness, industry, and the utilization of renewable energy. This study investigates the intricate connections among nations involved in the Belt and Road Initiative (BRI). The study employed panel econometric techniques, including DSUR, Cup-BC, and CUP-FM, to document independent variables' elasticities. Study findings suggest that urbanization is initially negatively correlated with renewable energy consumption (REC) because of the rising demand for energy, particularly non-renewable sources. Urbanization beyond a certain threshold fosters renewable energy, showcasing the positive effects of Renewable Energy Certificates (RECs). The influence of urbanization on energy use has changed throughout time. Furthermore, there is an initial positive relationship between trade openness and REC, indicating that adopting liberalized trade policies encourages the use of clean energy. Nevertheless, over time, this connection becomes less strong, suggesting a critical moment when the promotion of trade openness may lead to an increase in the use of non-renewable resources. Industrialization first stimulates the need for traditional energy sources but ultimately encourages using renewable energy. The U-invert connection demonstrates the interplay between industrialization and energy consumption patterns, emphasizing the need for flexible policies. Our study assists policymakers and stakeholders in effectively addressing energy sustainability concerns related to the Belt and Road Initiative (BRI).

Keywords: Urbanization; Trade Openness; Industrialization; Renewable energy consumption; BRI

1. Introduction

United Nations Sustainable Development Goals (SDGs) prioritize the provision of affordable and clean energy (SDG 7), the promotion of sustainable industrialization and infrastructure (SDG 9), and the development of sustainable cities and communities (SDG 11)[1-3]. The interconnected objectives emphasize the need for sustainable development, particularly within the context of the countries involved in the Belt and Road Initiative (BRI). The Belt and Road Initiative (BRI) is a significant worldwide development initiative that aims to enhance economic cooperation and connectivity among the participating nations. Understanding the impact of urbanization, trade openness, and industrialization on renewable energy consumption in these countries is crucial for this project. By examining these interconnections, the study aims to provide empirical evidence that may inform crucial decisions in advancing the adoption of renewable energy and mitigating ecological damage in Belt and Road Initiative (BRI) nations, eventually contributing to the development of a sustainable and environmentally friendly future[4-6].

As the world continues to grapple with the challenges of climate change, finding sustainable and clean energy sources has become a top priority. Recent decades have witnessed rapid urbanization, trade openness, and industrialization in the Belt and Road Initiative nations [7-11]. These factors have driven economic growth and raised concerns about their impact on the environment and energy consumption patterns. This study aims to explore the relationship between

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urbanization, trade openness, and industrialization with clean energy consumption in BRI nations. Understanding these determinants can provide valuable insights into crafting policies and strategies to promote sustainable energy practices in these regions. With a growing demand for energy and increasing awareness of environmental challenges, it is crucial to delve into this research area to pave the way for a cleaner and more sustainable energy future[12-15]. Given the increasing global focus on clean energy consumption and sustainable development, examining the factors influencing these practices in emerging economies is important. The completion should range from a few words to a full sentence. This study seeks to contribute to the existing literature by investigating how urbanization, trade openness, and industrialization impact clean energy consumption in BRI nations.

The research aims to investigate the factors that impact clean energy consumption in Belt and Road Initiative (BRI) nations. Urbanization, trade openness, and industrialization are crucial in influencing the adoption and use of clean energy sources. Studying the impact of urbanization, trade policies, and industrial growth on clean energy consumption is essential for sustainable energy planning and policy development, especially in nations experiencing rapid economic development and infrastructural changes. This study aims to examine the relationships within the context of BRI nations to offer empirical evidence that can guide strategic decisions to promote clean energy adoption and reduce environmental impacts. This study is motivated by the distinct socio-economic landscape of BRI nations, which includes varying levels of urbanization, trade dynamics, and industrial activities. It is crucial to comprehend how these factors influence clean energy consumption patterns to advance sustainable development and tackle global climate change challenges. This study makes a valuable contribution to energy economics and environmental sustainability by examining urbanization, trade openness, and industrialization as factors influencing clean energy consumption. The results of this study could assist policymakers, energy planners, and stakeholders in developing specific strategies to promote cleaner energy transitions in BRI nations, thereby supporting a more sustainable and environmentally aware future.

The rest of the article is structured as follows. Section II deals with the literature survey, data, and methodology of the study, which are available in Section III. Section IV reported the interpretation and discussion of the study findings. Conclusion and policy suggestions are available in Section V, respectively.

2. Literature review and hypothesis development

2.1. Urbanization influences renewable energy consumption

Delving into the intricate tapestry of urbanization and its profound impact on renewable energy consumption, the literature unveils a dynamic landscape shaped by multifaceted interplays between urban growth, energy demands, and sustainability imperatives. A nuanced understanding emerges through a comprehensive review of scholarly works across various disciplines, elucidating the intricate relationship between urbanization patterns and the adoption of renewable energy sources.[16-19]

Scholars have long scrutinized the repercussions of rapid urbanization on energy consumption, recognizing cities as epicenters of burgeoning energy demands. The surge in population density, infrastructural expansion, and economic activities within urban agglomerations engenders an insatiable appetite for energy, prompting a reevaluation of conventional energy paradigms[11, 20]. In this vein, scholars underscore the imperative of transitioning towards renewable energy sources to mitigate environmental degradation, alleviate energy insecurities, and foster sustainable urban development. Research findings indicate that urbanization wields a dual-edged sword in shaping renewable energy consumption, a phenomenon influenced by economic dynamics, energy efficiency initiatives, and policy frameworks. On the one hand, the urban landscape presents opportunities for heightened adoption of renewable energy sources, driven by embracing sustainable building practices, eco-conscious architectural designs, and integrating renewable technologies within urban settings. Think of it as cities embracing greener alternatives, like rooftop solar panels or wind turbines nestled among skyscrapers, to power their bustling cores[21-24].

Urban planners emerge as pivotal actors in this realm, crafting infrastructural blueprints that prioritize renewable energy infrastructure and champion resource-efficient solutions. Their designs lean towards efficient use of space, blending functionality with sustainability and incorporating water-saving measures to minimize environmental footprint. They are crafting cities that breathe with energy efficiency, where every nook and cranny is optimized to harness renewable power and minimize waste. However, the urbanization saga unveils its darker shades, too[25]. The surge in energy-intensive industries and the burgeoning demand for power-hungry services within urban territories can escalate overall energy consumption levels. Picture the rapid growth of factories and high-rise buildings gobbling up energy resources, contributing to the urban energy glut. Moreover, in developing regions like China, the urban sprawl exacerbates direct energy consumption, adding another layer to the energy conundrum.

