Natural resources abundance, economic globalization, and carbon emissions: Advancing sustainable development agenda

Wu Xiaoman1 | Abdul Majeed2,3 | Dinara G. Vasbieva4 | Claire Emilienne Wati Yameogo5 | Nazim Hussain6

1School of Economics and Management, Foshan University, Foshan, China
2School of International Trade and Economics, University of International Business and Economics, Beijing, China
3Department of Business Administration, ILMA University, Karachi, Pakistan
4Financial University under the Government of the Russia Federation, Moscow, Russia
5Department of Economics, University of Lagos, Lagos, Nigeria
6University of Groningen, Groningen, The Netherlands

Correspondence
Nazim Hussain, University of Groningen, Nettelbosch2, 9747 AE Groningen, The Netherlands.
Email: n.hussain@rug.nl

Abstract
The high pace of economic growth has posed many challenges. These challenges include depletion of natural resources, globalization challenges, and environmental degradation. The Middle East and North Africa (MENA) economies are rich in mineral resources. Economic globalization has put the MENA countries in the spotlight for the developed world. Despite the status of being a hotspot for mineral resource richness, there is limited research on the effect of natural resources and economic globalization on the environmental degradation of the MENA countries. This paper examines the effects of natural resource abundance and economic globalization on environmental quality by considering trade openness, urbanization, and economic growth from the year 1980 to 2018. We apply second-generation panel cointegration techniques along with continuously updated fully modified (Cup-FM) and continuously updated bias-corrected (Cup-BC) techniques. The findings show that natural resource abundance significantly improves environmental quality. Likewise, economic globalization also mitigates emissions levels in the MENA countries. In contrast, trade openness, urbanization, and economic growth significantly deteriorate environmental quality. The unidirectional link indicates natural resources and economic globalization create trade openness. The paper provides novel empirical evidence and policy recommendations for sustainable development goals.

KEYWORDS
carbon emission, economic globalization, environmental sustainability, natural resources, sustainable development

1 | INTRODUCTION

Humanity has faced the major challenge of climate change since the turn of this century. Climate change is linked to energy consumption and resultant greenhouse gas emissions (GHGs) (Nathaniel & Iheonu, 2019). Many environmental studies have highlighted the need to reduce GHGs, mainly carbon dioxide (CO2) emissions, as CO2 emissions make up the leading share of GHGs (Ahmed et al. 2019a).

Understanding the causes of growing CO2 emissions and choosing appropriate mitigation strategies is critical for all countries; however, this subject is crucial for the MENA (Middle East North African) region due to its specific characteristics.

The MENA countries have abundant natural resources and hold almost 6% of the global population, approximately 60% of the world’s oil resources, and about 45% of the world’s gas reserves. The MENA economies are a significant source of international economic...
prosperity because of the region's extensive petroleum and natural gas reserves (Kiprop, 2019). The domestic abundance of gas and oil resources, high energy consumption, and energy exports to meet global energy demands increase this region's significance and strategic importance. The economic development sustained by consuming massive natural resource reserves, such as oil and gas, has sparked industrialization, urbanization, and unsustainable agriculture activities in the region (Magazzino & Cerulli, 2019).

These conditions have created a severe challenge for the sustainable development of the region. Almost 85% of GHGs emissions in the region are caused by energy consumption and production. The region's emissions level is higher than the global average in nearly all countries (Charfeddine & Mrabet, 2017). Moreover, the regional population is expected to double in the next 40 years (Magazzino, 2019). It could significantly increase natural resource exploration and intensify regional CO2 emissions. In addition, rising regional energy demands, vulnerability to highly volatile energy prices, and the region's unique weather distinguish MENA counties from other nations. Despite significant economic development, the countries in this region have not completed the first industrialization stage, which is generally characterized by less sophisticated products requiring high energy consumption (Can & Gozgor, 2017). Therefore, the region still relies on foreign countries for machinery and equipment. These nations also largely depend upon natural resource exports for their economic development. As such, interacting with other nations through economic globalization is crucial for this region.

Therefore, this research explores the connection among natural resource abundance, economic globalization, and CO2 emissions in the unique context of MENA countries. Natural resources consist of minerals, gas, oil, and forest resources. Balsalobre-Lorente, Shahbaz, Roubaud, and Farhani (2018) posit that natural resources discourage the use of certain high pollutant fossil fuels by decreasing their import and providing a viable option to switch to low pollutant energy resources such as natural gas. Some empirical investigations support this view. For example, Zafar et al. (2019b) indicate that natural resource has curbed environmental damage in the U.S., and similar findings were found in BRICS economies (Danish, Baloch, Mahmood, & Zhang, 2019).

In contrast, Ahmed et al. (2020a) posited that natural resource abundance pollutes the environment as mining activities degrade the environment. A country's tendency to use ample high pollutant low-cost fossil fuels makes it unlikely to capitalize on abundant natural resources' environmental benefit. Similarly, Sarkodie and Adams (2018) concluded that deforestation, mining, and chain saw operations are leading sources of environmental pollution and natural habitat loss. Ahmed et al. (2020b) and Zafar et al. (2020) also support the view that economic development and the resulting industrialization and urbanization kindle natural resources exploration. It ultimately increases environmental degradation. Previous studies have presented different perspectives and significant disagreement; thus, we propose that whether abundant natural resources degrade the environment or increase environmental sustainability depends on the studied area's unique characteristics and natural resources exploration practices.

Curbing the negative environmental consequences of mining activities relies on upgrades to green exploration. Technological development can also nurture sustainable mining practices, which may mitigate the environmental threats associated with different mining stages. MENA countries have not shown an ability to produce green technology; thus, we included economic globalization in the model. Economic globalization covers the effects of foreign investment and trade. Both these factors are crucial to adopt modern technology. For example, Ahmed et al. (2019b) found that economic globalization can increase technology transfers through foreign trade, stimulating environmental quality. In contrast, in the absence of favorable environmental regulations, trade openness may decrease environmental sustainability through a scale effect. Likewise, foreign investment can pollute the environment as developed countries preferred to invest in developing countries with relaxed environmental regulations (Shahbaz, Nasir, & Roubaud, 2018). Governments in developing economies tend to promote economic development by offering relaxed environmental regulation and this phenomenon, which is known as pollution havens, increases environmental degradation associated with FDI (Shahbaz, Nasreen, Abbas, & Anis, 2015). In contrast, investing in energy-efficient technology can support environmental sustainability (Zhu, Duan, Guo, & Yu, 2016).

