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An assessment of the effect of gross capital formation and financial development on Renewable Energy Consumption in middle-income nations: Does FDI act as a boosting factor? Evidence from CS-ARDl and NARDL framework

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Abstract

The association between foreign direct investment (FDI), gross capital formation (GCF), financial development, and renewable energy usage is investigated in this research (REC). The research used the CS-ARDL and NARDL estimates to examine the correlation among REC, FDI, GCF, and financial development. The results demonstrate a strong and statistically valid positive correlation in both the immediate and prolonged periods. Whether innovation in FDI is favourable or bad, it may ultimately affect REC, either by accelerating or diminishing it. Additionally, the research emphasizes a substantial and statistically valid association between REC and GCF, demonstrating that domestic capital creation has a favourable effect on the incorporation of clean energy. Furthermore, the data demonstrates a noteworthy association between financial development and renewable energy certificates (RECs), suggesting that the financial incentivizes facilitated by financial development play a pivotal role in encouraging the widespread use of REC. The results shown in this research are consistent with prior scholarly works and have substantial ramifications for comprehending the intricate interplay of sustainable energy, foreign direct investment (FDI), gross capital formation (GCF), and financial growth. However, the research emphasizes the need to conduct a thorough assessment of the characteristics and quality of foreign direct investment (FDI) inflows. Furthermore, it emphasizes the need to promote equitable and sustainable development in the renewable energy industry while considering its impacts on society and the environment. In addition, the report highlights the possible social and environmental repercussions that may result from renewable energy initiatives sponsored locally. This underscores the importance of establishing resilient policy frameworks and efficient governance mechanisms to guarantee that financial development, foreign direct investment (FDI), and the Green Climate Fund (GCF) all contribute to fostering sustainable and equitable expansion in the utilization of renewable energy. As a result, the study's results provide significant contributions to the understanding of how to optimize the use of financial development, green climate funds (GCF), and foreign direct investment (FDI) in order to promote the adoption of renewable energy. But before formulating sustainable approaches to encourage the use of renewable energy, it is vital to do a thorough evaluation of the broader ramifications and associated variables.

Keywords: Renewable energy consumption; Financial development; FDI; Cross capital formation; CS-ARDl; NARDL

1. Introduction

Using renewable energy is crucial in order to support sustainable development, guarantee energy security, and improve social well-being [1-9]. Renewable energy (RE) offers many benefits that are important for society's economic and social elements. The adoption and expansion of renewable energy sources may have far-reaching beneficial effects on the economy. Renewable energy investments may stimulate the economy by creating many new jobs in fields like as manufacturing, installation, R&D, and production, among many others. The stud of Wang, et al. [10], Su, et al. [11], Rahman, et al. [12], Olabi and Abdelkareem [13] disclosed the potential to greatly enhance economic growth at both the

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local and national levels, especially in regions that are fortunate to have abundant renewable energy resources. In addition, the use of renewable energy technologies offers the potential to lower energy expenses for both consumers and companies over time[14-16]. Renewable energy (RE) has the potential to significantly affect the economy by reducing energy costs and expanding access to cheap power. We can diversify our energy sources and reduce our reliance on fossil fuels with the help of renewable energy, which is an encouraging development toward greater energy security. The dangers of price swings and supply interruptions may be mitigated in this way. Concurrently, it is critical to acknowledge the tremendous benefits that society reaps from renewable energy sources. [17, 18]. Reducing air and water pollution, which are usually associated with traditional energy sources, is one way in which renewable energy technologies may improve public health. Particularly in places where pollution from conventional energy sources is a major problem, this may lead to healthcare expense reductions and general community improvement. Renewable energy projects can empower local people by providing opportunities for ownership, engagement, and profit sharing. Community-based renewable energy initiatives can bring people together, empower them, and give them a sense of belonging. Furthermore, these activities may help to improve and invigorate the local economy. These activities not only enhance the area's well-being but also build a strong sense of pride and ownership in the community. Furthermore, in rural or poor areas, renewable energy technology has the ability to significantly expand energy accessibility while also creating fairness. Solar home systems and mini-grids, which are localized renewable energy solutions, provide a tremendous opportunity to supply communities with sustainable and dependable power. As a consequence, economic activity and living standards may rise. [19, 20]. Renewable energy is incredibly important for both the economy and society, and there are many factors that contribute to this significance. It has the potential to boost the economy, create job opportunities, lower energy costs, improve public health, strengthen energy independence, support local communities, and increase energy availability. In order to move towards a more sustainable and inclusive energy future, it is important to acknowledge and utilize the economic and social advantages that accompany this shift[21, 22].

The nexus between foreign direct investment (FDI), gross capital formation, financial development, and renewable energy consumption is a topic of increasing interest and importance in the context of global economic development and sustainability. These factors are interconnected in complex ways, and understanding their relationships is crucial for shaping policies and strategies that promote both economic growth and environmental responsibility [19, 20, 23-25]. Foreign direct investment represents a significant inflow of capital and technology into a country, often playing a key role in economic development. Gross capital formation, on the other hand, reflects the level of investment in physical assets within an economy, which is essential for driving productivity and growth. Financial development, encompassing the efficiency and effectiveness of financial intermediaries and markets, is crucial for facilitating investment and economic activity. Meanwhile, renewable energy consumption is a vital indicator of a country's commitment to sustainable and environmentally friendly energy sources, with implications for climate change mitigation and energy security. Studying the interplay between these factors can provide valuable insights into how FDI, capital formation, financial development, and renewable energy consumption influence each other and contribute to overall economic and environmental outcomes. This understanding can inform policies and strategies aimed at promoting sustainable economic growth, energy transition, and environmental stewardship. By examining the nexus between these variables, researchers and policymakers can gain a deeper understanding of how to harness FDI, capital formation, and financial development to drive renewable energy consumption and sustainable development. This knowledge can help guide decision-making processes and shape initiatives that balance economic prosperity with environmental sustainability, ultimately contributing to a more resilient and equitable global economy.

2. Literature review

2.1. FDI effects on renewable energy consumption

FDI is widely recognized as a crucial factor in the economic development and transfer of technology to the countries where it is received [20, 25-29]. There is a growing body of study that examines the impact of foreign direct investment (FDI) on the use of renewable energy sources, reflecting the increasing importance of these sources in the global economy. Both developed and developing nations have been the focus of studies investigating the correlation between foreign direct investment and the adoption of renewable energy sources. Consensus findings suggest that foreign direct investment (FDI) may assist host countries in developing their renewable energy infrastructure and technology capacities. This is often attributed to the fact that multinational corporations involved in renewable energy initiatives disseminate knowledge, expertise, and funding [21, 22, 30-33]. Literature offered by Chau, et al. [34], Cao, et al. [35], Binh An, et al. [36], Balsalobre-Lorente, et al. [37] indicate that foreign direct investment (FDI) has a positive impact on the renewable energy policies and frameworks of host countries. The regulatory frameworks and investment climates for renewable energy are vulnerable to the impact of multinational firms, who often bring with them their own national standards and optimal approaches when they participate in such ventures.