Amidst this dynamic interplay, the literature underscores the indispensable role of supportive policies, collaborative endeavors, and public awareness campaigns in steering urban areas toward sustainable energy pathways. Governments are urged to craft incentives that incentivize energy-efficient building standards and enforce compliance with eco-friendly norms[26]. Collaboration becomes key as urban planners, architects, engineers, and construction experts come together, pooling their expertise to innovate and ensure eco-conscious practices pervade every aspect of urban development. Educating the masses about the dividends of energy efficiency emerges as a linchpin in this narrative, fostering public buy-in and galvanizing community support for sustainable initiatives[27]. After all, it is not just about erecting green buildings but about fostering a culture where sustainability is ingrained in the urban ethos. In essence, the literature portrays urbanization as a complex dance with renewable energy consumption, where the steps can lead either toward sustainability or towards heightened resource depletion. To tip the scales in favor of the former, policymakers, urban planners, and stakeholders must rally behind the banner of sustainable urbanism, ushering in an era where renewable energy sources illuminate the path towards a greener, more resilient urban future[28-32].

Existing literature see [16-18, 25, 33-38], espouses a holistic perspective, delineating the multifaceted dimensions of urbanization effects on renewable energy consumption. It elucidates how the spatial configuration of urban landscapes, characterized by varying degrees of density, land-use patterns, and socio-economic dynamics, exerts differential influences on the diffusion and adoption of renewable energy technologies. Urban form emerges as a critical determinant, with compact, mixed-use developments often facilitating more efficient energy utilization and the integration of renewables into the urban fabric. Moreover, the literature delves into the institutional frameworks, policy interventions, and socio-economic factors shaping the uptake of renewable energy within urban contexts. It highlights the pivotal role of supportive regulatory frameworks, financial incentives, and public awareness campaigns in fostering the mainstreaming of renewable energy technologies across urban landscapes. Furthermore, scholars underscore the significance of socio-economic factors such as income levels, education, and cultural attitudes in influencing individual and collective energy choices within urban communities.

In addition, the literature scrutinizes the environmental implications of urbanization-induced shifts in energy consumption patterns, elucidating both the challenges and opportunities inherent in the quest for sustainable urban energy transitions. It underscores the imperative of holistic approaches that harmonize urban planning, energy policy, and environmental conservation goals to navigate the complex nexus between urbanization and renewable energy consumption effectively[10, 19, 39-44]—overall, weaving together diverse strands of research to illuminate the intricate dynamics underpinning the relationship between urbanization and renewable energy consumption. It underscores the imperative of adopting integrated, multidisciplinary approaches to address the challenges and harness the transformative potential of renewable energy in fostering sustainable urban futures.

2.2. Trade openness and renewable energy consumption

There has been significant academic interest in the relationship between trade openness and renewable energy consumption. Studies have concentrated on analyzing the impact of trade regulations and international trade dynamics on the uptake and utilization of renewable energy sources. Research indicates that trade openness can directly and indirectly affect the adoption of renewable energy, leading to shifts in energy source composition and environmental sustainability across various countries and regions. Studies have indicated that trade openness can impact the utilization of renewable energy through various channels, including the scale, technology, and composition of the energy industry. According to the scale effect theory, an uptick in commercial activities could lead to higher energy usage in manufacturing, subsequently leading to increased carbon emissions. On the other hand, the technical impact emphasizes how commerce can facilitate the transfer of innovative technology and practices to enhance energy efficiency and promote the adoption of renewable energy sources. In addition, the impact of composition emphasizes the importance of resource allocation and traded commodities in supporting or hindering renewable energy use [45-53]. Moreover, recent research has delved into the intricate relationship among trade liberalization, institutional quality, economic development, and environmental aspects like renewable energy usage and carbon emissions. Scholars have examined how trade agreements, environmental laws, and economic factors influence the environmental impact of Trade. Understanding these complex relationships is crucial for policymakers looking to promote sustainable development, reduce carbon emissions, and support the global economy's transition to cleaner energy sources [54-56].

2.3. Industrialization and renewable consumption

Academic research has extensively examined the intricate link between trade openness and the use of renewable energy sources. This research has been a significant area of interest, exploring the complicated dynamics between international commerce and renewable energy consumption. Considerable studies have been carried out to examine the effects of trade policies, Globalization, and economic interconnections on the composition of energy and environmental sustainability in various nations and areas. A scholarly paper extensively examines the effects of using renewable energy, promoting commerce, advancing industry, and fostering urbanization. This research aims to provide a deeper understanding of the interplay between these elements and their impact on energy consumption patterns. A supplementary analysis investigates trade liberalization's effects on renewable energy use in 35 OECD nations between 1999 and 2018. This research explores the complex impacts of trade policies on incorporating renewable energy sources by analyzing data over almost twenty years. Furthermore, a current scholarly study has used advanced regression modeling techniques to uncover the influence of trade openness on the usage of renewable energy in OECD countries [28, 29, 57-62]. Researchers use panel smooth transition regression modeling to capture the nonlinear associations between trade openness and clean energy consumption. Moreover, extensive research has examined the triangle correlation between energy consumption, trade openness, and economic development in a diverse set of countries [30, 31, 63-70]. The findings provide vital insights into the influence of trade openness on the use of renewable energy and its effects on the overall economic and environmental results[7, 27].

3. Data and methodology of the study

3.1. Model specification

The motivation of the study is to assess the role of urbanization (UR), trade openness (TO), and industrialization (in) on renewable energy consumption in BRI nations for the period 2004-2020. The generalized equation of the empirical nexus is as follows;

$$REC|UR, TO, IND \ldots\ldots\ldots\ldots(1)$$

The equation has been extended with three control variables following the existing literature [71-76]; the revised equation (1) is as follows.

$$REC|UR, TO, IND, FDI, FD \ldots\ldots\ldots\ldots(1)$$

The general form of a linear regression equation is $Y = \beta0 + \beta1 * X1 + \beta2 * X2 + \beta3 * X3 + \beta4 * X4 + \beta5 * X5 + \beta6 * X6 + e$.

Where Y is the dependent variable (renewable energy consumption), X_1 to X_6 are the independent variables (urbanization, trade openness, industrialization, foreign direct investment, GDP, and financial development), β_0 is the intercept, β_1 to β_6 are the coefficients for each independent variable, and e is the error term.

4. Results and discussion

Table 1 displays the slope of heterogeneity, cross-sectional dependency, and unit root test results. Referring to the test statistics, the study revealed that research variables have heterogeneity and cross-sectional dependence. Furthermore, the test of variables order integration test exposed all the variables found stationary after the first difference.

Table 1 Results of SH, CSD, and PUR test

Panel A: SH test of Bersvendsen and Ditzen (2021)						
	Δ Statistic	**Adjusted Δ Statistic**		**SH exits**		
Model	**4.199*** **	**5.8829*** **		**Yes**		
	(Breusch and Pagan 1980)	Pesaran (2004)	Pesaran, Ullah et al. (2008)	Pesaran (2006)	Juodis and Reese (2022)	
REC	283.993***	32.975***	222.256***	28.44***	-0.7255***	
UR	204.385***	15.16***	231.57***	19.001***	-3.2629***	
TO	301.044***	29.343***	131.266***	8.677***	-0.0078***	
IND	446.612***	40.105***	147.515***	30.831***	3.4941***	
FDI	225.247***	43.881***	238.757***	44.901***	-1.5004***	
FD	384.573***	36.645***	240.886***	31.967***	-0.1161***	

Variables	CADF test statistic		CIPS test statistic		Herwartz and Siedenburg -2008	
	Level	first difference	Level	first difference	Level	first difference
REC	-1.981	-4.583***	-2.163	-6.711***	-0.5616	8.0662***
FD	-1.126	-6.991***	-1.923	-2.211***	-0.9421	-2.2797***
FDI	-2.961	-2.225***	-2.965	-7.28***	-0.5837	6.0458***
TO	-1.591	-4.937***	-2.339	-7.886***	1.7548	1.5245***
GCF	-1.598	-6.559***	-2.494	-5.173***	1.0204	-6.6653***
UR	-2.134	-5.514***	-2.57	-4.084***	1.3778	-3.6246***

The long-run cointegration has been assessed through the implementation of the panel cointegration test following padroni [77, 78], [79], and [80, 81]—the results of the panel cointegration test reported in Table 2. Study findings revealed a long-run association available in the empirical relation, supported by all four estimation techniques.