Given this background, this study makes the following contributions to the literature. Firstly, it explores the nexus among natural resource abundance, economic globalization, and CO2 emissions in the unique setting of MENA countries. To our best knowledge, previous studies have not investigated this complicated relationship in the MENA region, even though the region is blessed with natural resources, and economic globalization plays a critical role in the economic development of this region. The countries in the region are dependent on economic globalization not only to export natural resources but also to avail the technical capacity required for natural resource exploration. Secondly, this research employs an advanced panel data estimation method to mitigate the problem of cross-section dependence (CD). Traditional panel data techniques, such as fully modified least squares (FMOLS) and dynamic least squares (DOLS), assume no dependence among panel cross-sections. It means that a shock in one country/section does not impact other countries/cross-sections. However, due to globalization, economies are closely connected socially, politically, and economically. Therefore, this research uses continuously updated fully modified (Cup-FM) and continuously updated bias-corrected (Cup-BC) methods introduced by Bai, Kao, and Ng (2009) to generate robust and reliable findings. In addition to CD, the methodology used in the paper can also solve autocorrelation and endogeneity problems. Besides long-run analysis, the study used Dumitrescu and Hurlin test to check causality between variables for recommending appropriate policy suggestions.

The rest of the paper is arranged as follows. Section 2 of the paper includes a review of the literature. Section 3 explains the empirical modeling, data, and methodology. Section 4 describes the empirical results and discussion. Section 5 presents the conclusions and policy implications.
2  |  LITERATURE REVIEW

Climate change and global warming, along with an increase in the awareness of these problems, have increased the importance of understanding environmental degradation and its elements. This study investigates the role of natural resources and economic globalization concerning environmental quality for MENA countries. We divide the literature into two sections to elaborate on the relationship between study variables. The first section describes the nexus between natural resources and CO2 emissions, and the second section addresses economic globalization and CO2 emissions.

2.1  |  Nexus between natural resources and CO2 emissions

Some researchers have studied the relationships between natural resources and CO2 emissions by applying different econometric methods for panel and time-series data. However, these studies have found mixed results for these two variables. For example, Balsalobre-Lorente et al. (2018) assessed the effect of economic growth, electricity, and natural resource on CO2 emissions for five European Union (EU) economies from 1985–2016. They applied the panel least squares (PLS) model and showed that natural resources and renewable electricity reduced CO2 emissions. Bekun, Alola, and Sarkodie (2019) evaluated the effect of economic growth, energy consumption, and natural resource rentals on CO2 emissions for 16 E.-U. economies over the 1996–2014 period. They applied Panel Mean Group (PMG) techniques and found that economic growth, energy consumption, and natural resource rentals degraded the long-term environmental quality of the E.U. countries.

Danish, Baloch, and Suad (2018) examined the impact of energy use, economic growth, and natural resources on Pakistan’s CO2 emissions between 1990 and 2013. The analysis applied autoregressive distributive lag (ARDL) techniques and found that trade and natural resources vitiate the environment’s quality. Using the autoregressive integrated moving average approach, Aeknarajindawat, Suteerachai, and Suksood (2020) also observed that natural resources increased CO2 emissions in Malaysia from 2008 to 2017. Kwakwa, Alhassan, and Adu (2020) investigated the impact of extracting natural resources on Ghana’s CO2 emissions from 1971 to 2013, using the “Stochastic Impacts by Regression on Population, Affluence, and Technology” framework. The results of the FMOLS and CSR estimation techniques showed that natural resource extraction increased CO2 emissions and energy consumption, increasing environmental degradation. Shen et al. (2021) studied the link among investments, natural resources, and CO2 emissions for China from 1995–2017. They applied cross-sectional augmented autoregressive distributed lags (CS-ARDL) techniques, and the outcomes showed that natural resources increased CO2 emissions while green investment contributed to improved environmental quality. However, applying the Generalized Method of Moments (GMM) method, A. Khan, Chenggang, Hussain, Bano, and Nawaz (2020) used data from Belt & Road Initiative (BRI) countries and found positive linkages between natural resources and CO2 emissions. In contrast, I. Khan, Hou, and Le (2021) found that natural resources could control CO2 emissions for the U.S.

Wang, Vo, Shahbaz, and Ak (2020) assessed the effect of economic globalization on CO2 emissions in the 1996–2017 period for the G-7 economies. That study investigated the role of natural resources and financial development plays in influencing CO2 emissions. The empirical findings from CS-ARDL revealed that economic globalization, natural resources, and financial development lead to rising CO2 emissions. Umar, Ji, Kirikkaleli, Shahbaz, and Zhou (2020) examined the linkage among CO2 emissions determinants in China during the period from 1980 to 2017. Results estimated by FMOLS, DOLS, demonstrate that natural resources and economic growth positively affect China’s CO2 emissions, while globalization tends to boost environmental sustainability. The causality results show that natural resources, globalization, and economic growth contribute to CO2 emission.

2.2  |  Nexus between economic globalization and CO2 emissions

Different scholars have assessed the linkages between economic globalization and environmental quality, analyzing time series and panel data using various econometric methods. These studies have found mixed results regarding these two variables, and researchers have not reached a consensus about whether economic globalization generally increases CO2 emissions levels or not. For example, Sharmin and Tareque (2018) investigated the effects of economic globalization, urbanization, and economic growth on Bangladesh’s CO2 emissions from 1980 to 2014. The Vector Error Correction Model (VECM) results showed that economic globalization, urbanization, and economic growth led to environmental degradation. Haseeb, Xia, Baloch, and Abbas (2018) analyzed the link between globalization, financial development, and CO2 emissions for BRICS countries from 1995 to 2014. The study applied dynamic seemingly unrelated regression (DSUR) techniques. The findings were indicating that globalization and urbanization did not impact BRICS countries’ environmental quality.

Kalaycı and Hayaloglu (2019) applied a fixed-effects model to evaluate the connection among economic globalization, trade, and CO2 emissions for North American Free Trade Agreement (NAFTA) economies from 1990 to 2015. The findings found that economic globalization and trade increase environmental degradation. Zaidi, Zafar, Shahbaz, and Hou (2019) also investigated the impact of financial development and globalization on CO2 emissions for Asia Pacific Economic Cooperation (APEC) economies from 1990 to 2016. They applied Continuously Updated Bias-Corrected (Cup-BC) and Continuously Updated Fully Modified (Cup-FM) techniques to conclude that financial development and globalization improved the environmental quality of APEC economies.

Liu, Ren, Cheng, and Wang (2020) applied the panel fixed effects method to analyze globalization’s effects on CO2 emissions for G7
economies from 1970 to 2015. They observed that globalization and economic growth increased environmental degradation. By applying the CS-ARDL model, Wang et al. (2020) also evaluated the impacts of economic globalization and natural resources on CO2 for G7 countries from 1996 to 2017. They found that economic globalization and natural resources deepened the environmental degradation of the countries involved. Erdogan, Çakar, Ulucak, Danish, and Kassouri (2021) examined the impact of natural resource abundance and globalization on Sub-Saharan Africa’s ecological sustainability level from 1980 to 2016. The study applied the Cup-BC and Cup-FM long-term techniques and found that both resource abundance and globalization increased environmental sustainability. Awan, Azam, Saeed, and Bakhtyar (2020) used the fixed effects and the feasible generalized least squares (FGLS) models to analyze the relationships among globalization, financial development, and CO2 emissions for MENA countries from 1971 to 2015. The findings documented that globalization and financial development significantly contributed to improvements in environmental quality.

