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Assessing the Impact of Cultural Globalization on Renewable Energy in the Era of Environmental Pressures

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ABSTRACT

Renewable energy is widely acknowledged as the most viable option to combat the rising trends of climate change and global warming. Given its significance, a significant number of empirical studies have focused on identifying the factors that can promote renewable energy. However, the role of environmental pressures and cultural globalization has not been the subject matter of many past studies. This study aims to fill this gap by analyzing the influence of cultural globalization and environmental pressures on renewable energy using the novel MMQR approach. The outcomes of the analysis highlight that cultural globalization significantly and positively influences renewable energy from the lowest to the medium levels, while it does not exert any significant influence at the highest levels of renewable energy. Environmental pressures can also foster renewable energy from the lowest to the highest levels. In contrast, economic growth hindered renewable energy across all quantiles, whereas political stability hindered it only at the lower quantiles. Policymakers should take advantage of people-to-people contact and the rising environmental pressures to promote renewable energy consumption.

Keywords: Cultural Globalization, Renewable Energy, Environmental Pressures
JEL Classifications: Q43, Q54, F43

1. INTRODUCTION

The world now agrees that there is a need to reform the energy system and accelerate the shift to sustainable energy. Usage of renewable sources of energy across the globe has increased by 13.4% per year on average during the previous decade. Increasing research and deployment of renewable energy (RE) sources are being seen in industrialized nations throughout Europe and North America (Saidi and Omri, 2020). Europe's industrialized nations drew 28.2% of the global production from RE sources in 2019. Increasing urbanization, industrialization, energy demand, and the fact that emerging economies find themselves at the last stage of the product distribution network and have accepted industries relocating from advanced economies with high carbon footprints as an element of their globalization make the extraction of clean energy in emerging markets more pressing compared to that in advanced nations. Sustainability has gained worldwide interest because of the tension it resolves between advancing the economy and safeguarding the environment (Dong and Ullah, 2023). Sustainable development, defined as "development that meets the contemporary demands without sacrificing the potential for subsequent generations to fulfil their own demands," is gaining traction as a new economic growth approach in industrialized and emerging nations (Hopwood et al., 2005).

This age of globalization has helped several economies worldwide achieve high growth rates. Researchers have spent considerable work over the last 30 years investigating the correlation between

globalization and energy use. The basic premise is that overall energy consumption will change as the world becomes increasingly globalized. Globalization is only one of the numerous variables that might positively or negatively influence the overall changes in energy demand (Shahbaz et al., 2018). Globalization and eliminating trade obstacles have increased economic production and affluence throughout the globe, which is thought to be driving up energy demand (Pata and Caglar, 2021). Thus, because of the documented empirical relationship between economic development and energy usage, it is generally accepted that the advancement of globalization is related to an increase in energy usage. Researchers have spent considerable work over the last 30 years investigating the correlation between globalization and energy use. The basic premise is that overall energy usage will vary as the globe grows increasingly globalized.

Globalization has optimized innovations in numerous nations (Kautish et al., 2025), and much more sophisticated technology can be implemented for energy generation and usage to increase energy efficiency, decrease energy requirements and extraction expenses, and meet energy savings and decarbonization goals. Zeren and Akkuş (2020) investigated globalization's impact on the growth of renewables from the standpoint of trade liberalization. It also reported that increasing trade openness might enhance the consumption of clean energy and promote the diffusion of energy technologies, which would be good for the application of renewables in emerging regions. Several economists have investigated the relationship between RE and globalization in the context of an influx of foreign investment and confirmed the positive influence of foreign investment on REC (Gozgor et al., 2020). Nevertheless, owing to the rapidity of globalization, it is simply not sufficient to measure the influence of globalization on RE solely using the aspects of international trade liberalization and foreign investment. Numerous research has shown this to be true. Chen and Zhang (2023) examines the effects of globalization on RE. They found that the usage of RE and globalization are positively connected to each other. Some other researchers have examined the link between globalization and the environment (Wen et al., 2021); however, limited research work has analyzed the relationship between cultural globalization and REC.

Cultural globalization refers to the exchange of cultural ideas, values, and practices across the global (Tomlinson, 2007). Regarding RE, cultural globalization plays a vital role in transforming public perceptions, attitudes, and preferences about the development and implementation of RE. It can also help develop global consensus regarding the benefits of promoting eco-friendly practices and fostering the progress of RE projects (Zhang et al. 2023). On the other hand, globalization is made up of several factors, including economic, political, social, and cultural factors. It is a factor the combinedly estimate the impact of all these factors on RE and the past studies have focused on globalization. Thus, examining the nexus between cultural globalization and RE is crucial in identifying how the cultural connections between different nations can promote RE.