Table 2 Results of panel cointegration test

Model	**UR--->REC**	**TO--->REC**	**IN--->REC**	**FD--->REC**	**FDI--->REC**	
GT	-12.817***	-4.53***	-13.788***	-5.207***	-15.919***	
Ga	-13.586***	-11.539***	-5.187***	-11.591***	-8.984***	
Pt	-11.593***	-9.047***	-14.192***	-13.049***	-5.056***	
Pa	-12.176***	-6.261***	-9.895***	-8.799***	-14.543***	
KRCPT						
MDF	20.413***	2.208***	7.218***	22.814***	-2.005***	
DF	20.132***	6.435***	20.188***	-1.36***	21.304***	
ADF	-2.866***	-0.033***	5.026***	19.232***	7.478***	
UMDF	17.98***	19.855***	9.045***	18.763***	-5.298***	
UDF	3.809***	14.49***	8.359***	15.555***	13.348***	
PCT						
MDF	-0.187***	9.485***	8.795***	13.757***	15.696***	
PP	7.45***	5.702***	5.708***	15.458***	-0.808***	
ADF	8.356***	15.585***	14.121***	13.944***	15.46***	
Panel B: Cointegration test of Westerlund and Edgerton (2008)						
	no shift		mean shift		regime shift	
	LMr stat.	LMΦ stat.	LMr stat.	LMΦ stat.	LMr stat.	LMΦ stat.
Model 1	-2.7646***	-4.0841***	-4.2556***	-2.0815***	-3.8524***	-3.4159***

The coefficients of urbanization (see Table 3) have exposed a negative statistical significance towards REC, whereas the sign of UR^2 disclosed positive statistical significance toward REC, suggesting UR in the initial stage increases energy consumption, especially with the non-renewable source; however, after a point of time, UR has become a conducive variable in fostering the clean energy consumption in BRI nation. Our finding is supported by the study of [75, 82-87]. The study "Urbanization, trade openness, and industrialization as determinants of clean energy consumption: evidence from BRI nations" found that the level of urbanization is negatively and significantly correlated with renewable energy consumption (REC). In addition, the coefficient of UR2 (urbanization squared) was positive and had a statistically significant effect. Urbanization is known to have a propensity to increase energy consumption, particularly from non-renewable sources. Nevertheless, when progress is achieved, urbanization may actively facilitate the acceptance and implementation of environmentally friendly energy sources in countries included in the Belt and Road Initiative (BRI).

This finding is consistent with the existing body of research on the relationship between urbanization and the use of renewable energy. Research investigating the influence of renewable energy and urbanization on CO2 emissions found that an increased use of renewable energy leads to decreased CO2 emissions. In contrast, greater urbanization had a detrimental effect on air quality. Another research has shown that using renewable energy has a favorable effect on economic development and a negative effect on carbon emissions. Moreover, there is a correlation between urbanization and a rise in the release of pollutants and energy consumption[20, 88-94]. The findings suggest that the urbanization process might result in a combination of positive and negative effects on using renewable energy. In the first stages, urbanization may cause an increase in energy use, particularly from non-renewable sources. This is due to the growth of energy-intensive companies and the rising demand for energy-intensive services in urban areas[1]. Urbanization may facilitate the adoption of clean energy consumption as urban planners and policymakers prioritize sustainable urban development and integrate renewable energy sources to mitigate the adverse impacts of urbanization on energy consumption [95-103].

The coefficients of trade openness were found to be positive and statistically significant to REC. In contrast, the coefficient of TO^2 was revealed to be negatively connected to REC, indicating that domestic trade liberalization fosters clean energy consumption in the initial stage. Furthermore, the contributory effect reduces with time progress. After a certain point, TO has adversely influenced REC; that is, the consumption of non-renewable energy has intensified over renewable sources. Our study aligns with existing literature such as [104-111]. The study's analysis of the influence of trade openness on renewable energy consumption offers intriguing insights into the relationship between trade policies and the uptake of clean energy sources. The coefficients associated with trade openness exhibit a statistically significant positive correlation with renewable energy consumption (REC), indicating that heightened trade openness corresponds to increased utilization of renewable energy sources[28, 29, 45, 50, 58]. This positive correlation suggests that the liberalization of domestic Trade can facilitate clean energy consumption, particularly during the early stages of economic development.

However, the study uncovers a nuanced association between trade openness and REC, as reflected by the negative relationship between the trade openness squared (TO2) coefficient and renewable energy consumption. This negative correlation implies that beyond a certain threshold, the positive impact of trade openness on clean energy consumption diminishes, potentially leading to a shift towards greater reliance on non-renewable energy sources over renewables[34, 37, 41, 86]. This finding underscores the importance of discerning the temporal dynamics and thresholds at which trade openness may transition from promoting clean energy adoption to impeding it. These findings underscore the intricate interplay between trade policies, economic progress, and energy consumption patterns. They underscore the necessity for policymakers to carefully assess the long-term ramifications of trade openness on adopting renewable energy and to implement strategies that facilitate a sustainable transition towards cleaner energy sources while simultaneously mitigating the risk of escalating dependence on non-renewable alternatives over time.

The study revealed a U-invert linkage between industrialization and clean energy consumption, indicating that initially, IND increases energy demand for conventional sources. However, the reliance on fossil energy decreases, and at a point in time, the influences that foster the inclusion of clean energy instead of non-renewable sources become evident. The literature supports our study findings, such as [32, 112-121]. The research results demonstrate a U-shaped correlation between industrialization and the use of clean energy, suggesting a fluctuating trend in the shift towards renewable energy sources. At first, industrialization was discovered to augment the need for energy from traditional sources, indicating a dependence on fossil fuels. Nevertheless, with the advancement of industrialization, there is a discernible transition towards reduced dependence on fossil energy. Over time, industrialization has increasingly promoted using clean energy instead of non-renewable sources [6]. The U-invert connection highlights the intricate relationship between industrialization and energy usage patterns. The results indicate that industrialization has a double impact on energy consumption, first promoting conventional energy sources but ultimately enabling the shift towards more environmentally friendly options. This shift emphasizes the need to comprehend the time-related changes and critical points at which industrialization impacts the acceptance of renewable energy sources. Policymakers and stakeholders may use these observations to formulate tactics that support sustainable industrial expansion while promoting the adoption of clean energy technology to alleviate environmental consequences and encourage enduring energy sustainability[122, 123].