Mehmood, Mansoor, Tariq, and Ul-Haq (2021) analyzed the effects of globalization and tourism on CO2 emissions by analyzing the quarterly data of 1995Q1–2016Q4 in South Asian countries. ARDL test results showed that globalization in South Asian countries brought cleaner technology innovations, improving air quality. Furthermore, the study found that gross domestic product (GDP) and electricity use in South Asia countries significantly increase CO2 emissions. South Asia countries are speeding up their economic development using fossil fuels. Le and Ozturk (2020) explored how globalization, GDP per capita, government spending, financial development, and institutional quality influenced CO2 emissions for 47 emerging markets and developing countries from 1990–2014. The results of CCEMG, AMG, and DCCE suggest that globalization and economic growth increase CO2 emissions. Further, a Dumitrescu and Hurlin causality study revealed the feedback relationship among variables and CO2 emissions. This evidence highlights the trade-offs between economic development and environmental quality.

3 | THEORETICAL FRAMEWORK, DATA, AND METHODOLOGY

3.1 | Theoretical framework

This study explored how natural resources and economic globalization affect environmental sustainability in the MENA region. The unsustainable mining and excessive utilization of natural resources can increase environmental deterioration (Ahmed et al., 2020a). However, abundant natural resources may limit fossil energy source imports, improving environmental quality (Zafar, Zaidi, Shahbaz, & Hou, 2019a). Economic Development in the MENA region relies on non-mineral and mineral natural resources (Charfeddine & Mrabet, 2017).

Economic globalization can affect natural resource extraction practices because trade openness is associated with efficient technology transfer. However, the scale effect of trade and foreign investment in dirty technology can also lead to environmental pollution (Ahmed et al. 2020b). In the context of the MENA region, economic globalization is critical because exporting natural resources to the rest of the world is the primary source of regional income. Worldwide interactions through economic globalization make it possible to fulfill global demand. These countries also largely depend on the other parts of the world to import equipment and machinery required for resource extraction and other needs.

Environmental degradation is tied with economic development because economic development involves utilizing resources to increase economic activities. Producing and consuming resources place stress on the environment and increase waste generation (Ahmed et al., 2019a). Urbanization can increase housing, transport, and energy demands, stimulating fossil fuel consumption and generating more CO2 emissions. In contrast, urbanization may alleviate pollution levels by promoting resource efficiency through train and bus-based collective transportation (Ahmed et al. 2019a). Using the arguments above, we constructed the following model to unfold the impact of natural resources and economic globalization on CO2 emissions.

\[ CO_2 = f(Y, TO, NR, EG, UR) \]  

(1)

For the empirical estimation, the model variables are log-transformed so that the sharpness in data is diminished and variables show better distributional properties. Natural logarithmic transformation helps to remove autocorrelation and heteroskedasticity issues from data. Compared to the linear transformation, results derived from log-transformed models are more consistent and efficient. The log-linear form of augmented carbon emissions is as per the following:

\[ \ln CO_{2t} = \phi_0 + \phi_1 \ln Y_{1t} + \phi_2 \ln TO_{1t} + \phi_3 \ln NR_{1t} + \phi_4 \ln EG_{1t} + \phi_5 \ln UR_{1t} + \epsilon_{1t} \]  

(2)

where \( \phi_1, \phi_2, \phi_3, \phi_4 \) and \( \phi_5 \) are the coefficients of economic growth (Y), trade openness (TO), Natural resources (NR), Economic Globalization (EG), and Urbanization (UR). where cross-sections are denoted by “i,” MENA economies, while “t” is for the time from 1980 to 2018. \( \ln \) is the natural log. “\( \phi \)” represents the intercept term, “ \( \phi \)” are the parameters, and “\( \epsilon \)” is the error term.

It is widely believed that an increase in output contributes to environmental deterioration due to the growing demand for energy and resource consumption. The continuous increase in output in MENA economies poses a significant threat to the environment due to unsustainable growth patterns. Hence based on the above argument, economic growth is expected to have a positive effect on CO2 emission. Natural resources play a crucial role in reducing environmental degradation. It is considered as one of the pure and cleaner sources of sustainable energy and fulfills the current and future demands from natural resources (Panwar, Kaushik, & Kothari, 2011). Hence, it is predicted that natural resources lessen environmental degradation and are projected to have a negative impact on CO2 emission.

Trade openness is the ultimate factor in increasing environmental degradation and climate change (Destek & Sinha, 2020). Hence, trade
openness is projected to have a positive impact on CO₂ emissions. Economic globalization is another critical aspect that affects environmental quality. Can and Gozgor (2017) argue that economic globalization exerts a negative impact on carbon emissions, and therefore, it is beneficial in decreasing environmental pollution. Based on the argument, economic globalization is expected to have a negative effect on CO₂ emissions. Furthermore, Neagu (2020) argues that urbanization poses a positive effect on CO₂ emissions. Consequently, urbanization is anticipated to have a positive and negative effect on CO₂ emissions.

3.2 Data

The study applied a panel data analysis for MENA (Algeria, Bahrain, Egypt, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, Qatar, Saudi Arabia, Syria, Tunisia, United Arab Emirates, and Yemen) economies for the period 1980 to 2018. The selection of periods relies on data availability. Bahrain, Iraq, Libya, and Syria were ultimately excluded from the study due to unavailable data. The study analyzed CO₂ emissions to measure environmental sustainability and inspect the effect of natural resources and economic globalization on CO₂ emissions. The control variables in the model include trade openness, urbanization, and economic growth. Data for CO₂, natural resources, urbanization, trade openness, and economic growth variables were collected from the World Development Indicators (WDI) databank. Economic globalization data obtained from Dreher (2006). Table 1 presents the definition and sources of data.

3.3 Methodology

3.3.1 Cross-sectional dependence

The first characteristic of the panel data to measure cross-section dependence (CD). This study applied the Lagrange Multiplier (LM), introduced by Breusch and Pagan (1980), and the CD test developed by Pesaran (2004) to generate reliable results. Inspecting CD is vital in a panel data analysis since not considering CD may yield misleading and biased estimates. The Breusch and Pagan (1980) equations are specified as:

\[ CD = T \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \rho_{ij}^2 \]  (3)

The Pesaran (2004)' CD test is as follow:

\[ CD = \sqrt{\frac{2T}{N(N-1)} \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \rho_{ij}^2} \]  (4)

where \( T \) stands for periods; \( N \) is the panel data size; and \( \rho_{ij} \) is the correlation coefficient. The null hypothesis of the CD test is that there is cross-sectional independence between the cross-sectional units. The alternative hypothesis is that there is cross-sectional dependence between sample economies.