When RE sources and environmental pressures are combined in a single study, the study often centres on the effects that renewables may have on reducing or adapting to environmental pressures, with the primary focus on controlling greenhouse gas emissions. This study examines how environmental pressures may affect energy output from renewable sources. Currently, only a limited number of empirical studies have focused on this topic (Chen et al., 2021). The most recent study from the Intergovernmental Panel on Climate Change indicates that a substantial increase in greenhouse gas concentrations may raise the average global temperature by up to 6.4 °C by 2100. The effects of this temperature change are highly uncertain; nonetheless, the current climatic shift is already evident. Given that climatic conditions influence most RE sources, it is essential to evaluate anticipated climate changes that may affect their utilisation (Pašičko et al. 2012). Since it is widely acknowledged that the energy industry significantly contributes to the rising environmental pressures on the ecosystem, it is also evident that the reduction of CO2 emissions and controlling environmental pressures necessitate the enhanced and more effective utilisation of renewable resources in the future, highlighting the need for better modelling of the environmental degradation effects on renewables.

Agenda 2030 is the product of the collective wisdom of the world leaders and was adopted during the UN General Assembly meeting held in March 2015. This agenda is comprised of 17 major objectives that have social, economic, and environmental dimensions (Mehmood et al. 2024). Out of these 17 objectives, several have shed light on the significance of RE in achieving social, economic, and ecological sustainability (Sinha et al. 2021). For instance, the sustainable development goal (SDG) number 7 is named Affordable and Clean Energy, which specifically emphasizes promoting and adopting clean, green, and RE sources (Caglar et al. 2024). The 26th UN Climate Change Conference (COP26) supported the swift transition towards RE sources and asked the parties of SDGs to quickly replace the non-RE sources with renewable and clean ones in order to keep the rising emissions under control. Thus, for a sustainable future of the world, it is crucial for policymakers to work in line with SDGs and to take concrete steps for the promotion of RE (Cernev and Fenner, 2020). After the adoption of Agenda 2030, the significance of RE has increased manifold, and it is widely acknowledged as the best possible option to deal with several diverse issues the world is facing right now, including climate change, energy transition, and energy security. Thus, estimating the impact of cultural globalization and environmental pressures on RE in China is important.

From the above discussion, the study pointed out the following research gaps. Firstly, the existing literature on REC, particularly in China, lacks a comprehensive exploration of the impact of cultural globalization and environmental pressures. Secondly, while some studies have explored the link between globalization and environmental quality, there is a noticeable omission in investigating the relationship between cultural globalization and renewable energy. Thirdly, limited literature is available on impact of environmental pressures on renewable energy. The study makes the following contributions. Firstly, examining REC in BRICS is vital due to its significant impact on environmental sustainability. The study examines the nonlinear impact of cultural globalization

and environmental pressures on renewable energy in BRICS. Secondly, the study's findings will inform policy formulation, guiding the development of strategies that align economic growth with sustainable energy practices, enhance environmental responsibility, and contribute to the nation's long-term energy security and resilience.

2. LITERATURE REVIEW

As carbon footprints increase the danger of climate change and rising temperatures, there is a growing worldwide agreement in favor of developing and using RE to replace fossil fuels. Even while REC is flourishing, their percentage of total energy use is still relatively modest. To decide on the future of RE, a sizable body of work has recently evolved. According to Saqib et et al. (2025), reduced carbon footprints, an efficient energy framework, and an ecologically sound environment are all associated with a sustainable energy future. In addition, a considerable portion of the research investigates the influential factor determining REC. The most widely accepted factors influencing RE are energy costs, the legal framework, environmental contamination, energy usage, energy security, the prospects for green energy, the political climate, financial movements, and economic expansion. The seminal research conducted by Sadorsky (2011) and Aguirre and Ibikunle (2014) provided a solid foundation for subsequent scholars to inspect the factors of REC. Over the previous decade, most scholars have considered energy prices and economic development to be the key factors affecting REC. Shan et al. (2021) recently incorporated green technology and energy efficiency into their function of REC.

One such factor is cultural globalization, which is part of overall globalization and highlights the cultural aspect of globalization. Though hardly any studies have used it as a determinant of REC, the role of culture in renewable development has been investigated in some of the past studies. One of the few studies to do so is one conducted by Pelau and Pop (2018), examining the connection between REC and national culture using fixed effect and random effect models. Likewise, the influence of the individualism cultural dimension on the adoption of RE technology is examined by Ang et al. (2020), with a specific emphasis on the European region using the probit regression model. The authors propose that when formulating national action plans, cultural attributes should be taken into account. Conversely, some empirics have focused on the relationship between globalization and related indicators (such as trade liberalization, FDI inflows) and REC. Tiwari et al. (2022) used panel quantile regression model and concluded that trade openness facilitates the advancement of REC. Doytch and Narayan (2016) used the GMM method to illustrate that FDI inflows have a favourable impact on REC.