Table 3 Results of DSUR, CUP-BC, and CUP-FM

	DSUR			CUP-BC			CUP-FM		
	Coeff.	**t-stat**	**std. error**	**Coeff.**	**t-stat**	**std. error**	**Coeff.**	**t-stat**	**std. error**
UR	-0.0491	0.0115	-4.2695	-0.0918	0.005	-18.36	-0.1724	0.002	-86.2
UR^2	0.0152	0.0065	2.3384	0.0508	0.0021	24.1904	0.1663	0.0102	16.3039
TO	0.098	0.0091	10.7692	0.118	0.0018	65.5555	0.1339	0.0021	63.7619
TO^2	-0.0519	0.0046	-11.2826	-0.0854	0.0053	-16.1132	-0.1334	0.0105	-12.7047
IND	-0.0446	0.0098	-4.551	-0.0706	0.0093	-7.5913	-0.0836	0.0035	-23.8857
IND^2	0.0703	0.0024	29.2916	0.0994	0.0098	10.1428	0.1446	0.0045	32.1333
FD	0.0783	0.0108	7.25	0.0846	0.0083	10.1927	0.08	0.0026	30.7692
FDI	0.0738	0.0091	8.1098	0.034	0.0028	12.1428	0.0278	0.0045	6.1777
c	4.8749	0.258	18.8949	3.1948	0.5749	5.5571	10.022	0.2928	34.2281
CD test		0.0241			0.0287			0.0278	
Wooldridge Test		0.0317			0.027			0.0221	
Normality test		0.0259			0.0254			0.0288	
Ramsey RESET test		0.0298			0.0305			0.0324	

5. Conclusion

This study's findings offer valuable insights into the complex interplay among urbanization, trade openness, industrialization, and their impact on renewable energy consumption (REC) within the countries participating in the Belt and Road Initiative (BRI).

Based on the analysis, it is evident that an intricate relationship exists between urbanization and energy consumption. At the outset, a significant negative correlation exists between the coefficients and REC, suggesting a rise in energy consumption, particularly from non-renewable sources, in the initial stages of urban expansion. With the progression of urbanization, the coefficient of UR2, which is statistically significant, suggests a trend toward encouraging the use of clean energy. This signifies a pivotal moment when urbanization becomes conducive to adopting renewable energy sources. The findings align with prior studies and underscore the dual impact of urbanization on energy consumption. Implementing sustainable urban development strategies and incorporating renewable energy sources to minimize negative consequences is emphasized.

The analysis focuses on the influence of trade openness on REC. Positive coefficients suggest a rise in clean energy consumption due to domestic trade liberalization. However, the decreasing impact demonstrated by the negative correlation between TO2 and REC emphasizes the importance of policymakers effectively handling the time-sensitive fluctuations in trade openness to facilitate a sustainable transition to cleaner energy sources.

Furthermore, the study illustrates a U-shaped correlation between industrialization and the utilization of clean energy. The pattern suggests transitioning from traditional energy sources to renewable energy as industrialization progresses. The U-invert link highlights the relationship between industrialization and energy consumption patterns, emphasizing the importance of policymakers recognizing key turning points and leveraging industrial growth to promote the adoption of clean energy technology.

The results underscore the critical importance of policymakers and stakeholders promptly establishing a thorough strategy to promote the adoption of renewable energy in nations involved in the Belt and Road Initiative (BRI). To promote sustainable development and decrease dependence on non-renewable energy sources, policymakers should understand the intricate connection among urbanization, trade openness, industrialization, and energy consumption patterns. The research offers valuable insights into the complexities of energy transition within the framework of global economic integration. It aids in making well-informed decisions and shaping sustainable energy futures.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

References

[1] Dash, R. K.; Gupta, D. J.; Singh, N., Remittances and environment quality: Asymmetric evidence from South Asia. *Research in Globalization* 2024, 8, 100182.

[2] Xing, H.; Husain, S.; Simionescu, M.; Ghosh, S.; Zhao, X., Role of green innovation technologies and urbanization growth for energy demand: Contextual evidence from G7 countries. *Gondwana Research* 2024, 129, 220-238.

[3] Rej, S.; Bandyopadhyay, A.; Das, N.; Hossain, M. E.; Islam, M. S.; Bera, P.; Yeediballi, T., The asymmetric influence of environmental-related technological innovation on climate change mitigation: what role do FDI and renewable energy play? *Environmental Science and Pollution Research* 2023, 30, (6), 14916-14931.

[4] Shahid, R.; Shahid, H.; Shijie, L.; Jian, G., Developing nexus between economic opening-up, environmental regulations, rent of natural resources, green innovation, and environmental upgrading of China - empirical analysis using ARDL bound-testing approach. *Innovation and Green Development* 2024, 3, (1), 100088.

[5] Saqib, N.; Usman, M.; Ozturk, I.; Sharif, A., Harnessing the synergistic impacts of environmental innovations, financial development, green growth, and ecological footprint through the lens of SDGs policies for countries exhibiting high ecological footprints. *Energy Policy* 2024, 184, 113863.

[6] Moosavian, S. F.; Noorollahi, Y.; Shoaei, M., Renewable energy resources utilization planning for sustainable energy system development on a stand-alone island. *Journal of Cleaner Production* 2024, 439, 140892.

[7] Mngumi, F.; Huang, L.; Xiuli, G.; Ayub, B., Financial efficiency and CO2 emission in BRICS. Dose digital economy development matter? *Heliyon* 2024, e24321.

[8] Suhrab, M.; Chen, P.; Ullah, A., Digital financial inclusion and income inequality nexus: Can technology innovation and infrastructure development help in achieving sustainable development goals? *Technology in Society* 2024, 76, 102411.

[9] Manigandan, P.; Alam, M. S.; Alagirisamy, K.; Pachiyappan, D.; Murshed, M.; Mahmood, H., Realizing the Sustainable Development Goals through technological innovation: juxtaposing the economic and environmental effects of financial development and energy use. *Environmental Science and Pollution Research* 2023, 30, (3), 8239-8256.

[10] Qamruzzaman, M., Does financial innovation foster financial inclusion in Arab world? examining the nexus between financial innovation, FDI, remittances, trade openness, and gross capital formation. *PLOS ONE* 2023, 18, (6), e0287475.

[11] Chen, Y.; Raza, K., Asymmetric impact of technological innovation, foreign direct investment and agricultural production on environmental degradation: evidence from Pakistan. *Environmental Science and Pollution Research* 2023.

[12] Chen, L.; Tan, Y.; Lv, G.; Cai, W.; Gao, X.; Li, R., Uncovering the coupling effect with energy-related carbon emissions and human development variety in Chinese provinces. *Journal of Environmental Sciences* 2024, 139, 527-542.