3.3.2 Unit root tests

The integration order of the variables is examined after the results of the CD tests. First-generation unit root methods, such as Levin-Lin & Chu and I'm, Pesaran, and Shin (IPS), cannot mitigate CD’s problem (Lv & Xu, 2018). Therefore, keeping in view the presence of CD, this study used the second generation cross-section augmented IPS (CIPS) and the cross-sectional augmented Dickey–Fuller (CADF) unit root tests (Pesaran, 2007). The equation of the test statistic is as follows:

\[ \Delta CA_i,t = \phi_i + \phi_{\Delta CA_{i-1}} + \sum_{j=0}^{p} \phi_{\Delta CA_{i-j-1}} + \sum_{j=0}^{p} \phi_{\Delta CA_{i-j-1}} + \mu_i \]  (5)

where \( \overline{CA}_{t-1} \) and \( \overline{\Delta CA}_{t-1} \) are the averages for the cross-sections. The study elaborates the statistics of the CIPS test as follows:

| TABLE 1 | Data description and source |
|-----------------|-----------------------------|
| **Variables** | **Symbol** | **Measurement** | **Sources** |
| Carbon dioxide  | CO₂           | It is the amount of carbon that is discharged from activities (kt). | WDI |
| Natural resources abundance | N.R. | It is the total of natural resources rent (% of GDP). | WDI |
| Economic globalization | E.G. | The KOF index forms economic globalization. It is calculated in terms of FDI, real trade flows, foreign national income outflows, and various controls (import barriers and taxes on foreign trade, etc.) | KOF Index |
| Trade openness  | TO            | It is the ratio of imports and export divided by GDP (% of GDP). | WDI |
| Urbanization    | U.R.          | Urban population is the percentage of the total population. | WDI |
| Economic growth | Y             | Gross Domestic Product (constant $ U.S. 2010) | WDI |

Abbreviation: WDI, World development indicators.
\[
CIPS = \frac{1}{N} \sum_{i=1}^{n} CDF_i
\]

where CDF is the cross-sectional augmented Dickey–Fuller (CADF) in Equation (6).

3.3.3 | Panel cointegration test

Before estimating the long-run parameters, we assessed whether there is cointegration among the underlying variables. The first and second generation’s panel cointegration tests cannot jointly address structural breaks and CD (Larsson, Lyhagen, & Löthgren, 2001; McCoskey & Kao, 1998; Pedroni, 2004; Westerlund, 2005, 2007). According to Phillips and Sul (2003), traditional cointegration techniques can yield deceptive and unreliable findings when the model experiences CD and heteroscedasticity. Therefore, this study used Westerlund and Edgerton (2008) panel cointegration test because the Westerlund and Edgerton (2008) panel cointegration test allows for CD, autocorrelation, and structural breaks. Westerlund and Edgerton (2008) identified in two statistics:

\[
LM_i = \frac{\hat{\phi}_i}{SE(\hat{\phi}_i)}
\]

\[
LM_p = T \hat{\phi}_i \left( \frac{\hat{\sigma}_i}{\sigma_i} \right)
\]

where \( \hat{\phi}_i \) represents the estimator of least squares; \( \sigma_i \) the SE of \( \phi_i \); and \( SE(\hat{\phi}_i) \) represents the SE of \( \hat{\phi}_i \). The Westerlund and Edgerton (2008) cointegration analysis presumes that the null hypothesis is that there is no cointegration. The alternative hypothesis is that there are long-run relationships between variables.

3.3.4 | Long-run analysis

Researchers have used different econometric techniques to evaluate independent variables’ effect on dependent variables, such as pooled ordinary least squares, GMM, and OLS. Each method has advantages and disadvantages and also depends on the nature of the data. These methods do not mitigate the problem of CD. This study applied the Cup-FM introduced by Bai and Kao (2006) and the Cup-BC estimation method for robustness Bai et al. (2009) by following recent studies of (Ahmed et al., 2020b; Uluçak & Bilgili, 2018; Zafar et al., 2019a). Our research sample is large and has high power values, supporting using these two Cup-FM and Cup-BC estimation methods. Because of their capacity to produce accurate findings, even in the presence of CD, endogeneity, and autocorrelation, these methods are efficient for panel data compared to other estimation methods (Ahmed et al., 2020b). The techniques produce unbiased and reliable outcomes in the case of exogenous regressors. These estimation methods also address mixed I(1)/I(0) factors and provide robust results. Even when there is no endogeneity, these measures can predict consistent results (Bai et al., 2009).

The Cup-FM estimation method maintains a constant limited model parameter distribution. Using simulations, the parameters are continuously updated (Cup) over time until they converge. This approach assumes that the error term follows the factor model. As described, we formalize the factor model:

\[
\hat{\beta}_{cup}, \hat{F}_{cup} = \arg \min_1 \frac{1}{nT^2} \sum_{i=1}^{n} (y_i - x_i\beta)^T M_T (y_i - x_i\beta)
\]

where; \( M_T = I_T - T^{-2}FF^T \), \( I_T \) demonstrates the elements; and \( T^2 \) shows the identity matrix. The error term assumes there are common latent factors. Initial estimates are allocated to \( F \). This process is repeated until convergence is achieved.

3.3.5 | Granger causality test

The Cup-FM and Cup-BC results do not indicate the direction of the relationship between the variables, which is vital for developing policy recommendations. As such, this research applied the Granger causality test of Dumitrescu and Hurlin (2012) to observe the causal relationship between underlying variables. This method yields two statistics: \( W \) and \( Z \). The \( W \) statistics show the test averages while \( Z \) represents the standard normal distribution. The model is expressed as:

\[
z_{ij} = \alpha_i + \sum_{j=1}^{p} \beta_j z_{ij-1} + \sum_{j=1}^{p} \theta_j t_{ij-1}
\]

In this expression \( j \) signifies the lag length and \( \beta_j(j) \) specifies the autoregressive parameters.

4 | RESULTS AND DISCUSSION

Table 2 reveals the correlation matrix and indicates a positive linkage between economic growth, trade openness, natural resources, economic globalization, and urbanization with respect to CO2 emissions. The outcomes also reveal a negative correlation between natural resources and economic globalization. The empirical research starts by examining the CD, followed by the unit root and cointegration analysis.

Table 3 provides the CD results and indicates cross-dependence between the variables; in other words, the study accepts the alternative hypothesis against the null hypothesis with respect to cross-section independence. This outcome reaffirms that most of the MENA countries are inter-connected in the globalized world. A shock in any variable in one sample economy can spread to other economies. Hence, due to spillover effects, the variables are cross-sectionally
If we had not considered the CD, the outcomes might have been unreliable (Pesaran, 2004). After confirming the CD, the study examined the integrated level of variables. Table 4 indicates the CIPS and CADF test results and indicates that the variables have a mixed integration order. Table 4 indicates that all the variables, except natural resources, are non-stationary at the level and become stationary at the first difference at a 1% critical value of significance.