Much of the existing literature elaborated that countries facing greater carbon pressures tend to intensify their adoption of RE. For example, Sadorsky (2009) provided evidence for both G7 and emerging economies, showing that per capita CO_2 enhance REC. Similarly, Salim and Rafiq (2012) reported that environmental degradation encourages reliance on RE in Brazil, China, India, and Indonesia. Examining central American countries, Apergis and Payne (2014) also identified a positive and long-run linkage between CO_2 and REC. For a cross-country analysis, Omri and Nguyen (2014) further supported the argument that rising CO_2 drive RE uptake. The diversity of findings becomes more distinct when studies distinguish between developed and developing economies. For instance, Bamati and Raoofi (2020) showed that high-income countries respond more systematically to environmental degradation by expanding RE capacity, whereas developing countries face financial, institutional, or technological barriers that weaken the emissions–renewables linkage. Mac Domhnaill and Ryan (2020) further indicated that higher greenhouse gas emissions encourage renewable electricity generation in advanced regions. More recently, using quantiles regression technique, Ali et al. (2025) revealed that CO2 produce mixed effects on REC across different quantiles and country groups. The study showed that environmental pressures do not always translate directly into increased RE use, it may also interact with structural and socio-economic factors.

To conclude the discussion on the literature regarding REC, this study can state that a growing body of empirics has tried to find the determinants of REC, but most of them have focused on traditional economic variables such as energy prices, economic growth, financial development, globalization, etc., and observed contradictory findings. Moreover, the available empirical works have mostly concentrated on finding the factors that may impact REC, and relatively few researchers have focused on the determinants of REC. However, past empirical literature has hardly investigated the impact of cultural globalization and environmental pressure on REC. The empirical literature has mostly focused on outdated panel estimation methods. The current study addresses a lacuna in the literature by suggesting new factors that may influence REC.

3. ECONOMETRIC MODEL AND DATA

To assess the impact of cultural globalisation and environmental pressure on renewable energy, the study proposes the following model

$$REC_t = \psi_0 + \psi_1 CG_{it} + \psi_2 EP_{it} + \psi_3 EG_{it} + \psi_4 PS_{it} + \varepsilon_{it} \quad (1)$$

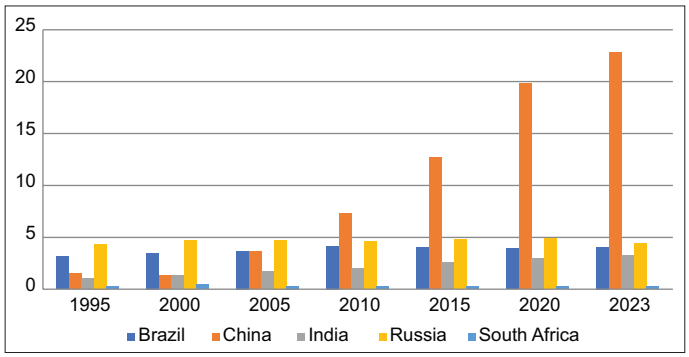
Where renewable energy production (REC) is dependent on cultural globalisation (CG), environmental pressure (EP), economic growth (EG), political stability (PS), and error term (ε_{it}). To analyze the influence of cultural globalization and environmental pressures on RE, the study has assembled the data for BRICS economies spanning the years 1996-2023. BRICS economies are amongst the top consumers of RE globally. Therefore, the study choice of sample is BRICS. Table A1 reports the variables description. The dependent variable is renewable energy consumption (REC), measured through energy consumption from all sources such as nuclear, renewables, and others (quad Btu). Data series for REC is collected from the EIA. Independent variables in the model are cultural globalization (CG) and environmental pressure (EP). CG is measured as cultural globalization index, constructed by the KOF. Environmental pressure (EP) is measured through total greenhouse gas emissions excluding LULUCF (Mt CO2e). Required data

for environmental pressure is assembled from the WDI. Trend of key variables are reported in Figure 1. Following theoretical and empirical literature (Tu et al., 2022; Wang et al., 2025), this study included economic growth (EG) and political stability (PS) as control variables in our empirical analysis. EG is assessed through annual percent of GDP growth, while PS is determined by the estimates of political stability and absence of violence and terrorism. The data series for both variables is collected from the WDI. The theory of energy transitions (Berkhout et al., 2012) suggests economic growth and political stability play fundamental roles in determining REC due to their economic and political implications. Empirically, Wang et al. (2025) noted that higher GDP growth indicates higher technological advancement, higher living standards, and greater financial resources that lead to higher investment in RE.