[13] Zhang, Y.; Zheng, K.; Xia, F.; Cheng, Z., Fintech, natural resource rents, renewable energy consumption and environmental quality: A perspective of green economic recovery from BRICS economies. *Resources Policy* 2024, 89, 104604.

[14] Mahmood, H.; Irshad, A. u. R.; Tanveer, M., Do innovation and renewable energy transition play their role in environmental sustainability in Western Europe? *Humanities and Social Sciences Communications* 2024, 11, (1), 22.

[15] Erdogan, S., On the impact of natural resources on environmental sustainability in African countries: A comparative approach based on the EKC and LCC hypotheses. *Resources Policy* 2024, 88, 104492.

[16] Yan, H.; Qamruzzaman, M.; Kor, S., Nexus between Green Investment, Fiscal Policy, Environmental Tax, Energy Price, Natural Resources, and Clean Energy—A Step towards Sustainable Development by Fostering Clean Energy Inclusion. *Sustainability* 2023, 15, (18), 13591.

[17] Serfraz, A.; Qamruzzaman, M.; Karim, S., Revisiting the Nexus between Economic Policy Uncertainty, Financial Development, and FDI Inflows in Pakistan during Covid-19: Does Clean Energy Matter? *International Journal of Energy Economics and Policy* 2023, 13, (4), 91-101.

[18] Qamruzzaman, M.; Karim, S., Does public-private investment augment renewable energy consumption in BIMSTEC nations? Evidence from symmetric and asymmetric assessment. *Energy Strategy Reviews* 2023, 49, 101169.

[19] Qamruzzaman, M., Empowering Malaysian tourism with clean energy, sustainable environment, and inward FDI: evidence from symmetric and asymmetric assessment. *Environmental Science and Pollution Research* 2023.

[20] Islam, Y.; Mindia, P. M.; Farzana, N.; Qamruzzaman, M., Nexus between environmental sustainability, good governance, financial inclusion, and tourism development in Bangladesh: Evidence from symmetric and asymmetric investigation. *Frontiers in Environmental Science* 2023, 10.

[21] Jan, A.; Xin-gang, Z.; Babar, S. F.; Khan, M. K., Role of financial development, foreign direct investment inflow, innovation in environmental degradation in Pakistan with dynamic ARDL simulation model. *Environmental Science and Pollution Research* 2023.

[22] Kilinc-Ata, N.; Alshami, M., Analysis of how environmental degradation affects clean energy transition: evidence from the UAE. *Environmental Science and Pollution Research* 2023, 30, (28), 72756-72768.

[23] Gyamfi, B. A.; Agozie, D. Q.; Bekun, F. V.; Köksal, C., Beyond the environmental Kuznets Curve in South Asian economies: accounting for the combined effect of information and communication technology, human development and urbanization. *Environ Dev Sustain* 2023.

[24] Pata, U. K.; Caglar, A. E.; Kartal, M. T.; Depren, S. K., Evaluation of the role of clean energy technologies, human capital, urbanization, and income on the environmental quality in the United States. *Journal of Cleaner Production* 2023, 402, 136802.

[25] Tan, Y.; Qamruzzaman, M.; Karim, S., An investigation of financial openness, trade openness, gross capital formation, urbanization, financial development, education and energy nexus in BRI: Evidence from the symmetric and asymmetric framework. *PLOS ONE* 2023, 18, (12), e0290121.

[26] Iqbal, M.; Chand, S.; Ul Haq, Z., Economic policy uncertainty and CO2 emissions: a comparative analysis of developed and developing nations. *Environmental Science and Pollution Research* 2023, 30, (6), 15034-15043.

[27] Raihan, A., The dynamic nexus between economic growth, renewable energy use, urbanization, industrialization, tourism, agricultural productivity, forest area, and carbon dioxide emissions in the Philippines. *Energy Nexus* 2023, 9, 100180.

[28] Qamruzzaman, M., Nexus between Renewable Energy, Environmental Innovation, Trade and environmental sustainability in Russia and India. *Energy Research & Social Science* 2022, 88, 1-27.

[29] Ma, R.; Qamruzzaman, M., Nexus between Government Debt, Economic Policy Uncertainty, Government Spending and Governmental Effectiveness in BRIC: Evidence for Linear and Nonlinear Assessment. *Frontiers in Environmental Science* 2022, 1151.

[30] Zhang, Y.; Qamruzzaman, M.; Karim, S.; Jahan, I., Nexus between Economic Policy Uncertainty and Renewable Energy Consumption in BRIC Nations: The Mediating Role of Foreign Direct Investment and Financial Development. *Energies* 2021, 14, (15), 4687.

[31] Qamruzzaman, M.; Tayachi, T.; Mehta, A. M.; Ali, M., Do International Capital Flows, Institutional Quality Matter for Innovation Output: The Mediating Role of Economic Policy Uncertainty. *Journal of Open Innovation: Technology, Market, and Complexity* 2021, 7, (2), 141.

[32] MEHTA, A. M.; QAMRUZZAMAN, M.; SERFRAZ, A.; ALI, A., The role of remittances in financial development: Evidence from nonlinear ARDL and asymmetric causality. *The Journal of Asian Finance, Economics and Business* 2021, 8, (3), 139-154.

[33] Wang, Y.; Qamruzzaman, M.; Serfraz, A.; Theivanayaki, M., Does Financial Deepening Foster Clean Energy Sustainability over Conventional Ones? Examining the Nexus between Financial Deepening, Urbanization, Institutional Quality, and Energy Consumption in China. *Sustainability* 2023, 15, (10), 8026.

[34] Wang, Y.; Qamruzzaman, M.; Kor, S., Greening the Future: Harnessing ICT, Innovation, Eco-Taxes, and Clean Energy for Sustainable Ecology—Insights from Dynamic Seemingly Unrelated Regression, Continuously Updated Fully Modified, and Continuously Updated Bias-Corrected Models. *Sustainability* 2023, 15, (23), 1-26.

[35] Su, S.; Qamruzzaman, M.; Karim, S., Charting a Sustainable Future: The Impact of Economic Policy, Environmental Taxation, Innovation, and Natural Resources on Clean Energy Consumption. *Sustainability* 2023, 15, (18), 13585.

[36] Qamruzzaman, M.; Kler, R., Do Clean Energy and Financial Innovation Induce SME Performance? Clarifying the Nexus between Financial Innovation, Technological Innovation, Clean Energy, Environmental Degradation, and SMEs Performance in Bangladesh. *International Journal of Energy Economics and Policy* 2023, 13, (3), 313-324.

[37] Qamruzzaman, M.; Karim, S.; Kor, S., Does environmental degradation matter for poverty? Clarifying the nexus between FDI, environmental degradation, renewable energy, education, and poverty in Morocco and Tunisia. *Environmental Science and Pollution Research* 2023, 30, (18), 52872-52894.

[38] Qamruzzaman, M.; Karim, S., Clarifying the relationship between green investment, technological innovation, financial openness, and renewable energy consumption in MINT. *Heliyon* 2023, 9, (11), e21083.