Table 5 demonstrates the outcomes of the Westerlund and Edgerton (2008) cointegration test. The findings indicate a long-run connection among the variables of natural resources, economic globalization, economic growth, trade openness, urbanization, and CO₂ emissions at a 1% significance level. A break estimator model developed by Westerlund and Edgerton (2008) was also applied to determine each MENA country’s breakpoint. This method was first developed by Bai and Perron (1998) to ascertain the structural breakpoint.

Table 6 presents the structural breakpoints of each country and reveals many structural breaks. In particular, multiple structural breaks occurred in 1991, 1992, 1993, 1994, 1997, 1998, 2000, 2001, 2003, 2005, and 2006. These breaks influenced both global shocks and local shocks for each selected country. After confirming the presence of the long-term association using the Westerlund and Edgerton (2008) panel cointegration test, we gauged the long-term relationship elasticities applying the Cup-FM and Cup-BC method. Table 7 provides the findings of both estimators. The Cup-FM test shows that the coefficient values for economic growth, trade openness, natural resources, economic globalization, and urbanization are 0.136, 0.069, −0.009, −0.170, and 0.939%, respectively.

The study findings reveal a positive relationship between economic development and deterioration of the environment. The coefficient value of economic growth (lnY) is significant and positive, inferring that the scale effect exceeds the technique and composition effect in MENA economies. It denotes that economic growth is causing environmental degradation, uses more energy, and creates more emissions. The positive outcome of economic growth on CO₂ emissions is owing to the acceleration of MENA’s economic growth for the
past two decades. The intensification in income level has enhanced economic activities, including industrialization and natural resource consumption in every sector of the economy. It has resulted in a rise in CO₂ levels and environmental degradation. Growth and the environment are fundamentally connected, making all economic activities environmentally based. Critical basic inputs, such as metals and minerals, soil, forest resources, and electricity, are essential for processing. The environment is the recipient of wastes generated by businesses. MENA economies did not sign the Kyoto Protocol; however, they face the same environmental problems as developing countries. Similarly, as the manufacturing scale increases, the environment is rapidly degrading in MENA countries. This outcome is consistent with other studies addressing APEC economies (Zaidi et al., 2019) and Asian economies (Zafar et al., 2020).

The findings further reveal a negative association between natural resources and CO₂ emissions. It is because governments use safe and green technologies to extract natural resources, which contributes to reducing the amount of CO₂ emitted into the atmosphere. The MENA countries have large oil and gas reserves, providing permanent standing in the international economy. The World Atlas indicates that MENA countries hold 45% of the world’s natural gas reserves and 60% of the world’s oil reserves. In 2018, the MENA countries emitted 3.2 billion tons of CO₂ and generated 8.7% of the total GHGs. These findings are closely related to the MENA countries’ use of renewable energy, which produces fewer emissions than fossil-fuel sources such as oil. These results differ from other studies’ findings focusing on Europe (Bekun et al., 2019) and Pakistan (Danish, Ulucak, & Khan, 2020). In contrast, these results are consistent with a study on five EU countries (Balsalobre-Lorente et al., 2018).

MENA’s economic globalization level is also negatively correlated with environmental quality. It may be because their globalization process is controlled by strong environmental laws that restrict them from degrading the environment. These environmental laws lead to green and efficient environmental-friendly technologies, contributing to improvements in environmental quality. Economic globalization is more than the movement of manufactured products; it also includes the movement of resources, intermediate goods, and technologies. Multinational corporations can transfer their expertise in green technology to economies having strong environmental standards. These environmental laws lead to significant levels of pollution caused by dirty factories. It means a large and dirty factory can move its activity to MENA countries to reduce pollution. These economies may use outdated technologies that are damaging to the environment, and the environment in these economies can contain significant levels of pollution caused by dirty factories. It means a rise in trade openness can increase CO₂ emissions under weak environmental regulations because of dirty manufacturing’s competitive advantage. This study’s findings are consistent with (Danish, 2020; Hakimi & Hamdi, 2016) but not consistent with (Gardiner & Hajek, 2020). In the case of urbanization, the coefficient also indicates a positive and significant effect with respect to CO₂ emissions, indicating that urbanization is harmful to environmental quality. It may be because these nations are not using environmentally friendly policies during urbanization. Urbanization influences the physical environment

### Table 6: Structural breaks of Westerlund and Edgerton (2008) cointegration test

| Country  | No shift | Mean shift | Regime shift |
|----------|----------|------------|--------------|
| Algeria  | 1992     | 2000       | 2000         |
| Egypt    | 1992     | 2000       | 2000         |
| Iran     | 1992     | 1998       | 1998         |
| Israel   | 1992     | 1991       | 2001         |
| Jordan   | 1992     | 1991       | 1991         |
| Kuwait   | 1992     | 1991       | 1991         |
| Lebanon  | 1992     | 1991       | 2006         |
| Morocco  | 1992     | 2003       | 2003         |
| Oman     | 1992     | 2005       | 2005         |
| Qatar    | 1992     | 1991       | 1991         |
| Saudi Arabia | 1992 | 1994       | 1994         |
| Tunisia  | 1992     | 1991       | 1993         |
| UAE      | 1992     | 1997       | 1997         |
| Yemen    | 1992     | 1992       | 1997         |

### Table 7: Results of Cup-FM and Cup-BC tests

| Variables | Cup-FM | Cup-BC |
|-----------|--------|--------|
| lnY       | 0.1362*** | 0.1228*** |
| lnTO      | 0.0694*** | 0.1160*** |
| lnNR      | -0.0097*** | -0.0050** |
| lnEG      | -0.1703*** | -0.1643*** |
| lnUR      | 0.9398*** | 0.9006*** |

Note: ***Significant value at 1%, **significant value at 5%, *significant value at 10%. 

Note: Models are run with a maximum of five factors.
because it changes the human community, people's behaviors, and the need for resources. This outcome is consistent with other studies (Ali, Bakhsh, & Yasin, 2019; Hanif, 2018). The findings of the Cup-BC are consistent with the Cup-FM results.

Finally, Table 8 shows the Dumitrescu and Hurlin panel causality analysis findings, which gauged the causal association among the CO2 emissions, economic growth, natural resources, economic globalization, trade openness, and urbanization. The findings show bidirectional causality between CO2 and urbanization. It suggests any policy shock impacting CO2 emissions may significantly impact urbanization; the reverse is also true. However, our empirical findings demonstrate a one-way causality of natural resources and economic growth toward CO2. Any policy shock in natural resources and economic growth may cause changes in CO2; however, the reverse is not valid. A one-way causality exists from CO2 to trade openness.

A weak one-way connection was observed to come from trade openness and natural resources towards economic growth. It implies that if any change accrues in trade openness and natural resources, it directly causes a change in economic growth. In contrast, a two-way and strong connection exists between economic globalization and economic growth, and urbanization. The findings imply that natural resources and economic globalization cause trade openness, and this relationship is unidirectional. Alternatively, the relationship between urbanization and trade openness is bidirectional. Table 8 results reveal a weak unidirectional link, coming from economic growth to natural resources. A strong and two-way link is seen between urbanization and natural resources and economic globalization and urbanization.

