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The Causal Connection of Natural Resources and Globalization with Energy Consumption in Top Asian Countries: Evidence from a Nonparametric Causality-in-Quantile Approach

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Abstract: Given the significance of energy conservation as a prime objective of environmental sustainability, countries all around the world are keen to identify significant factors that lead to the augmentation of energy utilization. Considering the rising emphasis of economies in utilizing natural resources to attain higher levels of globalization, the current research was aimed at investigating how the returns of natural resources and globalization affect energy consumption in top Asian economies. In doing so, the study emphasized the nonlinear relationship among the variables and applied the novel nonparametric method of causality in quantile to identify the quantile-based causal connection of natural resources and globalization on the returns and volatility of energy utilization in selected Asian countries. Moreover, the presence of nonlinearity in the variables was tested by the Brock-Dechert-Scheinkman test (BDS test), which confirmed that all variables showed nonlinear behavior. Furthermore, the findings of quantile cointegration confirmed a nonlinear long-run relationship of natural resources and globalization with energy utilization. The prime findings of causality in quantile revealed that the returns of natural resources and globalization had a significant causal effect on the returns of energy consumption in all countries. On the other hand, the volatility in energy consumption concluded no causal association with the returns of natural resources and globalization in any of the studied Asian countries. The findings are beneficial for the policymakers to formulate policies that will help to reduce the level of energy consumption.

Keywords: natural resources; globalization; energy; nonparametric causality in quantiles

1. Introduction

Natural resources are the resources that are bestowed on a country by nature, without any particular investment by the country, and they are considered one of the most influential determinants of the economic development of a country [1–5].

Therefore, most of the investments of resource-abundant countries are normally focused on extraction, which itself is a huge and critical area for natural scientists, environmental economists, and practitioners [6]. Resource-abundant countries fall into two categories: (1) Richly endowed, where countries transform their operations for the advancement of the capacity and capability of various industries and direct the extraction of the natural resources towards the betterment of the economic development and financial health of the country [7]. (2) Narrowly focused, where countries make themselves and their respective economies more dependent on the natural resources by focusing most of the industries in the same field thus increasing the level of dependency on the presence of the natural resources [8–10].

Natural resources enable direct foreign investment to a country, and that has a tendency to improve the standard of living of the locals [11,12], however, it also adversely affects the potential growth of the country in the long term [13], thus making the host country intensely dependent on the consumption and extraction of the natural resources; this is referred to as a resource curse [14–18].

Moreover, most researchers are in agreement with respect to the adverse association between economic development and natural resources of a country [19–21]. Researchers also suggest that by improving institutional quality, having a good incentive program to the personnel engaged in the respective activities [22], and strengthening the political stability [23], the country can counter the phenomenon of being trapping in a resource curse.

Globalization refers to the phenomenon where countries are consolidated by means of intercountry and direct investments, which make the countries grow together by nurturing their potential and capabilities and fostering economic development [24].

Conventionally, the term was used for the development of communication and transportation infrastructure that creates connectivity among the countries, however, the scope of the term has broadened [2]. By strengthening foreign trade among countries, globalization can enhance the capabilities, capacity, and efficiency of the manufacturing countries and contribute significantly to achieving economies of scales [24–26]. Moreover, availability of abundant natural resources also leads to an increase in globalization, because the countries that have resources can transform them into a usable form that can be exported to the counties lacking those resources [27]. Therefore, natural resources also increase foreign trade, foreign investments, and foreign exchange, which increase globalization and improve the efficiency of energy consumption [2,28].

Despite of the generation of value-added services and goods by the consumption of energy, energy consumption damages the environment and adversely contributes to global climate change [29]. For instance, oil- and gas-oriented companies while transforming the natural resources into usable forms consume most of the energy, and hence pollute the environment [30,31]. Moreover, natural resources extraction leading to an increased energy consumption can ultimately harm the global environment. Therefore, protecting and safe guarding the environment is of significant importance [32–35].

Asian countries, on one hand, are progressive and fast growing regions in terms of industrialization, urbanization, globalization, and population. On the other hand, they significantly contribute adversely to global pollution, climate change, and environment degradation [36,37].