Table 1 reports the summary statistics for all variables. The mean values for REC, CG, EP, EG, and PS are 0.089, 3.949, 7.604, 4.416, and −0.579. However, the S.D values for REC, CG, EP, EG, and PS are 1.224, 0.217, 0.995, 3.935, and 0.423. The skewness test displays that all variables are negatively skewed except EP, which exhibits positive skewness. Additionally, The J.B stat estimates negate the normality of variables. The J.B test displays that all P-values are significant, confirming that all data series are non-normally distributed. Similar results are found in Q-Q plots that show non-normality (Figure 2).

The correlation matrix in Table 2 reveals that CG, EP, and EG have a positive linkage with REC. In contrast, PS exhibits a negative association with REC. The highest positive correlation is found between EP and REC, i.e., 0.746; then, the second highest positive correlation is reported between EG and EP, i.e., 0.519. In order to detect the multicollinearity issue, the VIF test is used. According to this test, a VIF value exceeding 5 confirms the presence of multicollinearity. Table 2 displays the VIF scores of each variable. It is confirmed that the VIF values range between 1.09 and 1.52, with Mean VIF 1.31. This confirms that our model is free from multicollinearity issue.

Figure 1: % share of REC in BRICS countries



Given the growing pattern of interdependence, the most critical aspect of any panel study analysis is to conduct the CSD test, which reveals the common correlated effects, also referred to as unobserved common factors that significantly impact the macroeconomic variables of all nations (Everaert and De Groote, 2016). The BRICS economies represent a coalition of rising markets that jointly contribute significantly to global population and trade (Sönmez et al., 2025). As emerging countries, their energy demands, resource utilisation trends, economic transformations, and global cooperation are largely similar; hence, the likelihood of CSD is elevated. This research used the CSD test established by Pesaran et al. (2004).

The research used the Pesaran and Yamagata (2008) test for slope heterogeneity to verify the accuracy of the findings and to establish the characteristics of the parameter slopes. The slope heterogeneity test posits the null hypothesis that slope coefficients are uniform across cross-sectional units, while the alternative hypothesis suggests otherwise. The decision on the slope heterogeneity is based on the two statistics delta and adj-delta. After validating CSD and slope heterogeneity, the second-generation unit root test emerges as the most suitable option, as it successfully addresses the CSD problem that the first generation could not accommodate (Chen et al., 2021). This work used the CIPS test, as formulated by Pesaran (2007), to assess the stationarity characteristics of the data series while addressing the CSD issue. The null hypothesis for these tests is defined as unit root present.

The last phase of the econometric technique before we move to regressions analysis is to analyse the long-term association among CG, EP, and RE of the BRICS countries. In this analysis we employed the Pedroni (2004) cointegration test to check whether