5 | CONCLUSIONS AND POLICY IMPLICATIONS

Environmental sustainability is a major global problem, and the topic has drawn the attention of researchers and policymakers because of climate change. This research adds to the literature by analyzing the relationships between natural resources, economic globalization, and CO2 emissions in the setting of rapid urbanization, trade openness, and economic growth for the period 1980–2018 in MENA countries. The study applied second-generation panel cointegration techniques and two tests for CD (Pesaran, 2004) and the Lagrange Multiplier (Breusch & Pagan, 1980). CADF and CIPS unit root assessments were used to assess the stationary properties of analyzed variables in CD’s presence. This study applied the DHGM cointegration method Westerlund and Edgerton (2008), and the long-term coefficients were calculated using the Cup-FM technique (Bai & Kao, 2006). This research applied Cup-BC to verify the robustness of the models (Bai et al., 2009).

We verified the presence of CD in the data. Moreover, the findings of the CIPS and CADF Pesaran (2007) unit root analyses found a mixed integration order of studied variables. The mixed integration of variables applies to the second-generation cointegration techniques. The long-run equilibrium between the variables was verified using the Westerlund and Edgerton (2008) cointegration method. All the variables are cointegrated with CO2 emissions when there is no shift, a mean shift, and a regime shift, indicating significant structural breaks. These breaks influence both global shocks and local shocks for each selected country. The long-term estimator’s results indicate that economic growth, trade openness, and urbanization contribute to CO2 emissions, whereas natural resources and economic globalization decrease the quantities of CO2 emissions. The Cup-FM shows coefficients values for economic growth, trade openness, natural resources, economic globalization, and urbanization are 0.136, 0.069, −0.009, −0.170, and 0.939%, respectively. The Cup-BC results are compatible with the Cup-FM estimates.

In practical terms, this study highlights significant and substantial policy recommendations that could help accomplish sustainable development goals to advance environmental quality in the MENA region. First, the empirical results indicate that economic growth and trade openness may increase CO2 emissions. As such, these nations’ policymakers should reconsider trade policy and replace outdated technology with the latest technology to produce goods. They should also accept fewer polluted imports from other countries. Trade is a key element needed to update technology and economic development. As such, these nations should consider significant steps to improve environmental quality through trade agreements, given that abundant natural resources can reduce environmental degradation. Industries and governments should implement more green and efficient environmental regulations and systems to reduce CO2 emissions. That may also contribute to reversing the effect of economic growth and environmental quality. In general, reducing environmental pollution without negatively affecting trade volumes and real income calls on MENA countries to develop renewable energy
investment as well as restructure energy-saving efforts to curb excessive energy loss.

Also, the results of the economic globalization variable show a negative and significant link with CO₂ emissions. Governments should continue to invest efforts to control the exchange of goods and services and implement bilateral trade agreements to reduce CO₂ emissions. In turn, it may positively impact environmental quality. It is well-known that economic globalization provides cleaner production technology transfers to underdeveloped countries and creates great awareness toward cleaner business strategies, and enables countries to achieve environmental sustainability and to design a sustainable future. Sustainable development mandates the protection of the environment and natural resources as well as to provide social and economic welfare to the present and to subsequent generations (Erdoğan et al., 2021).

This study has some limitations, highlighting future research opportunities. The model did not include certain important variables, such as institutional quality, energy consumption, and technological innovation. Future researchers could extend this study by inspecting the role of institutional quality and ecological footprint with respect to the pollution haven or halo hypothesis. Future researchers could also incorporate an interaction term representing institutional quality and the natural resources and highlight practical policy implications based on the results. Future expansions of this study should also take into account urbanization, sustainable energy distribution, sustainable development issues, innovation, human capital development, environmental regulation policy, etc., in multivariate analyses.

ORCID
Abdul Majeed  https://orcid.org/0000-0001-5231-8756
Claire Emilienne Wati Yameogo  https://orcid.org/0000-0002-4204-0444
Nazim Hussain  https://orcid.org/0000-0003-2873-5001