[39] Qamruzzaman, M., Does Environmental Degradation-Led Remittances Flow? Nexus between Environmental Degradation, Uncertainty, Financial Inclusion and Remittances Inflows in India and China. *International Journal of Energy Economics and Policy* 2023, 13, (2), 9.

[40] Qamruzzaman, M., Clean energy-led tourism development in Malaysia: Do environmental degradation, FDI, Education and ICT matter? *Heliyon* 2023, 9, (11).

[41] Qamruzzaman, M., An asymmetric nexus between clean energy, good governance, education and inward FDI in China: Do environment and technology matter? Evidence for chines provincial data. *Heliyon* 2023, 9, (5), e15612.

[42] Qamruzzaman, M., Does economic policy uncertainty influences personal remittances: Evidences from AARDL and NARDL. *World Journal of Advanced Research and Reviews* 2023, 18, (1), 014-034.

[43] Qamruzzaman, M., Do environmental and institutional quality attribute to inflows of FDI in Lower-Middle income Nations? Evidences from asymmetric investigation. *GSC Advanced Research and Reviews* 2023, 15, (3), 079-104.

[44] Qamruzzaman, M., Nexus between financial developments, renewable energy consumption and environmental sustainability in Bangladesh: Evidence from ARDL and NARDL. *World Journal of Advanced Research and Reviews* 2023, 18, (1), 1097-1113.

[45] Qamruzzaman, M.; Karim, S.; Jahan, I., Nexus between economic policy uncertainty, foreign direct investment, government debt and renewable energy consumption in 13 top oil importing nations: Evidence from the symmetric and asymmetric investigation. *Renewable Energy* 2022, 195, 121-136.

[46] Qamruzzaman, M., Nexus between FDI and globalization-led energy diversification in BRICS: Fresh evidence from a newly constructed Energy diversification index. *Energy Strategy Reviews* 2022, 44, 100997.

[47] Qamruzzaman, M., Nexus between energy intensity, human capital development, Trade and environmental quality in LIC, LMIC and UMIC: Evidence from GMM. *GSC Advanced Research and Reviews* 2022, 13, (2), 051–068.

[48] Qamruzzaman, M., Nexus between energy intensity and Environmental Quality SSA: Evidence from GMM. *World Journal of Advanced Research and Reviews* 2022, 16, (02), 193–210.

[49] Qamruzzaman, M., Symmetric and Asymmetric Nexus between Economic Policy Uncertainty, Oil Price and Renewable Energy Consumption in the USA, CHINA, INDIA, JAPAN, S. KORIA: Does Technological Innovation influence? *Frontiers in Energy Research* 2022, 1746.

[50] Qamruzzaman, M., Does Globalization augment environmental degradation through the channel energy and FDI? Evidence from BRI initiatives. *World Journal of Advanced Research and Reviews* 2022, 15, (3), 037–054.

[51] Qamruzzaman, M., Nexus between Globalization, energy consumption and Globalization in belt and road countries. *GSC Advanced Research and Reviews* 2022, 12, (3), 033–050.

[52] Qamruzzaman, M., Nexus between environmental innovation, energy efficiency and environmental sustainability in Southeast Asian economy. *International Journal of Multidisciplinary Research and Growth Evaluation* 2022, 3, (4), 181-193.

[53] Qamruzzaman, M., Nexus between environmental innovation, energy efficiency and environmental sustainability in the lower-income economy. *GSC Advanced Research and Reviews* 2022, 12, (1), 068–083.

[54] Wahab, S.; Imran, M.; Ahmed, B.; Rahim, S.; Hassan, T., Navigating environmental concerns: Unveiling the role of economic growth, Trade, resources and institutional quality on greenhouse gas emissions in OECD countries. *Journal of Cleaner Production* 2024, 434, 139851.

[55] Shabir, M.; Hussain, I.; Işık, Ö.; Razzaq, K.; Mehroush, I., The role of innovation in environmental-related technologies and institutional quality to drive environmental sustainability. *Frontiers in Environmental Science* 2023, 11.

[56] Qadri, S. U.; Shi, X.; Rahman, S. u.; Anees, A.; Ali, M. S. E.; Brancu, L.; Nayel, A. N., Green finance and foreign direct investment–environmental sustainability nexuses in emerging countries: new insights from the environmental Kuznets curve. *Frontiers in Environmental Science* 2023, 11.

[57] Qamruzzaman, M., Nexus between renewable energy, foreign direct investment, and agro-productivity: The mediating role of carbon emission. *Renewable Energy* 2022, 184, 526-540.

[58] Qamruzzaman, M., An asymmetric investigation of the nexus between Economic Policy Uncertainty, Knowledge spillover, Climate Change and Green Economy: Evidence from BRIC nations. *Frontiers in Environmental Science* 2022, 682.

[59] Qamruzzaman, M., Nexus between Economic Policy Uncertainty and Institutional Quality: Evidence from Indian and Pakistan. *Macroeconomics and Finance in Emerging Market Economies* 2022, 1-20.

[60] Qamruzzaman, M., A symmetry and asymmetry investigation of the Nexus between Environmental sustainability, Renewable Energy, Energy Innovation, and Trade: Evidence from Environmental Kuznets Curve Hypothesis in Selected MENA countries. *Frontiers in Energy Research* 2022, 873.

[61] Muneeb, M. A.; Md, Q.; Ayesha, S., The Effects of Finance and Knowledge on Entrepreneurship Development: An Empirical Study from Bangladesh. *The Journal of Asian Finance, Economics and Business* 2022, 9, (2), 409-418.

[62] Md, Q., Nexus between environmental innovation, energy efficiency and environmental sustainability in the lower-income economy. *GSC Advanced Research and Reviews* 2022, 12, (1), 068-083.

[63] Zhuo, J.; Qamruzzaman, M., Do financial development, FDI, and Globalization intensify environmental degradation through the channel of energy consumption: evidence from belt and road countries. *Environmental Science and Pollution Research* 2021.

[64] Yingjun, Z.; Jahan, S.; Qamruzzaman, M., Access to Finance and Legal Framework in Female Entrepreneurship Development in Bangladesh: The Mediating Role of Self-Leadership. *Asian Economic and Financial Review* 2021, 11, (9), 762-780.

[65] Yang, Y.; Qamruzzaman, M.; Rehman, M. Z.; Karim, S., Do Tourism and Institutional Quality Asymmetrically Effects on FDI Sustainability in BIMSTEC Countries: An Application of ARDL, CS-ARDL, NARDL, and Asymmetric Causality Test. *Sustainability* 2021, 13, (17), 9989.

[66] Xu, S.; Qamruzzaman, M.; Adow, A. H., Is financial innovation bestowed or a curse for economic sustainably: the mediating role of economic policy uncertainty. *Sustainability* 2021, 13, (4), 2391.

[67] Xu, S.; Qamruzzaman, M.; Adow, A., Is Financial Innovation Bestowed or a Curse for Economic Sustainably: The Mediating Role of Economic Policy Uncertainty. Sustainability 2021, 13, 2391. In s Note: MDPI stays neutral with regard to jurisdictional claims in published …: 2021.