Despite Asian countries being a major contributor to pollution and climate change, the current literature mainly focuses on the regions of the Organisation for Economic Co-operation and Development (OECD) countries and Asian countries have received less focus [38,39]. Therefore, this led to the motivation of the present study to examine the dynamic effects of natural resources and globalization on energy consumption in top Asian countries.

The remainder of this paper is arranged as follows: The next section presents evidence from the literature, followed by a discussion of the methodology of the present study. Next, estimations and findings of the study are discussed. Finally, conclusions are drawn and recommendations are given to the practitioners and policy makers for future guidance in devising strategies based on the findings of the present study.

2. Literature Review

The theoretical connection of globalization asserts that as the economy is globalized, its level of energy utilization changes. Being the prime source of energy, nearly 65% of worldwide carbon emanations come from the burning of fossil-fuels [40]. Following the apparent link, many studies believe that globalization is a crucial aspect of motivating energy usage. However, the rise or decline in the levels of energy depend on the net effect of multiple factors within the globalization. Generally, the upsurge in global output and income levels are linked with enhanced consumption and manufacturing along with the elimination of trade barricades due to enhanced globalization. This in turn amplifies energy usage and leads to a positive association [41]. On the other hand, the negative link between globalization and energy usage can also be attributed to new ventures leading to innovation spillover, which can assist in reducing energy usage by supporting energy efficient research [42]. Hence, the energy efficiency derived from importing skills as a result of globalization can reduce power usage, however, a rise in efficiency can only offset a portion and not all of the energy needs of an economy.

Similarly, the theoretical link between globalization and energy usage is also supported by the popular scale effect, technique effect, and composition effect [42]. The assumption of the scale effect asserts the positive connection between globalization and energy by stating that the expansion of fresh industries and economic activities augments energy usage [43,44]. Moreover, the alternative presumption of technique effect proclaims that a rise in globalization often empowers the economies to lower their energy utilization through importing progressive technologies and inflows of capital and supports the negative connection among the variables without obstructing the economic structure [45]. Finally, the composition effect in globalization confers the changes in energy intensity to the alteration in a country's industrial structure [46]. For instance, the emergence of globalization empowers a production shift from agriculture to industry and ultimately to the service industry, and thus changes the economic composition towards the sectors that demand lower energy use [40].

By linking higher levels of consumption and production to the environment, it is believed that the demand shift results in more eco-intensive processing that enlarges the environmental burden by putting more pressure on energy-insensitive processes [47]; this hinders the country's prospects of sustainable development. Conventionally, the dependence on natural resource consumption has been argued to persist the resource curse as it hinders sustainability of the economy by hindering growth [48]. In this regard, it is believed that countries having sufficient natural resources experience diminutive growth relative to those of resource-scarce economies [49]. Alternatively, many recent studies contradicted the concepts of a resource curse and found natural resources to be a blessing for countries [50]. Moreover, the growing dependence of economies on the utilization of natural resources demands reliable and sustainable access to numerous natural resources, such as forestry, water, minerals, productive land, and essential metals [51]. However, given the rate at which resource depletion is occurring, the physical accessibility of such natural resources is considered challenging. The dependence of many economies on minerals and metal extraction by consuming excessive amount of energy leads to environmental destruction [52]. In response, green sources of energy have provided a fine solution to fulfil energy needs with minimal pressure on the environment, but the installation and completion of green projects are often fossil-based and energy-dependent [53], while certain green sources such as biomass, wood, waste, and plants also enhance the pressure on natural resources and their sustainable access [54]. Hence, based on the above reasons, the link of globalization and natural resources with energy consumption is considered rather complex and needs to be re-evaluated in different time-series settings with the utilization of advanced methods to ensure the reliability of the derived findings [51].

Empirical Studies

Numerous research studies in the prevailing literature evaluated factors that contribute to environmental destruction [55]. Among them, energy consumption is regarded as a vital stimulator of environmental pollution [56]. The role of energy is inevitable for growth, however, by acknowledging the damaging consequences of energy use in climate change, the current economies are motivated to recognize the in-depth aspects of energy dependence so as to combat the environmental impact of energy use in the process of atmospheric downfall [57]. Following the adverse impact of energy dependence on environmental quality [58], particularly in damaging the ozone layer and emitting greenhouse gases [59], many studies have sought to identify the antecedents of energy usage in both developed [60,61] and developing economies [62,63].