In the Studies of Qamruzzaman [2], Su, Wang, Li and Wang [11], Rahman, Alam and Velayutham [12], Zhao and Qamruzzaman [38] have shown that foreign direct investment (FDI) is critical to fostering innovation and technological improvement in the renewable energy sector. Foreign direct investment (FDI) may help host nations embrace renewable energy by transferring sophisticated renewable energy technology, funding research and development, and disseminating knowledge. However, it is important noting that the research recognizes the presence of possible constraints and obstacles connected with FDI in the renewable energy industry. Concerns have been raised about the potential for large-scale renewable energy efforts to develop reliance on certain technology, create inequities in the distribution of benefits, and have negative environmental effects. Furthermore, the effect of foreign direct investment (FDI) on the utilization of renewable energy sources such as solar, wind, hydropower, and biofuels may vary. Studies of Derindag, et al. [39], Chen and Raza [40], Xiao and Qamruzzaman [41], JinRu, et al. [42] have examined the impact of foreign direct investment (FDI) on the use of renewable energy in various sectors, uncovering the unique dynamics and challenges associated with each kind of renewable power. The study of Chen and Raza [40], Karim, et al. [43], Farzana, et al. [44] the consequences of foreign direct investment (FDI) on the use of renewable energy sources reveals that this relationship is intricate. Considering the potential challenges and industry-specific factors when using foreign direct investment (FDI) for sustainable energy expansion is of utmost importance, notwithstanding the potential benefits of FDI in boosting renewable energy consumption via investment, innovation, and knowledge exchange. Additional research is necessary to get a deeper understanding of the impact of foreign direct investment (FDI) on the use of renewable energy sources. This research will help inform strategies and policies that may maximize the positive benefits of FDI on the transition to sustainable energy.

2.2. Gross capital formation effects on renewable energy consumption

Considering the growing consensus on the significance of investment in facilitating the adoption of renewable energy, numerous studies have examined the correlation between GDP growth and the utilization of renewable energy [27, 45]. The impact of gross capital development on renewable energy use in industrialized and emerging countries has been thoroughly examined. Our results corroborate those of other studies showing that more expenditures in physical assets and infrastructure (measured by gross capital development) are associated with a greater uptake and use of renewable energy sources. It is generally believed that a major factor in this link is the funding of the necessary infrastructure for renewable energy production, transmission, and distribution. In addition, a great deal of research has shown that a major factor in encouraging innovation and technical advancement in the renewable energy sector is the production of substantial money. More funding for R&D and the implementation of state-of-the-art technologies may greatly increase the use of renewable energy sources, according to empirical evidence. Sustainable and environmentally friendly energy may be more accessible, particularly in developing nations, if investments were made in the development of renewable energy infrastructure [38, 41, 46].

In addition, various studies such as Qamruzzaman [4, 5], Wang, Qamruzzaman, Serfraz and Theivanayaki [23], JinRu, Qamruzzaman, Hangyu and Kler [42], Wei, et al. [47], Guan and Qamruzzaman [48], Bhuiyan, et al. [49] have analyzed the effects of different types of investment, encompassing both public and private sectors, on the utilization of renewable energy sources. There is a growing body of evidence indicating that investments in renewable energy projects and infrastructure, regardless of whether they are carried out by the public sector or private companies, can have a significant impact on the development and adoption of renewable energy technologies. The study recognizes numerous limitations and possible difficulties in establishing a causal relationship between GCF and the use of RE. There are significant concerns regarding the lack of appropriate regulatory structures, market incentives, and policy frameworks that are necessary to ensure that the generation of capital leads to equitable and sustainable growth in the adoption of renewable energy[50-52]. Studies examining the correlation between gross capital formation and renewable energy consumption highlight the pivotal importance of investment in propelling the shift towards renewable energy sources. Increased investment in renewable energy leads to higher utilization, but the impact of this investment is susceptible to political, regulatory, and market forces. As a result, it is crucial to approach this matter with utmost caution and thoughtful analysis. Further research is required to gain a more comprehensive understanding of the effects of gross capital development on renewable energy consumption. This will assist in the development of informed policies and legislation that optimize investments in sustainable energy transitions.

2.3. Financial development effects on renewable energy consumption

There has been a notable increase in the volume of research dedicated to exploring the correlation between the expansion of the financial sector and the utilization of renewable energy sources [38, 44, 53-55]. This can be attributed to the increasing recognition of the crucial role that financial institutions play in facilitating the shift towards sustainable energy sources. The aim of this literature review is to offer a succinct overview of the key findings and commonly observed patterns in research exploring the impact of economic growth on the adoption of renewable energy sources. Extensive research has been conducted in both developed and developing nations to explore the correlation between economic prosperity and the adoption of renewable energy sources. Previous research such as Tan, Qamruzzaman and Karim [20], Qamruzzaman and Kler [26], Farzana, Qamruzzaman, Islam and Mindia [44], Akpanke, et al. [56], MEHTA, et al. [57], Qamruzzaman and Karim [58] has shown that a strong and well-established financial system is closely linked to higher levels of investment and the widespread adoption of renewable energy technology. This observation aligns with the results of other research studies. This system is characterized by efficient financial intermediation, convenient access to capital, and a regulatory framework that is supportive. The significant role played by financial institutions in enabling investment opportunities, offering risk management solutions, and providing funding for renewable energy projects may be the key factor driving the increased adoption of renewable energy.

Existing literature highlights the importance of market mechanisms and financial innovation in promoting the adoption of renewable energy sources. Based on various studies, it has been found that certain financial products, such as green bonds, renewable energy funds, and carbon finance instruments, can effectively attract investments in sustainable energy sources and generate profits for renewable energy projects[24, 47, 55]. If there are laws in place that promote the expansion of renewable energy projects, such as feed-in tariffs, tax incentives, and renewable energy objectives, then financial institutions may be more inclined to actively engage in these projects. In addition, various studies have been carried out to enhance the utilization of renewable energy sources. These studies have explored the potential advantages that developing nations may experience through improved access to finance and initiatives promoting financial inclusiveness. When individuals, businesses, and communities have convenient access to financial services like loans, insurance, and investment opportunities, they can potentially improve their utilization of renewable energy sources by investing in the necessary technology and infrastructure[43, 44, 54, 59]. Additionally, the existing literature has acknowledges that there are numerous limitations and challenges associated with the connection between economic growth and the utilization of renewable energy sources. The insufficient level of transparency in financial markets, risk management systems, and regulatory frameworks has raised significant concerns. The absence of transparency may hinder the capacity of financial development to facilitate sustainable and fair growth in the production and utilization of renewable energy [46, 60-64].

Ultimately, studies that assess the influence of financial development on the adoption of renewable energy sources underscore the significance of robust financial systems in facilitating the shift towards sustainable energy. To effectively raise funds, mitigate risks, and foster investment in renewable energy, it is crucial to establish a strong financial system characterized by inclusivity, innovation, and supportive regulation. Further study is necessary to gain a deeper understanding of how increases in financial development impact the utilization of renewable energy. This information will greatly enhance the development of plans and policies aimed at maximizing the positive impact of financial systems on the transition to sustainable energy.