REFERENCES
Aeknarajindawat, N., Suteerachai, B., & Suksod, P. (2020). The impact of natural resources, renewable energy, economic growth on carbon dioxide emission in Malaysia. International Journal of Energy Economics and Policy, 10, 211–218. https://doi.org/10.32479/ijeep.9180
Ahmed, Z., Asghar, M. M., Malik, M. N., & Nawaz, K. (2020a). Moving towards a sustainable environment: The dynamic linkage between natural resources, human capital, urbanization, economic growth, and ecological footprint in China. Resources Policy, 67, 101677. https://doi.org/10.1016/j.resourpol.2020.101677
Ahmed, Z., Wang, Z., & Ali, S. (2019a). Investigating the non-linear relationship between urbanization and CO₂ emissions: An empirical analysis. Air Quality, Atmosphere & Health, 12(8), 945–953. https://doi.org/10.1007/s11869-019-00711-x
Ahmed, Z., Wang, Z., Mahmood, F., Hafeez, M., & Ali, N. (2019b). Does globalization increase the ecological footprint? Empirical evidence from Malaysia. Environmental Science and Pollution Research, 26(18), 18565–18582. https://doi.org/10.1007/s11356-019-05224-9
Ahmed, Z., Wasif, M., & Ali, S. (2020b). Linking urbanization, human capital, and the ecological footprint in G7 countries: An empirical analysis. Sustainable Cities and Society, 55, 102064. https://doi.org/10.1016/j.scs.2020.102064
Ali, R., Bakhsh, K., & Yasin, M. A. (2019). Impact of urbanization on CO₂ emissions in emerging economy: Evidence from Pakistan. Sustainable Cities and Society, 48, 101553. https://doi.org/10.1016/j.scs.2019.101553
Awan, A. M., Azam, M., Saeed, I. U., & Bakhtyar, B. (2020). Does globalization and financial sector development affect environmental quality? A panel data investigation for the Middle East and North African countries. Environmental Science and Pollution Research, 27, 45405–45418. https://doi.org/10.1007/s11356-020-10445-4
Bai, J., & Kao, C. (2006). On the estimation and inference of a panel cointegration model with cross-sectional dependence. In B. H. Baltagi (Ed.), Contributions to economic analysis (Vol. 274). New York, NY: Elsevier. Retrieved from https://doi.org/10.1016/S0575-8550(06)47001-9
Bai, J., Kao, C., & Ng, S. (2009). Panel cointegration with global stochastic trends. Journal of Econometrics, 149(1), 82–99. https://doi.org/10.1016/j.jeconom.2008.10.012
Bai, J., & Perron, P. (1998). Estimating and testing linear models with multiple structural changes. Econometrica, 66(1), 47. https://doi.org/10.2307/23079540
Balsalobre-Lorente, D., Shabzad, M., Roubaud, D., & Farhani, S. (2018). How economic growth, renewable electricity and natural resources contribute to CO₂ emissions? Energy Policy, 113, 356–367. https://doi.org/10.1016/j.enpol.2017.10.050
Bekun, F. V., Alola, A. A., & Sarkodie, S. A. (2019). Toward a sustainable environment: Nexus between CO₂ emissions, resource rent, renewable and non-renewable energy in 16-EU countries. Science of the Total Environment, 657, 1023–1029. https://doi.org/10.1016/j.scitotenv.2018.12.104
Bresch, T. S., & Pagan, A. R. (1980). The Lagrange multiplier test and its applications to model specification in econometrics. The Review of Economic Studies, 47(1), 239–253. https://doi.org/10.2307/2297111
Can, M., & Gozgor, G. (2017). The impact of economic complexity on carbon emissions: Evidence from France. Environmental Science and Pollution Research, 24(19), 16364–16370. https://doi.org/10.1007/s11356-017-9219-7
Charfeddine, L., & Mrabet, Z. (2017). The impact of economic development and social-political factors on ecological footprint: A panel data analysis for 15 MENA countries. Renewable and Sustainable Energy Reviews, 76, 138–154. https://doi.org/10.1016/j.rser.2017.03.031
Danish. (2020). Moving toward sustainable development: The relationship between water productivity, natural resource rent, international trade, and carbon dioxide emissions. Sustainable Development, 28(4), 540–549. https://doi.org/10.1002/sd.2007
Danish, Baloch, M. A., Mahmood, N., & Zhang, J. W. (2019). Effect of natural resources, renewable energy and economic development on CO₂ emissions in BRICS countries. Science of the Total Environment, 678, 632–638. https://doi.org/10.1016/j.scitotenv.2019.05.028
Danish, Baloch, M. A., & Suad, S. (2018). Modeling the impact of transport energy consumption on CO₂ emission in Pakistan: Evidence from ARDL approach. Environmental Science and Pollution Research, 25(10), 9461–9473. https://doi.org/10.1007/s11356-018-1230-0
Danish, Ulucak, R., & Khan, S. U. D. (2020). Determinants of the ecological footprint: Role of renewable energy, natural resources, and urbanization. Sustainable Cities and Society, 54, 101996. https://doi.org/10.1016/j.scs.2019.101996
Dostek, M. A., & Sinha, A. (2020). Renewable, non-renewable energy consumption, economic growth, trade openness and ecological footprint: Evidence from organisation for economic Co-operation and development countries. Journal of Cleaner Production, 242, 118537. https://doi.org/10.1016/j.jclepro.2019.118537
Dreher, A. (2006). Does globalization affect growth? Evidence from a new index of globalization. Applied Economics, 38(10), 1091–1110. https://doi.org/10.1080/00036840500392078
Dumitrescu, E. I., & Hurlin, C. (2012). Testing for Granger non-causality in heterogeneous panels. Economic Modelling, 29, 1450–1460. https://doi.org/10.1016/j.econmod.2012.02.014

Erdogan, S. Çakar, N. D., Ulucak, R., Danish, & Kassouri, Y. (2021). The role of natural resources abundance and dependence in achieving environmental sustainability: Evidence from resource-based economies. Sustainable Development, 29(1), 143–154. https://doi.org/10.1002/sd.2137

Gardiner, R., & Hajek, P. (2020). Interactions among energy consumption, CO₂, and economic development in European Union countries. Sustainable Development, 28(4), 723–740. https://doi.org/10.1002/sd.2023

Hakimi, A., & Hamdi, H. (2016). Trade liberalization, FDI in flows, environmental quality and economic growth: A comparative analysis between Tunisia and Morocco. Renewable and Sustainable Energy Reviews, 58, 1445–1456. https://doi.org/10.1016/j.rser.2015.12.280

Hanif, I. (2018). Impact of fossil fuels energy consumption, energy policies, and urban sprawl on carbon emissions in East Asia and the Pacific: A panel investigation. Energy Strategy Reviews, 21, 16–24. https://doi. org/10.1016/j.esr.2018.04.006

Haseeb, A., Xia, E., Baloch, M. A., & Abbas, K. (2018). Financial development, globalization, and CO₂ emission in the presence of EKC: Evidence from BRICS countries. Environmental Science and Policy Research, 25, 31283–31296.

Kalayci, C., & Hayalolu, P. (2019). The impact of economic globalization on CO₂ emissions: The case of NAFTA countries. International Journal of Energy Economics and Policy, 9(1), 356–360. https://doi.org/10.32477/ijeep.7233

Khan, A., Chenggang, Y., Hussain, J., Bano, S., & Nawaz, A. (2020). Natural resources, tourism development, and energy-growth-CO₂ emission nexus: A simultaneity modeling analysis of BRI countries. Resources Policy, 68, 101751. https://doi.org/10.1016/j.respol.2020.101751

Khan, I., Hou, F., & Le, H. P. (2021). The impact of natural resources, energy consumption, and population growth on environmental quality: Fresh evidence from the United States of America. Science of the Total Environment, 754, 142222. https://doi.org/10.1016/j.scitotenv.2020.142222

Kiprop, V. (2019). What are the MENA countries?. WorldAtlas.

Kwakwa, P. A., Alhassan, H., & Adu, G. (2020). Effect of natural resources extraction on energy consumption and carbon dioxide emission in Ghana. International Journal of Energy Sector Management, 14(1), 20–34. https://doi.org/10.1108/IJESM-09-2019-0003

Larsson, R., Lyhagen, J., & Löthgren, M. (2001). Likelihood-based cointegration tests in heterogeneous panels. The Econometrics Journal, 4(1), 109–142. https://doi.org/10.1111/1368-432x.00059

Le, H. P., & Ozturk, I. (2020). The impacts of globalization, financial development, government expenditures, and institutional quality on CO₂ emissions in the presence of environmental Kuznets curve. Environmental Science and Policy Research, 27(18), 22680–22697. https://doi.org/10.1007/s11356-020-08812-2

Liu, M., Ren, X., Cheng, C., & Wang, Z. (2020). The role of globalization in CO₂ emissions: A semi-parametric panel data analysis for G7. Science of the Total Environment, 718, 137379. https://doi.org/10.1016/j.scitotenv.2020.137379

Lv, Z., & Xu, T. (2018). Is economic globalization good or bad for the environmental quality? New evidence from dynamic heterogeneous panel models. Technological Forecasting and Social Change, 137, 340–343. https://doi.org/10.1016/j.techfore.2018.08.004

Magazzino, C., & Cerulli, G. (2019). The determinants of CO₂ emissions in MENA countries: A responsiveness scores approach. International Journal of Sustainable Development and World Ecology, 26(6), 522–534. https://doi.org/10.1080/13504509.2019.1606863

Magazzino, C. (2019). Testing the stationarity and convergence of CO₂ emissions series in MENA countries. International Journal of Energy Sector Management, 13(4), 977–990. https://doi.org/10.1108/IJESM-09-2018-0008