For instance, Shahbaz et al. [40] examined the causal effect between globalization on energy utilization in twenty-five advanced countries. For this, the authors utilized the data from the timespan of 1970–2014. The empirical results of the study found significant causal associations among the variables in 14 out of 25 economies. Specifically, the results demonstrated the positive causal link between globalization and energy utilization in the majority of the studied economies except for in the UK and USA, where the rise in globalization was found to decrease energy usage. Lastly, the study reported that in the economies of Italy, New Zealand, Finland, Greece, Ireland, Portugal, Austria, Spain, Iceland, and Denmark, globalization did not exert significant influence on energy utilization. Also, Shahbaz et al. [41] examined the link between globalization and energy utilization in the economies of Ireland and the Netherlands. For this, the authors utilized the time-series quarterly data from the timespan of 1970–2015. The empirical results of the study found a significant impact of globalization on energy usage in the long run. Interestingly, the results stressed that a rise in globalization carried an upsurge in energy utilization in both of the highly globalized economies that were studied. However, the results failed to validate the existence of a short-term link among the considered variables.

Furthermore, in India, Shahbaz, Mallick, Mahalik, and Sadorsky [42] investigated the connection of globalization with energy utilization. For this, the authors utilized the time-series data from the timespan of 1971–2012 by applying the Autoregressive-Distributed Lag (ARDL) approach to perform empirical examination. The empirical outcomes of the study confirmed the presence of a significant link between globalization and energy utilization. Moreover, the results stressed that an increase in globalization curtails the adversities to the environment by lowering the level of energy usage in the Indian economy. For the economies of Indonesia, Malaysia, and Thailand, Azam et al. [63] analyzed the factors affecting energy utilization. For this, the authors utilized the time-series data from the timespan of 1980–2012. The empirical results of the study found a significant impact of globalization in the form of trade liberalization and foreign direct investment (FDI) in enhancing energy usage in the considered economies by documenting the presence of positive relationships among the variables.

In Bangladesh, Murshed, Tul-Jannat, and Amin [64] analyzed the impact of globalization on energy utilization in Pakistan. For this, the authors utilized the time-series data from the timespan of 1980–2015. The empirical results of the study stated that globalization had no causal relationship with energy usage in Bangladesh. Utilizing the indicator of trade openness to measure globalization, Shahbaz, Loganathan, Sbia, and Afza [65] also examined the link between globalization and energy utilization in Malaysia between 1970 and 2011. Similar to the findings of Azam et al. [63], the empirical results of the study also confirmed the positive influence of trade openness on energy usage in Malaysia. Bringing the impact of renewable energy to the globalization–energy nexus, Koengkan, Poveda, and Fuinhas [66] recently analyzed the impact of globalization on renewable energy utilization in Latin America. For this, the authors utilized the panel data for ten Latin American economies from 1980 to 2014. The empirical results of the study found a significant impact of globalization on renewable energy usage, highlighting that the rise in globalization led to an augmentation of the utilization of renewable energy in the studied economies.

Shahbaz et al. [67] investigated the relationship between globalization and energy utilization by validating the possibility of an environmental Kuznets link. For this, the authors utilized the mix panel data of eighty-six economies from the timespan of 1970–2015. The empirical results of the study validated the environmental Kuznets curve (EKC) hypothesis in a majority of the studied economies. Specifically, the results found that in sixty-four economies, the rise in globalization enhanced energy usage initially but ultimately resulted in increased energy efficiency and decreased energy consumption.

In another panel estimation, Rahman and Miah [27] examined the influence of numerous sources of energy on the level of globalization in a panel of twenty-six economies between 1990 and 2010. The findings documented that utilization of nonrenewable sources for power generation resulted in decreasing globalization in the studied economies. Alternatively, the adoption of green sources of energy were found to exert a positive influence on globalization in the considered sample.