[68] Wang, Z.; Zaman, S.; Zaman, Q. u.; Rasool, S. F., Impact of remittances on carbon emission: fresh evidence from a panel of five remittance-receiving countries. *Environmental Science and Pollution Research* 2021, 28, (37), 52418-52430.

[69] Qamruzzaman, M.; Kler, R.; Theivanayaki, M.; Karim, S., Stock Market Volatility Transmission and Interlinkage: Evidence from BRICS. *Universal Journal of Accounting and Finance* 2021, 1142-1158.

[70] Qamruzzaman, M.; Karim, S.; Jahan, I., COVID-19, Remittance Inflows, and the Stock Market: Empirical Evidence from Bangladesh. *The Journal of Asian Finance, Economics and Business* 2021, 8, (5), 265-275.

[71] Yin, C.; Qamruzzaman, M., Empowering renewable energy consumption through public-private investment, urbanization, and Globalization: Evidence from CS-ARDL and NARDL. *Heliyon* 2024, e26455.

[72] Qamruzzaman, M., Nexus between foreign direct investment, gross capital formation, financial development and renewable energy consumption: evidence from panel data estimation. *GSC Advanced Research and Reviews* 2024, 18, (1), 182-200.

[73] Lin, J.; Qamruzzaman, M., The Impact of Environmental Disclosure and the Quality Of Financial Disclosure Quality, and IT Adoption on Firm Performance: Does Corporate Governance Ensure Sustainability? *Frontiers in Environmental Science* 2023, 11, 23.

[74] JinRu, L.; Qamruzzaman, M.; Hangyu, W.; Kler, R., An assessment of the symmetric and asymmetric impact of Globalization, environmental sustainability on Tourism Development in BRICS nations: Mediating role of Good governance. *Frontiers in Environmental Science* 2023, 11, 190.

[75] Ju, S.; Qamruzzaman, M.; Kor, S.; Andriamahery, A., Effects of Financial development, FDI and Good governance on Environmental Degradation in the Arab Nation: Dose Technological Innovation matters. *Frontiers in Environmental Science* 2023, 11, 224.

[76] Lin, J.; Qamruzzaman, M., The impact of environmental disclosure and the quality of financial disclosure and IT adoption on firm performance: Does corporate governance ensure sustainability? *Frontiers in Environmental Science* 2023.

[77] Pedroni, P., Panel cointegration: asymptotic and finite sample properties of pooled time series tests with an application to the PPP hypothesis. *Econometric theory* 2004, 20, (3), 597-625.

[78] Pedroni, P., Purchasing power parity tests in cointegrated panels. *Review of Economics and Statistics* 2001, 83, (4), 727-731.

[79] Kao, C., Spurious regression and residual-based tests for cointegration in panel data. *Journal of econometrics* 1999, 90, (1), 1-44.

[80] Westerlund, J., Panel cointegration tests of the Fisher effect. *Journal of Applied Econometrics* 2008, 23, (2), 193-233.

[81] Westerlund, J., Testing for error correction in panel data. *Oxford Bulletin of Economics and statistics* 2007, 69, (6), 709-748.

[82] Qamruzzaman, M., Nexus between financial development and carbon emission in Bangladesh: Evidence from ARDL and NARDL. *GSC Advanced Research and Reviews* 2023, 14, (3), 300-312.

[83] Qamruzzaman, M., Nexus between environmental qualities, institutional quality and FDI inflows in Lower-income Countries. *World Journal of Advanced Research and Reviews* 2023, 18, (3), 321-345.

[84] Li, Z.; Qamruzzaman, M., Nexus between Environmental Degradation, Clean Energy, Financial Inclusion, and Poverty: Evidence with DSUR, CUP-FM, and CUP-BC Estimation. *Sustainability* 2023, 15, (19), 14161.

[85] Li, Q.; Qamruzzaman, M., Innovation-Led Environmental Sustainability in Vietnam—Towards a Green Future. *Sustainability* 2023, 15, (16), 12109.

[86] Kor, S.; Qamruzzaman, M., Nexus between FDI, Financial Development, Capital Formation and Renewable Energy Consumption; evidence from Bangladesh. *International Journal of Energy Economics and Policy* 2023, 13, (6), 129-145.

[87] Karim, S.; Qamruzzaman, M.; Jahan, I., Nexus between Government Debt, Globalization, FDI, Renewable Energy, and Institutional Quality in Bangladesh. *International Journal of Energy Economics and Policy* 2023, 13, (3), 443-456.

[88] Ju, S.; Andriamahery, A.; Qamruzzaman, M.; Kor, S., Effects of financial development, FDI and good governance on environmental degradation in the Arab nation: Dose technological innovation matters? *Frontiers in Environmental Science* 2023, 11.

[89] JinRu, L.; Qamruzzaman, M.; Hangyu, W.; Kler, R., Corrigendum: Do environmental quality, financial inclusion and good governance ensure the FDI sustainably in belt and road countries? Evidence from an application of CS-ARDL and NARDL. *Frontiers in Environmental Science* 2023.

[90] Farzana, N.; Qamruzzaman, M.; Islam, Y.; Mindia, P. M., Nexus between Personal Remittances, Financial Deepening, Urbanization, and Renewable Energy Consumption in Selected Southeast Asian Countries: Evidence from Linear and Nonlinear Assessment. *International Journal of Energy Economics and Policy* 2023, 13, (6), 270-287.

[91] Zhuo, J.; Qamruzzaman, M., Do financial development, FDI, and Globalization intensify environmental degradation through the channel of energy consumption: evidence from belt and road countries. *Environmental Science and Pollution Research* 2022, 29, (2), 2753-2772.

[92] Zhao, L.; Qamruzzaman, M., Do Urbanization, Remittances, and Globalization Matter for Energy Consumption in Belt and Road Countries: Evidence From Renewable and Non-Renewable Energy Consumption. *Frontiers in Environmental Science* 2022, 10.

[93] Xiao, Z.; Qamruzzaman, M., Nexus between Green investment and technological innovation in BRI nations: what is the role of Environmental Sustainably and Domestic Investment? *Frontiers in Environmental Science* 2022, 1472.

[94] Xiao, Z.; Qamruzzaman, M., Nexus between green investment and technological innovation in BRI nations: What is the role of environmental sustainability and domestic investment? *Frontiers in Environmental Science* 2022, 10.

[95] Xia, C.; Qamruzzaman, M.; Adow, A. H., An Asymmetric Nexus: Remittance-Led Human Capital Development in the Top 10 Remittance-Receiving Countries: Are FDI and Gross Capital Formation Critical for a Road to Sustainability? *Sustainability* 2022, 14, (6), 3703.

[96] Weixiang, S.; Qamruzzaman, M.; Rui, W.; Kler, R., An empirical assessment of Financial Literacy and Behavioural Biases on Investment Decision: Fresh Evidence from Small Investor Perception. *Frontiers in psychology* 2022, 5746.

[97] Weixiang, S.; Qamruzzaman, M.; Rui, W.; Kler, R., An empirical assessment of financial literacy and behavioral biases on investment decision: Fresh evidence from small investor perception. *Frontiers in psychology* 2022, 13.