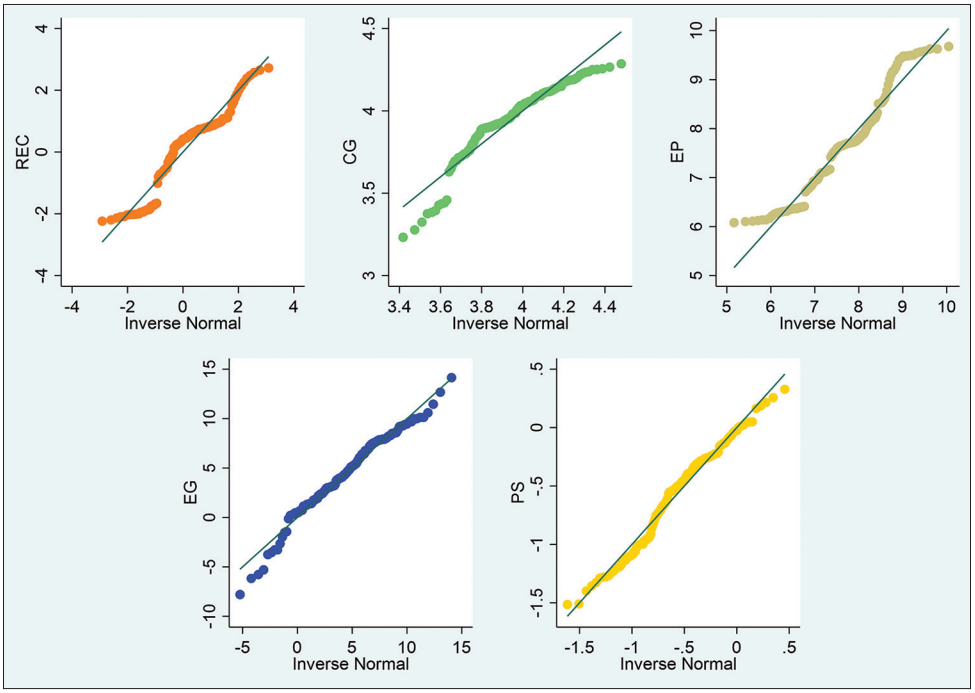
Table 1: Descriptive statistics

Variables	Mean	Median	Max	Mini	Standard deviation	Skewness	Kurtosis	J.B	Prob.
REC	0.089	0.448	2.723	−2.237	1.224	−0.379	2.508	4.771	0.092
CG	3.949	3.977	4.286	3.232	0.217	−1.204	4.495	46.870	0.000
EP	7.604	7.647	9.677	6.081	0.995	0.416	2.396	6.167	0.046
EG	4.416	4.444	14.150	−7.800	3.935	−0.484	3.358	6.204	0.045
PS	−0.579	−0.515	0.328	−1.515	0.423	−0.209	2.207	4.683	0.096

Table 2: Correlation matrix and VIF results

Variables	REC	CG	EP	EG	PS	Variable	VIF	1/VIF
REC	1					EG	1.52	0.657
CG	0.256	1				EP	1.52	0.658
EP	0.746	0.044	1			CG	1.12	0.897
EG	0.150	−0.249	0.519	1		PS	1.09	0.917
PS	−0.226	0.014	−0.287	−0.158	1	Mean VIF	1.31	

Figure 2: Q-Q plots for normality



non-stationary variables share a common long-run equilibrium relationship. It is based on the Engle–Granger approach to panel data, allowing intercepts, trends, and slope coefficients to differ across cross-sections (countries in our case). Pedroni (2004) proposes seven residual-based statistics, grouped into within- and between-dimension tests, to examine the null hypothesis of no cointegration. If most statistics are significant, we conclude that a stable long-run relationship exists among the variables.

The research proposed using the latest quantile-based technique, the "Method of the Moments Quantile Regression" (MMQR), developed by Machado and Silva (2019), for the regression analysis. This method is beneficial in many respects. It adeptly addresses heterogeneity and endogeneity by imposing moment restrictions and incorporating asymmetric and nonlinear relationships. Moreover, the MMQR strategy offers resilience against outliers that conventional regression techniques inadequately handle. Furthermore, MMQR permits individual effects to affect the entire range rather than only the mean, thereby facilitating the "conditional heterogeneous covariance effects" of the outcome variable (REC) (Machado and Silva 2019). Moreover, as the methodology is applicable to nonlinear systems, it yields dynamic outcomes across a range of settings, especially when the framework incorporates specific impacts and endogenous variables. In addition, because MMQR jointly models both the location and scale of the conditional distribution, the estimated quantiles are inherently non-crossing. The estimate of conditional quintiles for the location-scale variation model is outlined as follows:

$$Q_\tau\left(\tau \mid \hat{U}_{it}\right) = \left(\beta_i + \delta_i q(\tau)\right) + \ddot{\mathrm{U}}_{\mathrm{it}}\,\lambda + \mathrm{W}_{\mathrm{it}}^{'}\psi \mathrm{q}$$

In the above specification, $\ddot{\mathrm{U}}_{\mathrm{it}}$ represents the vector including all the regressors such as CG, EP, EG, and PS. The quantile distribution of $\mathrm{REC}_{\mathrm{it}}$ is denoted as $Q_\tau\left(\tau \mid \hat{U}_{it}\right)$.

Table 3: CSD test

Variables	Pesaran's test	Prob.	Off-diagonal elements
REC	2.978***	0.002	0.326
CG	9.012***	0.000	0.541
EP	6.366***	0.000	0.380
EG	8.396***	0.000	0.502
PS	−1.497	0.134	0.332

Table 4: Slope heterogeneity test

Variables	$\hat{\Delta}$	Prob.	$\hat{\Delta}_{adj.}$	Prob.
REC	9.715	0.000	10.96	0.000
CG	7.374	0.000	8.319	0.000
EP	10.80	0.000	12.19	0.000
EG	0.558	0.577	0.629	0.529
PS	8.511	0.000	9.602	0.000