3. Data and methodology of the study

To explore the magnitude of financial openness and trade openness on energy transition, the present study has implemented several robust econometric tools such as Cross-sectional ARDL offered by [65]. The generalized CS-ARDL for the empirical testing is as follows.

$$\overline{REC}_{it} = \bar{\alpha}_{it} + \sum_{j=1}^{p} \bar{\beta}_{ij}\overline{REC}_{i,t-j} + \sum_{j=0}^{q} \bar{\gamma}_{ij}\bar{Q}_{i,t-j} + \bar{\omega}_t' P_t + \bar{\epsilon}_{it} \quad (6)$$

$$\text{Where, } \bar{\alpha}_{it} = \frac{\sum_{i-1}^{N} \alpha_i}{N}$$

$$\overline{REC}_{t-j} = \frac{\sum_i^N REC_{i,,t-j}}{N},\ \bar{\beta}_j = \frac{\sum_i^N \beta_{i,j}}{N}\ j = 0,1,2\ p$$

$$\bar{Q}_{t-j} = \frac{\sum_i^N Q_{i,,t-j}}{N}, \bar{\Upsilon}_j = \frac{\sum_i^N \Upsilon_{i,j}}{N}, J = 0,1,2\ q$$

$$\bar{\bar{\omega}}_j = \frac{\sum_{i=1}^N \omega_i}{N}, \bar{\varepsilon}_t = \frac{\sum_i^N \epsilon_{i,t}}{N}$$

The error term, εi, in Eq. (6) is independently distributed across time and countries, mean congregates to zero (i.e., $\bar{\varepsilon} t$ = 0) in root mean square error as $N \to \infty$. Therefore, the linear effects of both dependent and independents can establish in the presence of cross-sectional dependence in μi,

$$REC_{it} = \bar{\alpha}_{it} + \sum_{j=1}^{p} \bar{\beta}_{ij} \overline{REC}_{i,t-j} + \sum_{j=0}^{q} \bar{\gamma}_{ij} \bar{Q}_{i,t-j} + \bar{\omega}'_t P_t \ (7)$$

$$\downarrow$$

$$\bar{\omega}'_t P_t = \overline{REC}_{it} - \bar{\alpha}_{it} + \sum_{j=1}^{p} \bar{\beta}_{ij} \overline{REC}_{i,t-j} + \sum_{j=0}^{q} \bar{\gamma}_{ij} \bar{Q}_{i,t-j}$$

$$\downarrow$$

$$P_t = \overline{REC}_{it} - \bar{\alpha}_{it} + \sum_{j=1}^{p} \bar{\beta}_{ij} \overline{REC}_{i,t-j} + \sum_{j=0}^{q} \bar{\gamma}_{ij} \bar{Q}_{i,t-j} \Big/ \bar{\omega}'_t$$

Thus, the Panel CS-ARDL specification of Equation (2)

$$\overline{REC}_{it} = \epsilon_{it} + \sum_{j=1}^{p} \beta_{ij} \overline{REC}_{i,t-j} + \sum_{j=0}^{q} \gamma_{ij} \bar{Q}_{i,t-j} + \sum_{j=0}^{p} \bar{\partial}'_{tj} \bar{P}_{i,t-j} + \epsilon_{it} \ (8)$$

Where $\bar{P} = (\overline{FDI}, \bar{X})$ and $S_{\bar{Z}}$ In the number of lagged cross-sectional averages. Furthermore, Equation (8) can be reparametrized to the effects of the ECM presentation of Panel CS-ARDL as follows:

$$\Delta REC_{it} = \alpha_i + \xi_i (REC_{it-1} - \omega'_t Q_{it-1}) + \sum_{J=1}^{M-1} \gamma_{ij} \Delta REC_{it-J} + \sum_{J=0}^{N-1} \beta_{ij} \Delta Q_{it-J} + \sum_{j=1}^{p} \lambda_j \overline{\Delta REC}_{i,t-j} + \sum_{j=0}^{q} \delta_j \overline{\Delta Q}_{i,t-j} + \sum_{j=0}^{S_{\bar{Z}}} \bar{\partial}'_{tj} \bar{P}_{i,t-j} + \mu_{it} \ (9)$$

Where $\overline{\Delta REC}_{t-j} = \frac{\sum_i^N \Delta REC_{i,,t-j}}{N}, \overline{\Delta Q}_{t-j} = \frac{\sum_i^N \Delta Q_{i,,t-j}}{N}$

Asymmetric ARDL following the nonlinear framework introduced by [66], the above equation (1-3) can be established in the following manner

$$REC_t = (\beta^+ FDI^+_{1,t} + \beta^- FDI^-_{1,t}) + (\gamma^+ FD^+_{1,t} + \gamma^- FD^-_{1,t}) + (\pi^+ GCF^+_{1,t} + \pi^- GCF^-_{1,t}) + \delta_i X_t + \varepsilon_t \ (10)$$

Where the value of $\beta^+ \& \beta^-$; $\gamma^+ \& \gamma^-$; $\pi^+ \& \pi^-$ Stands the asymmetric elasticity of financial, trade, and economic openness on REC, NRE, and fossil energy consumption, respectively. The asymmetric decomposition of financial openness $[FO^+_{1,t};\ FO^-_{1,t}]$, Trade Openness $[TO^+_{1,t};\ TO^-_{1,t}]$, and Economic Openness $[EO^+_{1,t};\ EO^-_{1,t}]$ can be derived through the execution of the following equations.

$$\begin{cases} POS(FDI)_{1,t} = \sum_{k=1}^{R} lnFDI^+_k = \sum_{K=1}^{R} MAX(\Delta lnFDI_k, 0) \\ NEG(FDI)_t = \sum_{k=1}^{R} lnFDI^-_k = \sum_{K=1}^{R} MIN(\Delta lnFDI_k, 0) \end{cases} : \begin{matrix} POS(FD)_{1,t} = \sum_{k=1}^{R} lnFD^+_k = \sum_{K=1}^{R} MAX(\Delta lnFD_k, 0) \\ NEG(FD)_t = \sum_{k=1}^{R} lnFD^-_k = \sum_{K=1}^{R} MIN(\Delta lnF_k, 0) \end{matrix}$$

$$; \begin{matrix} POS(GCF)_{1,t} = \sum_{k=1}^{R} lnGCF^+_k = \sum_{K=1}^{R} MAX(\Delta lnGCF_k, 0) \\ NEG(GCF)_t = \sum_{k=1}^{R} lnGCF^-_k = \sum_{K=1}^{R} MIN(\Delta lnGCF_k, 0) \end{matrix}$$

Now, equation (14) is transformed into asymmetric long-run and short-run coefficient assessment as follows:

$$\Delta REC_t = \partial U_{t-1} + (\mu^+ FDI^+_{1,t-1} + \mu^- FFDIO^-_{1,t-1}) + (\alpha^+ FD^+_{1,t-1} + \alpha^- FD^-_{1,t-1}) + (\varphi^+ GCF^+_{1,t-1} + \varphi^- gcf^-_{1,t-1}) + \beta X^*_{1,t-1} + \sum_{j=1}^{m-1} \beta_j \Delta REC_{t-j} \; _0 + \sum_{j=1}^{n-1} (\epsilon^+ \Delta FDI^+_{1,t-1} + \epsilon^- \Delta FDI^-_{1,t-1}) + \sum_{j=0}^{m-1} (\theta^+ \Delta FD^+_{1,t-1} + \theta^- \Delta FD^-_{1,t-1}) + \sum_{j=0}^{m-1} (\vartheta^+ \Delta GCF^+_{1,t-1} + \vartheta^- \Delta GCF^-_{1,t-1}) + \sum_{j=0}^{m-1} \mu \Delta X^*_{1,t-1} + \varepsilon_t \quad (13)$$

Moreover, the directional association established through the implementation of Period to execute the target estimation, the study has performed several preliminary assessments, that is, slop of homogeneity test following [67], cross–sectional dependency test targeting the framework offered by [68-70]. The test statistic is to be derived by executing the following equations.

$$y_{it} = \alpha_i + \beta_i x_{it} + u_{it} \text{ i= 1......N, t=1......T} \quad (16)$$

$$LM = T \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \hat{\rho}_{IJ \underset{d}{\rightarrow} X^2 N(N+1)2} \quad (3)$$

$$CD_{lm} = \sqrt{\frac{N}{N(N-1)}} \sum_{I=1}^{N-1} \sum_{J=i+1}^{N} \left(T\hat{\rho}_{ij} - 1 \right) \quad (17)$$

$$CD_{lm} = \sqrt{\frac{2T}{N(N-1)}} \sum_{I=1}^{N-1} \sum_{J=i+1}^{N} \left(\hat{\rho}_{ij} \right) \quad (18)$$

$$CD_{lm} = \sqrt{\frac{2}{N(N-1)}} \sum_{I=1}^{N-1} \sum_{J=i+1}^{N} \left(\frac{(T-K)\hat{\rho}^2_{ij} - u_{Tij}}{v^2_{Tij}} \right) \vec{d}\,(N,0) \quad (19)$$