Identifying the causal connection between green energy, fossil-based energy, and natural resources, Bekun, Alola, and Sarkodie [68] analyzed the panel of sixteen European economies. For this, the authors utilized the panel data from the timespan of 1996–2014. The empirical results of the study found that natural resources exert a unidirectional causal effect on both renewable and nonrenewable energy consumption. In Ghana, Kwakwa, Alhassan, and Adu [33] examined the link between the extraction of natural resources and energy utilization and carbon emanation. For this, the authors utilized the time-series data from the timespan of 1971–2013. The empirical results of the study found a significant impact of natural resources on energy as well as carbon discharge in Ghana. Specifically, the results reported that a rise in the extraction of natural resources enhanced the energy utilization and environmental degradation in the country.

3. Methodology

In the present study, an innovative hybrid approach for the identification of nonlinear based causality was employed, which was discussed and proposed by Balcilar et al. [1] and was founded on the frameworks proposed by Jeong et al. [69] and Nishiyama et al. [70]. The energy consumption is denoted by $\mathrm{y_t}$ and natural resources and globalization are denoted by x_{1t} and x_{2t}, respectively. As discussed by Jeong et al. [69] in the θ-th quantile, y_t, will not be effected by x_{1t} and x_{2t}, respectively, in terms of lag vector $\left\{y_{t-1}, \ldots, y_{t-p}, x_{1t-1}, \ldots, x_{1t-p}, x_{2t-1}, \ldots, x_{2t-p}\right\}$, whereby:

$$Q_\theta\Big(y_t y_{t-1}, \ldots, y_{t-p}, x_{1t-1}, \ldots, x_{1t-p}, x_{2t-1}, \ldots, x_{2t-p}\Big) = Q_\theta\Big(y_t y_{t-1}, \ldots, y_{t-p}\Big) \tag{1}$$

Moreover, the prima facie effect by x_{1t} and x_{2t}, respectively, on $\mathrm{y_t}$ in the θ-th quantile in terms of $\left\{y_{t-1}, \ldots, y_{t-p}, x_{1t-1}, \ldots, x_{1t-p}, x_{2t-1}, \ldots, x_{2t-p}\right\}$ is:

$$Q_\theta\Big(y_t y_{t-1}, \ldots, y_{t-p}, x_{1t-1}, \ldots, x_{1t-p}, x_{2t-1}, \ldots, x_{2t-p}\Big) \neq Q_\theta\Big(y_t y_{t-1}, \ldots, y_{t-p}\Big) \tag{2}$$

where $Q_\theta(y_t\bullet)$ represents the θ-th quantile of the y_t subject to t and $0 < \theta < 1$. Moreover, the conditional distribution function of $\mathrm{y_t}$ is denoted by $Y_{t-1} \equiv \left(y_{t-1}, \ldots, y_{t-p}\right)$, $X_{1t-1} \equiv \left(x_{1t-1}, \ldots, x_{1t-p}\right)$, $X_{2t-1} \equiv \left(x_{2t-1}, \ldots, x_{2t-p}\right)$, $Z_t = (X_{1t}, X_{2t}, Y_t)$, $F_{y_t|Z_{t-1}}\left(y_t \middle| Z_{t-1}\right)$, and $F_{y_t|Y_{t-1}}\left(y_t \middle| Y_{t-1}\right)$, where Z_{t-1} and Y_{t-1} are given, respectively. It is supposed that the conditional distribution $F_{y_t|Z_{t-1}}\left(y_t \middle| Z_{t-1}\right)$ is absolutely continuous in terms of $\mathrm{y_t}$ for all Z_{t-1}. Furthermore if it is represented that $Q_\theta(Z_{t-1}) \equiv Q_\theta\left(y_t \middle| Z_{t-1}\right)$ and $Q_\theta(Y_{t-1}) \equiv Q_\theta\left(y_t \middle| Y_{t-1}\right)$ will have $F_{y_t|Z_{t-1}}\left\{Q_\theta(Z_{t-1}) \middle| Z_{t-1}\right\} = \theta$ with a probability of 1. Therefore, as per the Equations (1) and (2), the hypotheses that need to be tested are shown below:

$$H_0 : P\Big\{F_{y_t|Z_{t-1}}\left\{Q_\theta(Y_{t-1}) \middle| Z_{t-1}\right\} = \theta\Big\} = 1 \tag{3}$$

$$H_1 : P\Big\{F_{y_t|Z_{t-1}}\left\{Q_\theta(Y_{t-1}) \middle| Z_{t-1}\right\} = \theta\Big\} < 1 \tag{4}$$