4. RESULTS AND DISCUSSION

As the study deals with panel data, the empirical analysis begins by assessing the dataset for CSD. CSD commonly emerges due to increasing globalization, stronger economic linkages among countries, shared global shocks, and other unobserved common influences. In order to detect CSD, Pesaran et al. (2004) CSD test is used and the results are reported in Table 3. The results shown in Table 3 indicate that all variables exhibit CSD, except PS. This implies that any shock occurring in one country will spill over to others. In the next step, Pesaran and Yamagata test is used to detect whether the slope parameters are homogeneous or not. Table 4 reports the slope homogeneity test results. As shown in Table 4, all test statistics are strongly significant, except for EG. This indicates that the slope coefficients vary across countries, meaning the associations between variables (REC, CG, EP, PS) are not uniform across the sample. In the presence of CSD and slope heterogeneity, the study employs 2nd generation CIPS test. In Table 5, the outcomes of CIPS

unit root test are presented. The findings suggest that apart from REC and EG, rest of the series (CG, EP, PS) contain the unit root i.e. I(1); however, the series REC and EG don't contain the unit root i.e. I(0). Given the presence of CSD and stationarity concerns, the study employs the cointegration test. Table 6 rejects the no-cointegration hypothesis, confirming a long-run link among the variables.

To investigate the effects of CG, EP, EG, and PS on REC, MMQR regression is applied across 0.10-0.90 quantiles. In Table 7, The results show that CG exhibits a positive and significant influence on REC across all quantiles, except highest quantiles i.e., 0.80 and 0.90 quantiles. However, the coefficient gradually declines from 1.050 at the 0.10 quantile to 0.744 at the 0.70 quantile, revealing that CG plays a more prominent role in boosting REC at lowest quantiles, whereas its effect weakens at higher quantiles. The outcomes suggest a positive association between cultural globalization and REC. This finding is also supported by Goggins et al. (2022), who suggest that cultures become more interconnected globally, and there is an increased exchange of information and ideas for RE. Increased awareness leads to a greater understanding of the importance of REC. The benefits of globalization on individuals, economies, and businesses are widely acknowledged within the framework of heightened outsourcing, expanded trade, and diminished barriers to global movement. Consequently, cultural globalization serves as a unifying force, fostering the exchange of ethical values, social concepts, and cultural norms between developed and underdeveloped nations. This interchange has the potential to inspire developing economies to embrace environmentally conscious practices prevalent in advanced economies, thereby contributing to the development of RE. These findings align with studies by Rehman et al. (2023) and Shahbaz et al. (2018). They also inferred that cultural globalization fosters international collaboration, including scientific R and D on RE. This means that cultural globalization influences consumer preferences and behaviour by increasing REC.

EP also demonstrates a statistically significant and positive effect on REC across all quantiles. The magnitude of the effect declines from 1.269 in the 0.10 quantile to 0.861 in the 0.90 quantile, indicating

Table 5: CIPS test

Variables	I (0)	I (1)	Decision
REC	−3.122***		I (0)
CG	−1.314	−3.630***	I (1)
EP	−1.236	−3.555***	I (1)
EG	−4.197***		I (0)
PS	−1.958	−5.495***	I (1)

Table 6: Pedroni test for cointegration

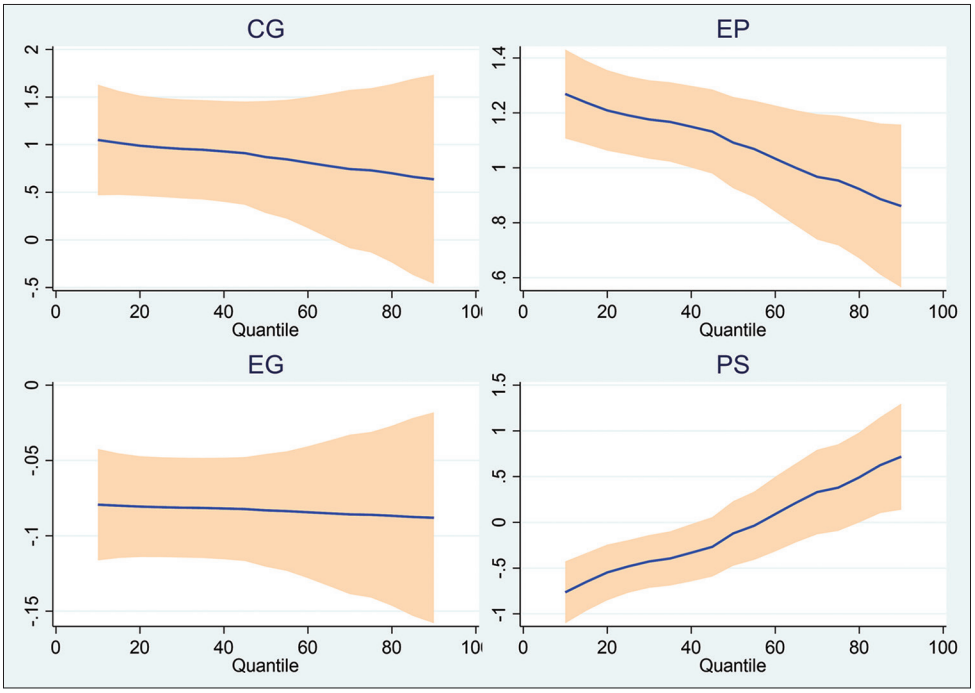
Test	Statistic	P-value
Pedroni cointegration test — between dimension		
Modified Phillips–Perron t	0.173	0.431
Phillips–Perron t	−3.510***	0.000
Augmented Dickey–Fuller t	−2.221**	0.013
Pedroni cointegration test — within dimension		
Modified variance ratio	−2.453***	0.007
Modified Phillips–Perron t	−0.375	0.354
Phillips–Perron t	−2.069**	0.019
Augmented Dickey–Fuller t	−1.295*	0.098