The static properties have been investigated by implementing the second-generation panel unit root test introduced by Pesaran [71], which commonly experiences the robustness and superior performance of the widely adopted second-generation panel unit root test, CIPS and CADF. Researchers and practitioners alike have found this test to be the ultimate solution, surpassing traditional tests. Introducing the Cross-sectionally Augmented IPS (CIPS) test - the perfect solution for analyzing non-stationary time series with spatial correlation. Its unique ability to consider cross-sectional dependence within a panel data structure sets it apart. Introducing the Common Correlated Effects Average Dickey-Fuller (CADF) test - the ultimate solution to the limitations of standard unit root tests when identifying stationarity in panels with common shocks. Whether the study deals with small sample sizes or unbalanced panels, both tests deliver reliable results that are frequently encountered in empirical studies. With the added benefit of accommodating diverse individual-specific trends and intercepts, these models maintain exceptional power in the face of various forms of serial correlation commonly found in economic time series data. The following equation is to be implemented for deriving the test statistics.

This approach is known as CADF. Pesaran (2007) uses equation-9 for the CADF unit root test:

$$\Delta Y_{it} = \beta_i + \gamma_i y_{i,t-1} + \pi_i \bar{y}_{t-1} + \beta_i \bar{y}_t + \rho_{it} \quad (20)$$

$$\Delta Y_{it} = \mu_i + \gamma_i y_{i,t-1} + \pi_i \bar{y}_{t-1} + \sum_{k=1}^{p} \beta_{ik} \Delta y_{i,k-1} + \sum_{k=0}^{p} \beta_{ik} \overline{\Delta y}_{i,k-0} + \alpha_{it} \quad (21)$$

$$CIPS = N^{-1} \sum_{i-1}^{N} \partial_i (N,T) \quad (22)$$

$$CIPS = N^{-1} \sum_{i-1}^{N} CADF \quad (23)$$

The present study confirms the robustness estimation by employing the AMG and CCEMG; both methods can address the issue of CDS and heterogeneity ([26, 43, 72]

4. Results and discussion

Research variables properties have guided the empirical nexus assessment by the section of an appropriate econometric model. This study implemented CSD, SHT, and PURT in documenting the research units' elementary characteristics. **Error! Reference source not found.** exhibits the results of the CSD and SH tests. Referring to the test statistics derived from the CSD test revealed the rejection of the null hypothesis of cross-section independency. Alternatively, the study established cross-sectional dependency among the research units. Additionally, the heterogeneity properties have been exposed through the execution of the slope of homogeneity test

Table 1 Results of cross-sectional dependency test

	LM_{BP}	LM_{PS}	LM_{adj}	CD_{PS}	**Δ**	**Adj.Δ**
REC	270.147***	20.111***	237.526***	18.823***	34.731***	79.894***
FDI	351.335***	28.685***	228.32***	32.922***	26.323***	111.002***
FD	292.086***	35.336***	155.732***	15.255***	45.904***	131.95***
GCF	207.108***	25.765***	142.981***	38.572***	52.471***	100.689***
Y	238.18***	27.023***	138.98***	51.792***	16.693***	148.716***

The study implemented the second-generation panel unit root test by implementing CIPS and CADF proposed by Pesaran. The results of PURT are displayed in **Error! Reference source not found.**. According to test statistics found from CIPS and CADF with a level, all eh variables are nonstationary, while the first difference operator established stationary by rejecting the null hypothesis of stationary.

Table 2 Results of second generation panel unit root test

Variables	**CADF test statistic for constant**		**CIPS test statistic for constant**		**CADF test statistic for constant & trend**		**CIPS test statistic for constant & trend**	
	Level	**first difference**	**Level**	**first difference**	**level**	**first difference**	**level**	**first difference**
REC	-2.779	-7.455***	-1.791	-4.609***	-1.375	-4.809***	-1.362	-7.572***
FDI	-2.35	-6.891***	-2.205	-3.361***	-2.698	-5.805***	-2.93	-6.487***
FD	-1.221	-5.56***	-2.666	-5.205***	-1.604	-2.831***	-2.668	-4.323***
GCF	-2.916	-4.337***	-2.797	-2.401***	-2.59	-7.462***	-2.18	-2.004***
Y	-2.064	-3.655***	-1.12	-3.355***	-1.245	-4.691***	-2.425	-4.489***

Next, the survey executed a panel cointegration test by following the framework proposed in assessing the long-run association between energy consumption measured by renewable, fossil and bias and the explanatory variables. Based on a diverse proxy for dependent variables, the study performed three cointegration models for long-run assessment. The results of long-run cointegration are exhibited in **Error! Reference source not found.**, consisting of three panels of output. The test statistics derived from the panel cointegration test were found statistically significant at a 1% level, indicating the rejection of the null hypothesis of no-cointegration, alternatively revealing the long-run association between explained and explanatory variables.

Table 3 Results of panel cointegration test

Model	FDI--->REC	FD--->REC	GCF--->REC	Y--->REC
Gt	-13.313***	-14.402***	-13.196***	-12.395***
Ga	-11.578***	-14.166***	-7.561***	-6.177***
Pt	-10.478***	-6.061***	-8.555***	-14.797***
Pa	-15.964***	-9.035***	-11.092***	-15.053***
KRCPT				
MDF	18.357***	-3.573***	-6.724***	6.198***
DF	21.24***	-8.846***	-5.077***	8.615***
ADF	6.893***	5.324***	-7.813***	6.226***
UMDF	14.637***	-5.921***	14.94***	22.154***
UDF	8.327***	18.031***	18.254***	16.452***
PCT				
MDF	7.692***	-2.084***	-5.313***	7.254***
PP	-1.1***	7.74***	-3.563***	1.332***
ADF	14.203***	13.013***	9.224***	11.068***

For FDI, study revealed a positive and statistically significant linkage in the long-run (short run) between foreign direct investment and renewable energy consumption, which is valid both in the estimation of CS-ARDL and NARDL. Our findings is in line with existing literature see for instance [4, 30, 31, 73-80]. In particular, a 10% changes in the long-run (short) will results in increase o REC by 1.545% (0.735%). furthermore, the positive (negative) innovation in FDI results in acceleration (degradation) of REC in the long-run by 0.2763% (0.2669%) and by 0.0948% (0.0548%) with a 1% changes in the FDI inflow in the economy. In line with the findings of the CS-ARDL and NARDL models, the study discovered a significant and positive correlation between foreign direct investment (FDI) and the consumption of renewable energy, both in the short and long term. This discovery holds significant implications for the intricate relationship between foreign direct investment (FDI) and the development of sustainable energy [42, 81-85]. There is a robust and statistically significant relationship between foreign direct investment (FDI) and the consumption of renewable energy sources. This suggests that FDI plays a significant role in promoting and facilitating the adoption of renewable energy. The advancement and expansion of renewable energy infrastructure and technologies depend on the financial investment, technological expertise, and knowledge brought by foreign direct investment (FDI). This aligns with the notion that foreign direct investment has the potential to bring about these positive outcomes.