As per the framework proposed by Jeong et al. [69], the measure is used to compute the distance, which is $J = \{\varepsilon_t E(\varepsilon_t|Z_{t-1}) f_Z(Z_{t-1})\}$, whereas the regression error is represented by ε_t and the function of marginal density of Z_{t-1} is represented by $f_Z(Z_{t-1})$. The regression error is calculated when the null hypothesis is found true as presented in Equation (3), which is possible only in the scenario where

$E[1\{y_t \le Q_\theta(Y_{t-1})Z_{t-1}\}] = \theta$ or equivalently $1\{y_t \le Q_\theta(Y_{t-1})\} = \theta + \varepsilon_t$, whereas the indicator function is represented by $1\{\bullet\}$. The distance function as specified by Jeong et al. [69] is shown below:

$$J = E\Big[\Big\{F_{y_t|Z_{t-1}}\{Q_\theta(Y_{t-1})\big|Z_{t-1}\} - \theta\Big\}^2 f_Z(Z_{t-1})\Big] \quad (5) \tag{5}$$

As shown in Equation (3), it is imperative to consider that $J \ge 0$; only when H_0, as shown in Equation (5), becomes true will $J = 0$, whereas as shown in Equation (4), the values $J > 0$ are underneath the alternative hypothesis that is H_1. Moreover, the feasible test statistic based on the kernel function as discussed by Jeong et al. [69] for J can be shown as follows:

$$\hat{J}_T = \frac{1}{T(T-1)h^{2p}} \sum_{t=p+1}^{T} \sum_{s=p+1,\ s\neq t}^{T} K\Big(\frac{Z_{t-1} - Z_{s-1}}{h}\Big)\hat{\varepsilon}_t\hat{\varepsilon}_s \tag{6}$$

In Equation (6), the kernel function is represented by $K(\bullet)$, having bandwidth h, sample size is represented by T, lag-order is shown by p, the estimated unknown regression error is calculated by $\hat{\varepsilon}_t$, which is computed as:

$$\hat{\varepsilon}_t = 1\Big\{y_t \le \hat{Q}_\theta(Y_{t-1})\Big\} - \theta \tag{7}$$

In Equation (7), the θ-th quantile of y_t is calculated by $\hat{Q}_\theta(Y_{t-1})$, whereby (Y_{t-1}) is given. Moreover, $\hat{Q}_\theta(Y_{t-1})$ can be calculated through the kernel method, which is based on a nonparametric method and is shown below:

$$\hat{Q}_\theta(Y_{t-1}) = \hat{F}^{-1}_{yt|Y_{t-1}}(\theta Y_{t-1}) \tag{8}$$

where the estimator of the Nadarya–Watson kernel is represented by $\hat{F}_{yt|Y_{t-1}}(y_t Y_{t-1})$ and is given as:

$$\hat{F}_{yt|Y_{t-1}}(y_t Y_{t-1}) = \frac{\sum_{s=p+1,\ s\neq t}^{T} L\Big(\frac{Y_{t-1}-Y_{s-1}}{h}\Big)1(y_s \le y_t)}{\sum_{s=p+1,\ s\neq t}^{T} L\Big(\frac{Y_{t-1}-Y_{s-1}}{h}\Big)} \tag{9}$$

In Equation (9), the kernel function is represented by $L(\bullet)$ and the bandwidth is represented by h.

While extending the framework proposed by Jeong et al. [69], a test was developed for the 2nd moment. For this purpose, the nonparametric approach, which is quantile causality based on Granger as suggested and proposed by Nishiyama et al. [70], was used. While computing the higher-order moment, the illustration of causality is assumed as:

$$y_t = g(Y_{t-1}) + \sigma(X_{1t-1})\varepsilon_t + \sigma(X_{2t-1})\varepsilon_t \tag{10}$$