McCoskey, S., & Kao, C. (1998). A residual-based test of the null of cointegration in panel data. Econometric Reviews, 17(1), 57–84. https://doi.org/10.1080/07474939808804003

Mehmood, U., Mansoor, A., Tariq, S., & U-I-Haq, Z. (2021). The interactional role of globalization in tourism-CO₂ nexus in South Asian countries. Environmental Science and Pollution Research, 1–8. https://doi.org/10.1007/s11356-021-12473-0

Nathaniel, S. P., & Iheonu, C. O. (2019). Carbon dioxide abatement in Africa: The role of sustainable and renewable-energy consumption. Science of the Total Environment, 679, 337–345. https://doi.org/10.1016/j. scitotenv.2019.05.011

Neagu, O. (2020). Economic complexity and ecological footprint: Evidence from the most complex economies in the world. Sustainability, 12(21), 9031. https://doi.org/10.3390/su12219031

Panwar, N. L., Kaushik, S. C., & Kothari, S. (2011). Role of renewable energy sources in environmental protection: A review. Renewable and Sustainable Energy Reviews, 15(3), 1513–1524. https://doi.org/10.1016/j.rser.2010.11.037

Pedroni, P. (2004). Panel cointegration: Asymmetric and finite sample properties of pooled time series tests with an application to the PPP hypothesis. Econometric Theory, 20(3), 597–625. https://doi.org/10. 1017/S0266466604203073

Pesaran, M. H. (2004. August). General diagnostic tests for cross section dependence in panels (Discussion Paper No. 1240). Iza, pp. 1–42.

Pesaran, M. H. (2007). A simple panel unit root test in the presence of cross-section dependence. Journal of Applied Econometrics, 22(2), 265–312. https://doi.org/10.1002/jae.951

Phillips, P. C. B., & Sul, D. (2003). Dynamic panel estimation and homogeneity testing under cross section dependence. The Econometrics Journal, 6, 217–239. https://doi.org/10.1111/1368-423x.00108

Saint Akadiri, S., Adewale Alola, A., Olashinde-Williams, G., & Udom Etokakpan, M. (2020). The role of electricity consumption, globalization and economic growth in carbon dioxide emissions and its implications for environmental sustainability targets. Science of the Total Environment, 708, 134653. https://doi.org/10.1016/j.scitotenv.2019.134653

Sarkodie, S. A., & Adams, S. (2018). Renewable energy, nuclear energy, and environmental pollution: Accounting for political institutional quality in South Africa. Science of the Total Environment, 643, 1590–1601. https://doi.org/10.1016/j.scitotenv.2018.06.320

Shahbaz, M., Nasir, M. A., & Roubaud, D. (2018). Environmental degradation in France: The effects of FDI, financial development, and energy innovations. Energy Economics, 74, 843–857. https://doi.org/10.1016/j.eneco.2018.07.020

Shahbaz, M., Nasreen, S., Abbas, F., & Anis, O. (2015). Does foreign direct investment impede environmental quality in high-, middle-, and low-income countries? Energy Economics, 51, 275–287. https://doi.org/10.1016/j.eneco.2015.06.014

Sharmin, M., & Tareque, M. (2018). Econometric analysis of the effect of economic globalization, energy intensity, urbanization, industrialization and growth on CO₂ emissions of Bangladesh. Managing Global Transitions, 16, 335–354.

Shen, Y., Su, Z.-W., Malik, M. Y., Umar, M., Khan, Z., & Khan, M. (2021). Does green investment, financial development and natural resources rent limit carbon emissions? A provincial panel analysis of China. Science of the Total Environment, 755, 142538. https://doi.org/10.1016/j.scitotenv.2020.142538

Ulucak, R., & Bilgili, F. (2018). A reinvestigation of EKC model by ecological footprint measurement for high, middle and low income countries. Journal of Cleaner Production, 188, 144–157. https://doi.org/10.1016/j.jclepro.2018.03.191
Ulucak, R., & Khan, S. U.-D. (2020). Does information and communication technology affect CO2 mitigation under the pathway of sustainable development during the mode of globalization? Sustainable Development, 28(4), 857–867. https://doi.org/10.1002/sd.2041

Umar, M., Ji, X., Kirikkaleli, D., Shahbaz, M., & Zhou, X. (2020). Environmental cost of natural resources utilization and economic growth: Can China shift some burden through globalization for sustainable development? Sustainable Development, 28, 1678–1688. https://doi.org/10.1002/sd.2041

Wang, L., Vo, X. V., Shahbaz, M., & Ak, A. (2020). Globalization and carbon emissions: Is there any role of agriculture value-added, financial development, and natural resource rent in the aftermath of COP21? Journal of Environmental Management, 268, 110712. https://doi.org/10.1016/j.jenvman.2020.110712

Westerlund, J. (2005). New simple tests for panel cointegration. Econometric Reviews, 24(3), 297–316. https://doi.org/10.1080/07474930500243019

Westerlund, J. (2007). Testing for error correction in panel data. Oxford Bulletin of Economics and Statistics, 69(6), 709–748. https://doi.org/10.1111/j.1468-0084.2007.00477.x

Westerlund, J., & Edgerton, D. L. (2008). A simple test for cointegration in dependent panels with structural breaks. Oxford Bulletin of Economics and Statistics, 70(5), 665–704. https://doi.org/10.1111/j.1468-0084.2008.00513.x

Zafar, M. W., Shahbaz, M., Hou, F., & Sinha, A. (2019a). From non-renewable to renewable energy and its impact on economic growth: The role of research & development expenditures in Asia-Pacific Economic Cooperation countries. Journal of Cleaner Production, 212, 1166–1178. https://doi.org/10.1016/j.jclepro.2018.12.081

Zafar, M. W., Shahbaz, M., Sinha, A., Sengupta, T., & Qin, Q. (2020). How renewable energy consumption contribute to environmental quality? The role of education in OECD countries. Journal of Cleaner Production, 268, 122149. https://doi.org/10.1016/j.jclepro.2020.122149

Zaidi, S. A. H., Zafar, M. W., Shahbaz, M., & Hou, F. (2019). Dynamic linkages between globalization, financial development and carbon emissions: Evidence from Asia Pacific Economic Cooperation countries. Journal of Cleaner Production, 228, 533–543. https://doi.org/10.1016/j.jclepro.2019.04.210

Zhu, H., Duan, L., Guo, Y., & Yu, K. (2016). The effects of FDI, economic growth and energy consumption on carbon emissions in ASEAN-5: Evidence from panel quantile regression. Economic Modelling, 58, 237–248. https://doi.org/10.1016/j.econmod.2016.05.003

How to cite this article: Xiaoman W, Majeed A, Vashbieva DG, Yameogo C, Hussain N. Natural resources abundance, economic globalization, and carbon emissions: Advancing sustainable development agenda. Sustainable Development. 2021;1–12. https://doi.org/10.1002/sd.2192