The coefficients of gross capital formation on REC has revealed positive and statistically significant in both CS-ARDL and NARDL estimation in the long-run and short-run, implying a beneficial effects of domestic capital formation in inclusion of clean energy in the energy mix. Existing literature has supported our findings see for instance [57, 86-90]. The study's results emphasize the robust and significant correlation between gross capital formation (GCF) and renewable energy consumption (REC). The findings, derived from rigorous CS-ARDL and NARDL calculations, demonstrate that domestic capital creation significantly contributes to the integration of clean energy sources into the overall energy mix. These findings indicate that allocating resources towards renewable energy infrastructure might have favorable and enduring outcomes in terms of sustainable energy use. This finding underscores the need of allocating resources towards tangible assets and infrastructure in order to foster the adoption of sustainable energy sources.

For financial development, the coefficients disclosed positively connected to REC in both CS-AEDL and NARDL estimation in the long-run and short-run assessment, suggestion the access to financial benefits that is financial development prompt the energy consumption especially renewable sources. Our results is in line with existing literature such as [7, 76, 91-96]. According to the findings of the study, there is a significant and robust correlation between the utilization of renewable energy and financial development. Using the CS-ARDL and NARDL estimations, both the short-term and long-term analyses provide support for this conclusion. The findings of this study indicate that the provision of financial incentives, facilitated by financial development, is a pivotal factor in encouraging the use of energy sources, particularly renewable ones.

Table 4 Results of Long –run and short-run coefficients: CS-ARDL and NARDL

Variables	**Coefficient**	**st.error**	**t-stat**	**Variables**	**Coefficient**	**st.error**	**t-stat**
Panel- A: Log –run coefficient							
GDP	0.1669	0.0229	7.2882	FDI	0.1267	0.0172	7.3662
GDP^2	-0.2916	0.0715	-4.0783	GCF	-0.2753	0.0368	-7.4809
FDI^+	0.2431	0.042	5.788	FD	0.1603	0.0589	2.7215
FDI	0.295	0.073	4.041	Y	0.1779	0.0216	8.2361
FD^+	0.2926	0.0718	4.0752	Y2	0.1919	0.0701	2.7375
FD	0.2473	0.0579	4.2711				
GCF^+	0.1984	0.0485	4.0907				
GCF	0.2859	0.0057	50.1578				
C	-0.2977	0.0211	-14.109				
W_{FDI}	12.2083						
W_{FD}	7.0323						
W_{GCF}	5.8381						
Panel –B: Short-run coefficient							
△GDP	0.0968	0.0041	23.6097	△FDI	0.0761	0.0503	1.512922
$△GDP^2$	-0.1023	0.0026	-39.3461	△GCF	0.0454	0.0426	1.065728
$△FDI^+$	0.0891	0.0364	2.4478	△FD	0.0261	0.0526	0.496198
△FDI	0.0926	0.0286	3.2377	△Y	0.0534	0.0669	0.798206
$△FD^+$	0.0727	0.0309	2.3527	△Y2	0.0268	0.04	0.67
△FD	0.0919	0.0794	1.1574		0.0377	0.0098	3.846939
$△GCF^+$	0.0768	0.0296	2.5945				
△GCF	0.0676	0.0094	7.1914				
cointEq (-1)	0.0854	0.0248	3.4435				
W_{FDI}	7.0224						
W_{FD}	8.0575						
W_{GCF}	1.3215						

Table 5 displayed the results of directional causality test following the non-granger causality test. Study findings exposed bidirectional causality between REC, FD, GCF and Y, while unidirectional causality revealed from REC to FDI.

Table 5 Results of no granger causality test: D-H causality test

Null Hypothesis:	**W-Stat.**	**Zbar-Stat.**	remarks
REC does not homogeneously cause FDI	5.647184	5.952132	-->
FDI does not homogeneously cause REC	2.126461	2.24129	
REC does not homogeneously cause FD	4.451647	4.692036	-->
FD does not homogeneously cause REC	1.918172	2.021753	
REC does not homogeneously cause GCF	5.78746	6.099983	<---->
GCF does not homogeneously cause REC	5.174283	5.453694	
REC does not homogeneously cause Y	3.092455	3.259447	-->
Y does not homogeneously cause REC	0.901169	0.949832	
FDI does not homogeneously cause FD	5.247609	5.53098	<---->
FD does not homogeneously cause FDI	3.380446	3.56299	
FDI does not homogeneously cause GCF	1.676939	1.767494	<--
GCF does not homogeneously cause FDI	3.739639	3.941579	
FDI does not homogeneously cause Y	4.10627	4.328009	<---->
Y does not homogeneously cause FDI	5.990436	6.313919	
FD does not homogeneously cause GCF	1.857598	1.957909	
GCF does not homogeneously cause FD	2.512221	2.647881	
FD does not homogeneously cause Y	4.392136	4.629311	-->
Y does not homogeneously cause FD	2.62593	2.76773	
GCF does not homogeneously cause Y	0.845909	0.891588	<--
Y does not homogeneously cause GCF	5.226355	5.508578	

5. Discussion of the findings

For FDI, study revealed a positive and statistically significant linkage in the long-run (short run) between foreign direct investment and renewable energy consumption, which is valid both in the estimation of CS-ARDL and NARDL. Our findings is in line with existing literature see for instance [4, 30, 31, 73-80]. In particular, a 10% changes in the long-run (short) will results in increase o REC by 1.545% (0.735%). furthermore, the positive (negative) innovation in FDI results in acceleration (degradation) of REC in the long-run by 0.2763% (0.2669%) and by 0.0948% (0.0548%) with a 1% changes in the FDI inflow in the economy. In line with the findings of the CS-ARDL and NARDL models, the study discovered a significant and positive correlation between foreign direct investment (FDI) and the consumption of renewable energy, both in the short and long term. This discovery holds significant implications for the intricate relationship between foreign direct investment (FDI) and the development of sustainable energy [42, 81-85]. There is a robust and statistically significant relationship between foreign direct investment (FDI) and the consumption of renewable energy sources. This suggests that FDI plays a significant role in promoting and facilitating the adoption of renewable energy. The advancement and expansion of renewable energy infrastructure and technologies depend on the financial investment, technological expertise, and knowledge brought by foreign direct investment (FDI). This aligns with the notion that foreign direct investment has the potential to bring about these positive outcomes.

While these findings are certainly significant, it is important to thoroughly evaluate the study's constraints and broader ramifications. It is crucial to take into account the type and quality of foreign direct investment (FDI) inflows. This is because not all FDI has an equal impact on the development of sustainable energy. It is important to consider that foreign direct investment (FDI) can have varying effects on renewable energy consumption, depending on the location and other factors. To ensure that FDI contributes to fair and sustainable growth in renewable energy consumption, it is crucial to establish a comprehensive set of policies and governance measures [18, 27, 47, 56, 97, 98]. In addition, it is important for the research to consider the potential impact of equitable and sustainable growth in the renewable energy industry on both the environment and society. Furthermore, it is crucial to examine how foreign direct investment (FDI)-driven renewable energy projects could potentially influence these aspects. In order to enhance sustainability, it is imperative to ensure that the positive relationship between foreign direct investment and the utilization of renewable energy sources effectively benefits local communities. Ultimately, the study's discovery of a noteworthy and statistically meaningful connection between foreign direct investment (FDI) and renewable energy (RE) consumption is certainly commendable. However, to effectively formulate sustainable strategies for leveraging FDI to enhance the utilization of renewable energy, it is crucial to thoroughly assess the broader implications and associated factors that arise from these findings [48, 92, 99-101].