where the noise process is represented by ε_t, and stationery conditions are satisfied through unknown functions, which are $g(\bullet)$ and $\sigma(\bullet)$. Moreover, it should be noted that the aforementioned description is not in accordance with the testing of Granger type causality from x_{1t} and x_{2t} to y_t, respectively, however, it has the possibility for detection of nonlinear predictive power, which is computed from x_{1t} and x_{2t} to ${y_t}^2$ whereas $\sigma(\bullet)$ is the function of general nonlinearity. Therefore, for explaining the variation through Granger causality, the explicit description of squares of X_{1t-1} and X_{2t-1} are not required. Moreover, the hypotheses forms of Equation (10) for the purpose of explanation of variation are shown below:

$$H_0 : P\Big\{F_{y_t^2|Z_{t-1}}\{Q_\theta(Y_{t-1})\big|Z_{t-1}\} = \theta\Big\} = 1 \tag{11}$$

$$H_1 : P\Big\{F_{y_t^2|Z_{t-1}}\{Q_\theta(Y_{t-1})\big|Z_{t-1}\} = \theta\Big\} < 1 \tag{12}$$

In order to test the null hypothesis as shown in Equation (11), a feasible test statistic was obtained and y_t was replaced in Equations (6)–(9), with ${y_t}^2$. Moreover, the issue related to the causality was resolved by incorporating the methodology proposed by Jeong et al. [69], in which conditional causality in the 1st moment (mean) denotes causality in the 2nd moment (variance). Therefore, in order to resolve this concern, the causality in the scenario of the higher order moments was examined and evaluated by utilizing the model as shown below:

$$y_t = g(X_{1t-1},\ X_{2t-1},\ Y_{t-1}) + \varepsilon_t \tag{13}$$

Therefore, the quantile causality based on higher order is stated as:

$$H_0 : P\Big\{F_{y_t^k|Z_{t-1}}\{Q_\theta(Y_{t-1})\big|Z_{t-1}\} = \theta\Big\} = 1 \quad for\ k = 1,\ 2, \ldots, K \tag{14}$$

$$H_1 : P\Big\{F_{y_t^k|Z_{t-1}}\{Q_\theta(Y_{t-1})\big|Z_{t-1}\} = \theta\Big\} < 1 \quad for\ k = 1,\ 2, \ldots, K \tag{15}$$

By integration of the whole framework, y_t is caused by x_{1t} and x_{2t} Granger in the quantile θ up to the Kth moment by employing Equation (14), whereby for each k, the test static using Equation (6) is constructed. Moreover, since the statistics are correlated mutually, for the combined null hypothesis shown in Equation (14), it is extremely difficult to join the diverse statistics for each k = 1, 2, 3 … K [70]. Therefore, as per the recommendations proposed by Nishiyama et al. [70], this issue was efficiently addressed by including a modified method based on sequential testing. At the first stage, the nonparametric Granger causality in the 1st moment is k = 1. When rejecting of null hypothesis fails at k = 1, it will not directly jump to evaluate the noncausality at the 2nd moment and, therefore, the test for k = 2 can be constructed. In this manner, the existence of causality in variance, and/or causality in mean can be tested.

The practical application of testing of causality by means of quantiles specifies three essential choices: (1) bandwidth, which is represented by h, (2) kernel type for $K(\bullet)$ and $L(\bullet)$ as shown in Equations (6) and (9), and (3) the lag order, which is represented by p. The determination of lag order was done by employing Schwarz Information Criterion (SIC) underneath vector autoregression (VAR), including natural resources, globalization, and energy consumption. The least square cross-validation method was used for the selection of bandwidth values. Lastly, the Gaussian kernels were employed for computing the $K(\bullet)$ and $L(\bullet)$.

4. Data Analysis and Interpretation

The aim of this study was to investigate the dynamic causal effect of natural resources and globalization on utilization of energy in top Asian countries. In so doing, the recent study used natural resources' rent (% of gross domestic product (GDP)) as a proxy of natural resources (NAR); overall globalization index, as represented by GLO (which consists of economic, social, and political globalization); and utilization of energy (EGY), which is a measure of per capita of Kg of oil equivalent for top Asian nations including China, India, Indonesia, Malaysia, and Thailand. The selection of these nations was made as they have the most natural resources among all the Asian nations. The data for NAR and EGY was gathered from the World Bank, however, the information for GLO was collected from the KOF Swiss Economic Institute. Yearly information was gathered for 1970–2018. As the aforementioned methodology needs long time-series information [71], hence, the recent study transformed the yearly information into quarterly information by selecting a quadratic match-sum technique. This technique is beneficial once lower frequency information is transformed into higher frequency information, as it corrects the seasonality problem and connects the end-to-end deviation in the sample period. This technique was also suggested in previous research [72,73]. Beginning with the fundamental test, the descriptive statistics are presented in Table 1.