Table 7: MMQR results

Variables	Location	Scale	Quantiles								
			0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90
CG	0.852***	−0.137	1.050***	0.989***	0.956***	0.929***	0.870***	0.811**	0.744*	0.699	0.636
	(0.313)	(0.208)	(0.297)	(0.269)	(0.265)	(0.270)	(0.300)	(0.351)	(0.424)	(0.478)	(0.560)
EP	1.074***	−0.135**	1.269***	1.209***	1.176***	1.150***	1.092***	1.034***	0.967***	0.923***	0.861***
	(0.0861)	(0.057)	(0.0827)	(0.0748)	(0.0729)	(0.076)	(0.0848)	(0.0987)	(0.117)	(0.129)	(0.151)
EG	−0.0835***	−0.00288	−0.0793***	−0.0806***	−0.0813***	−0.0819***	−0.0831***	−0.0843***	−0.0857***	−0.0867***	−0.0880**
	(0.020)	(0.0132)	(0.0189)	(0.0171)	(0.0169)	(0.0172)	(0.0191)	(0.0223)	(0.027)	(0.0305)	(0.0357)
PS	−0.0566	0.492***	−0.764***	−0.547***	−0.427***	−0.331**	−0.121	0.0909	0.332	0.492*	0.718**
	(0.173)	(0.115)	(0.173)	(0.155)	(0.147)	(0.160)	(0.180)	(0.208)	(0.236)	(0.251)	(0.296)
Constant	−11.11***	2.455***	−14.64***	−13.56***	−12.96***	−12.48***	−11.43***	−10.37***	−9.166***	−8.368***	−7.238***
	(1.258)	(0.833)	(1.219)	(1.101)	(1.068)	(1.120)	(1.253)	(1.457)	(1.709)	(1.879)	(2.208)
Observations	140	140	140	140	140	140	140	140	140	140	140

Standard errors in parentheses. ***P<0.01, **P<0.05, *P<0.1

Figure 3: MMQR graphical estimate.



that rising environmental pressure is a key driver of RE adoption. Environmental pressures, such as rising greenhouse gas emissions, environmental degradation, and climate-related risks, can provide strong incentives for economies to increase the production and consumption of RE. This result aligns with Ali et al. (2025). With growing ecological pressures, environmental regulations become stringent, leading to enhanced carbon pricing and significantly improved performance standards, raising the relative cost of fossil-fuel technologies and making low-carbon options more attractive. This result is consistent with the Porter Hypothesis, which holds that well-designed regulation, driven by increased environmental pressures, can stimulate green innovation. Empirical research indicates that climate vulnerability and risk are pivotal factors influencing the adoption of RE and green investments, as nations and investors respond to these risks by reallocating capital toward renewables (Hao and Shao, 2021; Rong et al., 2024). Furthermore, the policies specifically designed to address rising environmental pressures, such as net-zero pledges and carbon pricing, directly link climate goals to the spread of RE, thereby strengthening this beneficial impact. Consequently, environmental pressures act not only as constraints but also as catalysts, pushing policymakers and markets towards a more rapid and durable shift to RE systems.

In contrast, EG exerts a negative and significant impact on REC across all quantiles. However, the magnitude becomes slightly stronger toward higher quantiles, ranging from 0.0793 at the 0.10 quantile to 0.088 at the 0.90 quantile. This pattern indicates that rising economic growth tends to reduce REC across all quantiles. PS displays mixed influence on REC. At the lower and middle quantiles from 0.10 to 0.40 quantiles, PS has a significantly negative effect on REC, indicating that political stability does not promote REC at lower quantiles. However, the effect turns significantly positive at 0.80 and 0.90 quantiles, confirming the supportive role of political stability in enhancing REC. The graphical results are shown in Figure 3.