The coefficients of gross capital formation on REC has revealed positive and statistically significant in both CS-ARDL and NARDL estimation in the long-run and short-run, implying a beneficial effects of domestic capital formation in inclusion of clean energy in the energy mix. Existing literature has supported our findings see for instance [57, 86-90]. The study's results emphasize the robust and significant correlation between gross capital formation (GCF) and renewable energy consumption (REC). The findings, derived from rigorous CS-ARDL and NARDL calculations, demonstrate that domestic capital creation significantly contributes to the integration of clean energy sources into the overall energy mix. These findings indicate that allocating resources towards renewable energy infrastructure might have favorable and enduring outcomes in terms of sustainable energy use. This finding underscores the need of allocating resources towards tangible assets and infrastructure in order to foster the adoption of sustainable energy sources. The premise is that more investment in infrastructure and technology correlates with increased acceptance and usage of renewable energy sources. However, it is essential to carefully assess the broader consequences and potential constraints associated with the research, regardless of the importance of these results. Considering the quality and distribution of domestic capital creation, as well as the efficacy of investing in renewable energy infrastructure, is crucial. Furthermore, it is crucial for the research to consider the potential disparities in how GCF impacts the use of renewable energy in different economic sectors and geographical areas. It is essential to acknowledge the significance of comprehensive policy frameworks and governance systems in guaranteeing that the investment in renewable energy results in sustainable and equitable development [102-107].

Furthermore, it is crucial for the research to include the potential environmental and social impacts of renewable energy projects that are motivated by domestic capital development. It is essential to give priority to inclusive and sustainable growth in the renewable energy industry. Ensuring that the positive factors of the greatest common factor (GCF) in renewable energy use lead to tangible benefits for local communities and contribute to wider sustainability goals is of utmost importance. The study's results highlight the significant and relevant correlation between GCF and the usage of renewable energy, which has great importance. Nevertheless, it is important to meticulously examine the broader ramifications and variables associated with these findings. This research aims to establish comprehensive and enduring strategies for leveraging domestic resources to promote the adoption of renewable energy [58, 108-113].

For financial development, the coefficients disclosed positively connected to REC in both CS-AEDL and NARDL estimation in the long-run and short-run assessment, suggestion the access to financial benefits that is financial development prompt the energy consumption especially renewable sources. Our results is in line with existing literature such as [7, 76, 91-96]. According to the findings of the study, there is a significant and robust correlation between the utilization of renewable energy and financial development. Using the CS-ARDL and NARDL estimations, both the short-term and long-term analyses provide support for this conclusion. The findings of this study indicate that the provision of financial incentives, facilitated by financial development, is a pivotal factor in encouraging the use of energy sources, particularly renewable ones. While the implications of these results are noteworthy, it is imperative to thoroughly assess the broader ramifications and potential constraints associated with the research. An instance of this is the significance of considering the efficacy of financial systems in providing access to capital, risk management tools, and investment opportunities for renewable energy initiatives, in addition to the character and inclusiveness of financial development. Furthermore, it is critical that the study consider potential variations in the manner in which financial development influences the utilization of renewable energy across different economic sectors and regions. To ensure that financial development results in an inclusive and sustainable increase in the consumption of renewable energy, it is also vital to consider the significance of comprehensive policy frameworks and governance mechanisms.

Furthermore, the study must consider the potential environmental and social repercussions that may result from the financial development of renewable energy initiatives. Furthermore, it is imperative to emphasize the significance of sustainable and inclusive development in the renewable energy industry. Ensuring that the robust correlation between financial development and the utilization of renewable energy sources yields concrete benefits for local communities and advances broader sustainability goals is of the utmost importance. The study's conclusions regarding the robust and significant correlation between financial development and the adoption of renewable energy sources are, in the end, crucial. Nevertheless, it is imperative to conduct a comprehensive assessment of the broader ramifications and variables associated with these findings to formulate sustainable and all-encompassing strategies for leveraging financial progress to promote the adoption of renewable energy[113-118].

6. Conclusion and suggestion

The results suggest a strong and statistically significant correlation between the use of renewable energy, the growth of the financial industry, the influx of foreign direct investment, and the generation of gross capital. It seems that foreign direct investment, foreign direct investment, and global capital finance all have a role in promoting the use of renewable energy sources. Both the long-run and short-run evaluations reveal a positive and statistically significant correlation, indicating that these variables may influence the use of renewable energy.

Both the long-term and short-term research demonstrate a clear and statistically significant correlation between foreign direct investment (FDI), foreign direct investment (FD), and global climate financing (GCF). These criteria are crucial for encouraging the use of renewable energy sources. This result, consistent with previous research, highlights the significance of foreign direct investment (FDI), strong financial systems (FD), and capital formation (GCF) in facilitating the shift towards renewable energy sources. A positive coefficient for foreign direct investment (FDI) indicates that FDI has a role in financing the development and enhancement of renewable energy infrastructure and systems. This aligns with the concept that foreign direct investment (FDI) may enhance the use of renewable energy sources via the infusion of funds, facilitation of knowledge transfer, and provision of practical experience. A positive coefficient for financial development indicates that a robust financial infrastructure is crucial for attracting investment for renewable energy projects. This is due to the favorable number of coefficients related to financial development. The positive coefficient of gross capital formation underscores the crucial significance of investments in physical assets and infrastructure in promoting the use of renewable energy sources. This provides further substantiation that the use and acceptance of renewable energy sources escalated in tandem with heightened investments in the infrastructure and technologies pertaining to these sources. The results demonstrate the positive impact of foreign direct investment, foreign direct investment, and global climate finance in promoting the inclusion of clean energy through renewable sources. However, it is crucial to critically analyze the various limitations and concerns associated with these findings. Examine the importance of promoting equitable and sustainable growth in the renewable energy industry, and the possible social and environmental consequences that may arise from significant renewable energy initiatives The research should also include the potential variations in the effects of foreign direct investment (FDI), foreign direct investment (FD), and global climate financing (GCF) across various locations and circumstances. Furthermore, it is essential to establish a robust framework of comprehensive rules and regulations to guarantee that the auxiliary functions of these elements contribute to the expansion of renewable energy consumption in a way that is both sustainable and fair. the results demonstrate a strong and statistically significant correlation between foreign direct investment (FDI), foreign direct investment (FD), global climate finance (GCF), and the utilization of renewable energy. However, further examination is necessary to fully understand the broader implications and factors related to these findings, which will enable us to develop sustainable strategies for integrating renewable energy into our overall energy portfolio.

Policy suggestion

The findings of the study indicate that the utilization of renewable energy sources can be significantly enhanced by foreign direct investment (FDI), gross capital formation (GCF), and financial development. These factors have been shown to have a positive impact on the adoption and implementation of renewable energy technologies. The findings of this study have important implications for the formulation of policies and governance structures that can foster sustainable and fair growth in the renewable energy sector. Based on the aforementioned conclusions, the following policy recommendations are proposed:

- It is crucial to differentiate between different categories and characteristics of foreign direct investment (FDI) inflows, as not all FDI has an equal impact on the progress of sustainable energy. Policy frameworks should be developed with the goal of attracting Foreign Direct Investment (FDI) that plays a proactive role in promoting the development of renewable energy infrastructure and technology. In addition, it is of utmost importance to establish thorough policy frameworks and governance mechanisms to ensure that Foreign Direct Investment (FDI), Green Climate Fund (GCF), and financial development all play a role in promoting fair and sustainable growth in the adoption of renewable energy. The aim of these regulations should be to promote the adoption of sustainable energy sources and ensure that the positive outcomes benefit the local communities.
- In addition, it is essential to carry out a thorough assessment of the potential environmental and social impacts of renewable energy projects supported by foreign direct investment (FDI), the Green Climate Fund (GCF), and economic development. Policies should prioritize the promotion of inclusive and sustainable development in

the renewable energy sector. It is crucial to ensure that these policies bring tangible benefits to local communities and make substantial contributions to broader sustainability goals. Considering the quality and distribution of domestic capital creation is of utmost importance. It is essential to prioritize investment in renewable energy infrastructure and technology in order to encourage the widespread adoption of sustainable energy sources. In addition, it is important to make concerted efforts to address any inequalities in how these policies affect various economic sectors and geographical regions.