[98] Shi, Z.; Qamruzzaman, M., Re-visiting the role of education on poverty through the channel of financial inclusion: evidence from Lower-income and Lower Middle-income country. *Frontiers in Environmental Science* 2022, 10, 592.

[99] Shahzadi, I.; Yaseen, M. R.; Khan, M. T. I.; Makhdum, M. S. A.; Ali, Q., The nexus between research and development, renewable energy and environmental quality: Evidence from developed and developing countries. *Renewable Energy* 2022, 190, 1089-1099.

[100] SERFRAZ, A.; MUNIR, Z.; MEHTA, A. M.; Qamruzzaman, M., Nepotism effects on job satisfaction and withdrawal behavior: An empirical analysis of social, ethical and economic factors from Pakistan. *The Journal of Asian Finance, Economics and Business* 2022, 9, (3), 311-318.

[101] Rong, G.; Qamruzzaman, M., Symmetric and asymmetric nexus between economic policy uncertainty, oil price, and renewable energy consumption in the United States, China, India, Japan, and South Korea: Does technological innovation influence? *FRONTIERS IN ENERGY RESEARCH* 2022, 10.

[102] Qamruzzaman, M.; Mehta, A. M.; Naqvi, F. N., Nexus between Uncertainty, Remittances, and Households Consumption: Evidence from Dynamic SUR application. *Frontiers in Environmental Science* 2022, 1546.

[103] Qamruzzaman, M.; Kler, R., Do financial inclusion and financial efficiency play deterministic role for FDI in Road and Belt countries. *Journal of Multinational Financial Management* 2022, 63, (100716).

[104] Ma, C.; Qamruzzaman, M., An Asymmetric Nexus between Urbanization and Technological Innovation and Environmental Sustainability in Ethiopia and Egypt: What Is the Role of Renewable Energy? *Sustainability* 2022, 14, (13), 7639.

[105] Liang, Z.; Qamruzzaman, M., An Asymmetric Investigation of the Nexus Between Economic Policy Uncertainty, Knowledge Spillover, Climate Change, and Green Economy: Evidence From BRIC Nations. *Frontiers in Environmental Science* 2022, 9.

[106] Li, J.; Qamruzzaman, M., Does Tourism Induce Sustainable Human Capital Development in BRICS Through the Channel of Capital Formation and Financial Development? Evidence From Augmented ARDL With Structural Break and Fourier-TY Causality. In *Frontiers in psychology*, 2022; Vol. 13, p 804349.

[107] Li, J.; Qamruzzaman, M., Dose tourism induce Sustainable Human capital development in BRICS through the channel of capital formation and financial development: Evidence from Augmented ARDL with structural Break and Fourier TY causality. *Frontiers in psychology* 2022, 1260.

[108] Karim, S.; Qamruzzaman, M.; Jahan, I., INFORMATION TECHNOLOGY ADAPTATION, VOLUNTARY DISCLOSURE, OPEN INNOVATION AND SUSTAINABLE PERFORMANCE: EVIDENCE FROM BANK-BASED FINANCIAL INSTITUTIONS IN BANGLADESH. *Academy of Accounting and Financial Studies Journal* 2022, 26, (S6), 1-14.

[109] Jinru, L.; Qamruzzaman, M.; Hangyu, W.; Kler, R., Do Environmental Quality, Financial Inclusion and Good Governance ensure the FDI sustainably in Belt & Road Countries: Evidence from an application of CS-ARDL and NARDL? *Frontiers in Environmental Science* 2022, 2455.

[110] JinRu, L.; Qamruzzaman, M.; Hangyu, W.; Kler, R., Do environmental quality, financial inclusion, and good governance ensure the FDI sustainably in Belt and Road countries? Evidence from an application of CS-ARDL and NARDL. *Frontiers in Environmental Science* 2022, 10.

[111] JinRu, L.; Qamruzzaman, M., Nexus Between Environmental Innovation, Energy Efficiency, and Environmental Sustainability in G7: What is the Role of Institutional Quality? *Frontiers in Environmental Science* 2022, 10.

[112] Qamruzzaman, M., Nexus between financial innovations, remittances and credit performance: Evidence from augmented ARDL and nonlinear ARDL. *Investment Management and Financial Innovations* 2021, 18, (3), 295-311.

[113] Qamruzzaman, M., Nexus between Remittance, Trade openness and inequality in South Asian countries: New evidence from the nonlinear unit root, nonlinear OLS, and NARDL, and asymmetry causality test. *Contaduría y Administración* 2021, 66, (4), 1-27.

[114] Miao, M.; Qamruzzaman, M., Dose Remittances Matter for Openness and Financial Stability: Evidence From Least Developed Economies. *Frontiers in psychology* 2021, 12, 696600.

[115] Meng, L.; Qamruzzaman, M.; Adow, A. H. E., Technological Adaption and Open Innovation in SMEs: An Strategic Assessment for Women-Owned SMEs Sustainability in Bangladesh. *Sustainability* 2021, 13, (5), 2942.

[116] Md. Qamruzzaman; Ishrat, J.; Salma, K., The Impact of Voluntary Disclosure on Firm's Value: Evidence from Manufacturing Firms in Bangladesh. *The Journal of Asian Finance, Economics and Business* 2021, 8, (6), 671-685.

[117] Md, Q.; Muneeb, M. A.; Rimsha, K.; Ayesha, S.; Hina, S., Symmetric and Asymmetric Effects of Financial Innovation and FDI on Exchange Rate Volatility: Evidence from South Asian Countries. *The Journal of Asian Finance, Economics and Business* 2021, 8, (1), 23-36.

[118] Lingyan, M.; Qamruzzaman, M.; Adow, A. H. E., Technological Adaption and Open Innovation in SMEs: An Strategic Assessment for Women-Owned SMEs Sustainability in Bangladesh. *Sustainability* 2021, 13, (5), 2942.

[119] Jia, Z.; Mehta, A. M.; Qamruzzaman, M.; Ali, M., Economic Policy uncertainty and financial innovation: Is there any affiliation? *Frontiers in psychology* 2021, 12, 1781.

[120] Fang, L.; Qamruzzaman, M., An Asymmetric Investigation of Remittance and Trade Openness Impact on Inequality: Evidence From Selected South Asian Countries. *Frontiers in psychology* 2021, 12.

[121] Ali, Q.; Yaseen, M. R.; Anwar, S.; Makhdum, M. S. A.; Khan, M. T. I., The impact of tourism, renewable energy, and economic growth on ecological footprint and natural resources: A panel data analysis. *Resources Policy* 2021, 74, 102365.

[122] Hassan, Q.; Algburi, S.; Sameen, A. Z.; Al-Musawi, T. J.; Al-Jiboory, A. K.; Salman, H. M.; Ali, B. M.; Jaszczur, M., A comprehensive review of international renewable energy growth. *Energy and Built Environment* 2024.

[123] Yi, J.; Dai, S.; Li, L.; Cheng, J., How does digital economy development affect renewable energy innovation? *Renewable and Sustainable Energy Reviews* 2024, 192, 114221.