Table 8: Dumitrescu Hurlin causality results

Null hypothesis	W-Stat.	Prob.
CG→REC	3.178***	0.005
REC→CG	6.604***	0.000
EP→REC	2.511*	0.055
REC→EP	4.532***	0.000
EG→REC	1.473	0.606
REC→EG	1.438	0.639
PS→REC	1.296	0.782
REC→PS	2.200	0.134
EP→CG	9.541***	0.000
CG→EP	1.967	0.236
EG→CG	0.621	0.525
CG→EG	1.922	0.261
PS→CG	0.790	0.684
CG→PS	2.467*	0.063
EG→EP	0.626	0.530
EP→EG	1.746	0.376
PS→EP	3.281***	0.003
EP→PS	1.741	0.380
PS→EG	1.227	0.855
EG→PS	1.982	0.229

Table 8 highlights the outcomes of the Dumitrescu Hurlin causality test. The outcomes suggest a bi-directional causative connection exists between CG and REC, suggesting that any policy change that causes CG to rise also causes a change in REC and vice versa. Moreover, a two-way causative connection exists between EP → REC. Further, a few other one-way causative links are presented, such as EP →CG, CG →PS, and PS →EP.

5. CONCLUSION AND IMPLICATIONS

RE offers numerous advantages, with its paramount significance lying in its capacity to diminish carbon footprints and contribute to environmental protection. In addition, it improves the country's energy supply by reducing the reliance on imported fossil

fuels. Numerous global agreements robustly endorse initiatives promoting the adoption of REC. The global REC is increasing, leading to a surge in research investigating its impact on environmental quality. This research has confirmed REC to be the most significant mitigating factor of carbon emissions. However, the literature on the determinants of REC is still in its early stages. Consequently, the study's primary motive is to investigate the impact of cultural globalization and environmental pressure on REC in BRICS. Thus, the analysis has added significant value to the current body of RE literature. This pioneering work examines the impact of cultural globalization and environmental pressure on REC. Moreover, this is the first-ever effort in the context of BRICS, the biggest investors in the RE sector. Investigating the above-stated nexus in BRICS can help us understand factors that can impact RE dynamics. Further, the study employs the MMQR model that can investigate the heterogeneous impact of cultural globalization and environmental pressure on REC across 0.10-0.90 quantiles in BRICS. The MMQR estimates show that cultural globalization and environmental pressure foster REC across most of the quantiles. In terms of control variables, the GDP declines REC while political stability boost REC.

In terms of policy implications, these findings carry significant implications. First, the study suggests that policymakers should aim to enhance cultural globalization to foster cultural exchange, increase knowledge sharing, and extend international ties. This would encourage the spread of RE technologies and green practices across the globe. Therefore, the government should facilitate people-to-people interactions by easing visa restrictions, particularly for individuals from advanced economies. In addition, it is suggested that leaders worldwide should promote international collaboration within the domain of the RE sector. The advanced economies should send delegations of technical staff, engineers, and energy experts to the developing economies so that these economies can also benefit from the experience of the advanced economies. This would significantly help developing economies improve their energy management and enhance their operational and distributional efficiency. Moreover, this support enhances the potential of developing economies to produce RE technologies, reducing their reliance on imported fuels and reducing the risks related to energy security.

The study acknowledged a few limitations that must be addressed in future studies. Firstly, the study's findings are specific to BRICS and cannot be applied to other nations with different cultural contexts. Future studies should conduct comparative studies, including developing and developed economies in samples with varying levels of cultural globalization and environmental pressure. Secondly, while economic growth and political stability are included as control variables, other relevant factors (policy measures, technological innovations, and geographical factors) should be included in the analysis. Lastly, using MMQR represents an advancement in methodology within the context of RE studies. Future studies should also adopt the nonlinear estimation technique to capture the impact of shocks in cultural globalization and environmental pressure in context of developing and developed economies.

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APPENDIX

Table A1: Variables description

Variables	Definitions	Sources
Renewable energy consumption (REC)	Total energy consumption from nuclear, renewables, and other (quad Btu)	EIA
Cultural globalisation (CG)	Cultural globalisation index	KOF
Environmental pressure (EP)	Total greenhouse gas emissions excluding LULUCF (Mt CO2e)	WDI
Economic growth (EG)	GDP growth (annual %)	WDI
Political stability (PS)	Political stability and absence of violence/terrorism: estimate	WDI