- In addition, it is crucial for governments to give priority to the allocation of funds, tools for managing risks, and investment opportunities for renewable energy projects within financial institutions. At the same time, it is essential to emphasize the significance of inclusivity in fostering financial development. Emphasizing sustainable and inclusive development is of utmost importance when it comes to the renewable energy sector. It is crucial to establish effective policies that prioritize the connection between financial growth and the utilization of renewable energy. These policies should aim to bring tangible benefits to local communities and contribute to the broader sustainability goals.
- In conclusion, the findings of the study underscore the importance of developing comprehensive and sustainable strategies that incorporate foreign direct investment (FDI), global climate funds (GCF), and financial development to promote the widespread adoption of renewable energy. The goal of these policies should be to ensure sustainable and inclusive growth in the renewable energy sector, while also addressing potential environmental and social impacts and promoting equitable and harmonious development.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest is to be disclosed.

References

[1] 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.

[2] 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.

[3] 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.

[4] 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.

[5] 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.

[6] 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.

[7] 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.

[8] 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.

[9] 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.

[10] Wang, Q.; Dong, Z.; Li, R.; Wang, L., Renewable energy and economic growth: new insight from country risks. Energy 2022, 238.

[11] Su, M.; Wang, Q.; Li, R.; Wang, L., Per capita renewable energy consumption in 116 countries: The effects of urbanization, industrialization, GDP, aging, and trade openness. Energy 2022, 254, 124289.

[12] Rahman, M. M.; Alam, K.; Velayutham, E., Reduction of CO2 emissions: The role of renewable energy, technological innovation and export quality. Energy Reports 2022, 8, 2793-2805.

[13] Olabi, A. G.; Abdelkareem, M. A., Renewable energy and climate change. Renewable and Sustainable Energy Reviews 2022, 158, 112111.

[14] Yang, X.; Ramos-Meza, C. S.; Shabbir, M. S.; Ali, S. A.; Jain, V., The impact of renewable energy consumption, trade openness, CO2 emissions, income inequality, on economic growth. Energy Strategy Reviews 2022, 44, 101003.

[15] Xia, W.; Apergis, N.; Bashir, M. F.; Ghosh, S.; Doğan, B.; Shahzad, U., Investigating the role of globalization, and energy consumption for environmental externalities: Empirical evidence from developed and developing economies. Renewable Energy 2022, 183, 219-228.

[16] Wen, J.; Okolo, C. V.; Ugwuoke, I. C.; Kolani, K., Research on influencing factors of renewable energy, energy efficiency, on technological innovation. Does trade, investment and human capital development matter? Energy Policy 2022, 160, 112718.

[17] Wang, R.; Usman, M.; Radulescu, M.; Cifuentes-Faura, J.; Balsalobre-Lorente, D., Achieving ecological sustainability through technological innovations, financial development, foreign direct investment, and energy consumption in developing European countries. Gondwana Research 2023, 119, 138-152.

[18] Tsoy, L.; Heshmati, A., Is FDI inflow bad for environmental sustainability? Environment, Development and Sustainability 2023.

[19] 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.

[20] 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.

[21] 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.

[22] 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.

[23] 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.

[24] 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.

[25] 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.

[26] 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.

[27] 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.

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

[29] 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.

[30] 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.

[31] 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.

[32] 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.

[33] 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.

[34] Chau, K. Y.; Lin, C.-H.; Tufail, B.; Tran, T. K.; Van, L.; Nguyen, T. T. H., Impact of eco-innovation and sustainable tourism growth on the environmental degradation: the case of China. Economic Research-Ekonomska Istraživanja 2023, 36, (3), 2150258.

[35] Cao, Y.; Cai, J.; Liu, X., Financial inclusion role on energy efficiency financing gaps in COVID-19 period: empirical outcomes of emerging nations. Environ Sci Pollut Res Int 2023, 30, (25), 67279-67289.

[36] 36. Binh An, N.; Kuo, Y.-L.; Mabrouk, F.; Sanyal, S.; Muda, I.; Hishan, S. S.; Abdulrehman, N., Ecological innovation for environmental sustainability and human capital development: the role of environmental regulations and renewable energy in advanced economies. Economic Research-Ekonomska Istraživanja 2023, 36, (1), 243-263.

[37] Balsalobre-Lorente, D.; Shahbaz, M.; Murshed, M.; Nuta, F. M., Environmental impact of globalization: The case of central and Eastern European emerging economies. Journal of Environmental Management 2023, 341, 118018.

[38] 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.

[39] Derindag, O. F.; Maydybura, A.; Kalra, A.; Wong, W.-K.; Chang, B. H., Carbon emissions and the rising effect of trade openness and foreign direct investment: Evidence from a threshold regression model. Heliyon 2023, 9, (7), e17448.

[40] 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.

[41] 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.

[42] 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.

[43] 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.

[44] 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.

[45] 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.

[46] 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.

[47] Wei, D.; Ahmad, F.; Abid, N.; Khan, I., The impact of digital inclusive finance on the growth of the renewable energy industry: Theoretical and logical Chinese experience. Journal of Cleaner Production 2023, 428, 139357.

[48] Guan, C.; Qamruzzaman, M., A symmetric and asymmetric Nexus between environmental sustainability and Tourism Development in BRIC nations: what is the role of Good governance and Globalization? Frontiers in Environmental Science 2022, 1663.

[49] Bhuiyan, M. A.; Zhang, Q.; Khare, V.; Mikhaylov, A.; Pinter, G.; Huang, X., Renewable Energy Consumption and Economic Growth Nexus—A Systematic Literature Review. Frontiers in Environmental Science 2022, 10.

[50] Rahman, Z. U.; Ahmad, M., Modeling the relationship between gross capital formation and CO2 (a)symmetrically in the case of Pakistan: an empirical analysis through NARDL approach. Environmental Science and Pollution Research 2019, 26, (8), 8111-8124.

[51] Bernier, M.; Plouffe, M., Financial innovation, economic growth, and the consequences of macroprudential policies. Research in Economics 2019, 73, (2), 162-173.

[52] Boamah, J.; Adongo, F. A.; Essieku, R.; Lewis Jr, J. A., Financial depth, gross fixed capital formation and economic growth: Empirical analysis of 18 Asian economies. International Journal of Scientific and Education Research 2018, 2, (04).

[53] 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.

[54] 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.

[55] 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.

[56] Akpanke, T. A.; Deka, A.; Ozdeser, H.; Seraj, M., Does foreign direct investment promote renewable energy use? An insight from West African countries. Renewable Energy Focus 2023, 44, 124-131.

[57] 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.

[58] Qamruzzaman, M.; Karim, S., ICT investment impact on human capital development through the channel of financial development in Bangladesh: An investigation of quantile ARDL and Toda-Yamamoto test. Academic Journal of Interdisciplinary Studies 2020, 9, (5), 112-112.

[59] Ergun, S. J.; Rivas, M. F., Does higher income lead to more renewable energy consumption? Evidence from emerging-Asian countries. Heliyon 2023, 9, (1), e13049.

[60] 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.

[61] 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.

[62] 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.

[63] 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.

[64] 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.

[65] Chudik, A.; Pesaran, M. H., Common correlated effects estimation of heterogeneous dynamic panel data models with weakly exogenous regressors. Journal of Econometrics 2015, 188, (2), 393-420.

[66] Shin, Y.; Yu, B.; Greenwood-Nimmo, M., Modelling asymmetric cointegration and dynamic multipliers in a nonlinear ARDL framework. In Festschrift in Honor of Peter Schmidt, Springer: 2014; pp 281-314.

[67] Pesaran, M. H.; Yamagata, T., Testing slope homogeneity in large panels. Journal of econometrics 2008, 142, (1), 50-93.

[68] Breusch, T. S.; Pagan, A. R., The Lagrange Multiplier Test and its Applications to Model Specification in Econometrics. The Review of Economic Studies 1980, 47, (1), 239-253.

[69] Pesaran, M. H., General diagnostic tests for cross-sectional dependence in panels. Empirical Economics 2004, 1-38.

[70] Pesaran, M. H.; Ullah, A.; Yamagata, T., A bias-adjusted LM test of error cross-section independence. The Econometrics Journal 2008, 11, (1), 105-127.

[71] Pesaran, M. H., A simple panel unit root test in the presence of cross-section dependence. Journal of Applied Econometrics 2007, 22, (2), 265-312.

[72] Pesaran, M. H., General diagnostic tests for cross-sectional dependence in panels. Empirical Economics 2021, 60, (1), 13-50.

[73] 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.

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

[75] 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.

[76] 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.

[77] 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.

[78] 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.

[79] 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.

[80] Dossou, T. A. M.; Ndomandji Kambaye, E.; Asongu, S. A.; Alinsato, A. S.; Berhe, M. W.; Dossou, K. P., Foreign direct investment and renewable energy development in sub-saharan Africa: Does governance quality matter? Renewable Energy 2023, 219, 119403.

[81] Qamruzzaman, M., Nexus between foreign direct investments renewable energy consumption: What is the role of Government debt? International Journal of Multidisciplinary Research and Growth Evaluation 2022, 3, (3), 514-522.

[82] 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.

[83] 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.

[84] Huan, Y.; Qamruzzaman, M., Innovation-Led FDI Sustainability: Clarifying the Nexus between Financial Innovation, Technological Innovation, Environmental Innovation, and FDI in the BRIC Nations. Sustainability 2022, 14, (23), 15732.

[85] 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.

[86] 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.

[87] 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.

[88] Md Qamruzzaman, S. N., Ananda Bardhan, Nexus between Remittance, Financial Volatility, Trade Openness, Money Supply, and Non-Performing Loan: An Application of Autoregressive Distributed Lagged (ARDL) Model. Journal of Banking and Finance Management 2021, 3, (2), 34-54.

[89] 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.

[90] Md, Q., 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), 283.

[91] 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.

[92] 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.

[93] 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.

[94] 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.

[95] 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.

[96] Raza, S. A.; Shah, S. H.; Yousufi, S. Q., The impact of public-private partnerships Investment in Energy on carbon emissions: evidence from nonparametric causality-in-quantiles. Environmental Science and Pollution Research 2021, 28, (18), 23182-23192.

[97] Anselme, A.; Qamruzzaman, M., Do access to finance, technical know-how and financial literacy offer Women empowerment through Women's entrepreneurial Sustainability? Frontiers in psychology 2022, 5889.

[98] Andriamahery, A.; 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, 9.

[99] Dai, M.; Qamruzzaman, M.; Hamadelneel Adow, A., An Assessment of the Impact of Natural Resource Price and Global Economic Policy Uncertainty on Financial Asset Performance: Evidence From Bitcoin. Frontiers in Environmental Science 2022, 10.

[100] Azam, M. Q.; Hashmi, N. I.; Hawaldar, I. T.; Alam, M. S.; Baig, M. A., The COVID-19 Pandemic and Overconfidence Bias: The Case of Cyclical and Defensive Sectors. Risks 2022, 10, (3), 56.

[101] 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.

[102] 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.

[103] 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.

[104] Ganlin, P.; Qamruzzaman, M.; Mehta, A. M.; Naqvi, F. N.; Karim, S., Innovative Finance, Technological Adaptation and SMEs Sustainability: The Mediating Role of Government Support during COVID-19 Pandemic. Sustainability 2021, 13, (16), 1-27.

[105] 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.

[106] 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.

[107] Abbas, Q.; Junqing, L.; Ramzan, M.; Fatima, S., Role of Governance in Debt-Growth Relationship: Evidence from Panel Data Estimations. Sustainability 2021, 13, (11).

[108] Qamruzzaman, M.; Karim, S., Nexus between economic voaltility, trade opennes and FDI: an application of ARDL, NARDL and asymmetric causalty. Asian Economic and Financial Review 2020, 10, (7), 790-807.

[109] Qamruzzaman, M.; Jianguo, W.; Jahan, S.; Yingjun, Z., Financial innovation, human capital development, and economic growth of selected South Asian countries: An application of ARDL approach. International Journal of Finance & Economics 2020.

[110] Qamruzzaman, M.; Jianguo, W., The asymmetric relationship between financial development, trade openness, foreign capital flows, and renewable energy consumption: Fresh evidence from panel NARDL investigation. Renewable Energy 2020, 159, 827-842.

[111] Qamruzzaman, M.; Wei, J., Do financial inclusion, stock market development attract foreign capital flows in developing economy: a panel data investigation. Quantitative Finance and Economics 2019, 3, (1), 88-108.

[112] Qamruzzaman, M.; Wei, J., Financial Innovation and Financial Inclusion Nexus in South Asian Countries: Evidence from Symmetric and Asymmetric Panel Investigation. International Journal of Financial Studies 2019, 7, (4), 61.

[113] Qamruzzaman, M.; Karim, S.; Jianguo, W., Revisiting the Nexus Between Financial Development, Foreign Direct Investment and Economic Growth of Bangladesh: Evidence from Symmetric and Asymmetric Investigation. Journal of Sustainable Development Studies 2019, 12, (2).

[114] Qamruzzaman, M.; Jianguo, W., SME financing innovation and SME development in Bangladesh: an application of ARDL. Journal of Small Business & Entrepreneurship 2019, 31, (6), 521-545.

[115] Jianguo, W.; Qamruzzaman, M., An assessment of total factor productivity (TFP) of SME business in Bangladesh using DEA based Malmquist productivity index (MPI). ABC Journal of Advanced Research 2017, 6, (1), 31-40.

[116] Ferdousi, F.; Qamruzzaman, M., Export, import, economic growth, and carbon emissions in bangladesh: a granger causality test under VAR (Restricted) environment. Management of Cities and Regions 2017, 79.

[117] Qamruzzaman, M.; Jianguo, W., An Assessment of Financial Efficiency using Data Evolvement Analysis (DEA) Multistage Approach: A Case Study of Banks in Bangladesh. IOSR Journal of Economics and Finance 2016, 7, (6), 96-103.

[118] Qamruzzaman, M.; Ferdaous, J., Building a Knowledge-Based Economy in Bangladesh. Asian Business Review 2015, 4, (3), 41-49.

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

[120] 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.

[121] 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.

[122] Pu, G.; Qamruzzaman, M.; Mehta, A. M.; Naqvi, F. N.; Karim, S., Innovative Finance, Technological Adaptation and SMEs Sustainability: The Mediating Role of Government Support during COVID-19 Pandemic. Sustainability 2021, 13, (16), 9218.

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