The findings of the descriptive statistics confirmed that the mean (average) coefficients of NAR were positive for all top Asian countries. The biggest coefficient of mean for NAR was for Malaysia at 18.884 (ranged from 7.163 to 37.570) followed by Indonesia at 10.614 (ranged from 3.718 to 33.658). The smallest coefficient of mean of NAR was for Thailand at 1.725 (ranged from 0.562 to 3.785) followed by India at 2.985 (ranged from 0.834 to 7.351). China had the middle coefficient of mean for NAR at 6.202 (ranged from 0.811 to 19.232). On the other hand, the highest coefficient of mean for GLO was for Malaysia at 65.411 (varied from 47.769 to 79.615) followed by Thailand at 51.130 (varied from 32.576 to 69.129). The lowest coefficient of mean for GLO was for China at 46.262 (varied from 23.034 to 61.994) followed by India at 42.420 (varied from 31.081 to 58.274). In addition, the middle coefficient of mean for GLO was for Indonesia at 49.384 (varied from 32.022 to 63.315). Finally, the mean coefficients of EGY were also positive for all countries. The leading coefficient of mean was for Malaysia at 1637.991 (fluctuated from 523.576 to 3003.456) followed by China at 1013.589 (fluctuated from 464.933 to 2236.730). The lowest mean coefficient of EGY was for India at 390.043 (fluctuated from 267.309 to 636.570) followed by Indonesia at 584.885 (fluctuated from 297.306 to 883.918). The middle coefficient of mean of EGY was for Thailand at 979.875 (fluctuated from 360.594 to 1991.594).

Table 1. Results of descriptive statistics for top Asian economies.

Countries	Mean	Min	Max	Std.Dev.	Skew	Kurtosis	JB test	*p* Value
Panel A: Natural Resources (% of GDP)								
China	6.202	0.811	19.232	4.714	1.289	4.136	14.874	0.001
India	2.985	0.834	7.351	1.199	0.933	5.478	18.039	0.000
Indonesia	10.614	3.718	33.658	5.955	1.913	7.271	61.649	0.000
Malaysia	18.844	7.163	37.570	8.737	0.436	3.907	13.664	0.001
Thailand	1.725	0.562	3.785	0.833	0.454	2.235	22.644	0.000
Panel B: Globalization Index (including Political, Social, and Economic Globalization)								
China	42.262	23.034	61.994	14.348	0.097	3.366	15.074	0.000
India	42.420	31.081	58.274	10.221	0.441	3.546	15.425	0.000
Indonesia	49.384	32.022	63.315	9.994	0.033	3.447	14.532	0.001
Malaysia	65.411	47.769	79.615	10.494	−0.103	4.578	13.873	0.001
Thailand	51.130	32.576	69.129	12.855	0.037	5.410	14.750	0.001
Panel C: Primary Energy Consumption (Per capita of Kg of Oil Equivalent)								
China	1013.589	464.933	2236.730	551.683	1.142	2.911	9.803	0.007
India	390.043	267.309	636.570	108.122	0.812	2.606	15.236	0.000
Indonesia	584.885	297.306	883.918	203.876	−0.006	3.446	24.527	0.000
Malaysia	1637.991	523.576	3003.456	810.742	0.175	4.610	23.851	0.000
Thailand	979.875	360.594	1991.594	537.228	0.436	3.800	24.126	0.000
Source: Author Estimations								

Furthermore, the present study reported the skewness and kurtosis values, which were positive in almost all cases, however, the value of kurtosis was more than 3, which indicates a presence of nonlinearity in the dataset. In addition, the present research further applied the Jarque-Bera (JB) test to check the normality of the variables in all countries. The JB test statistics were statistically significant, which means NAR, GLO, and EGY were not normally distributed in all countries. The findings of the JB test also indicated a presence of nonlinearity among the variables for all countries. Hence, there is a need to apply a proper test to affirm the nonlinearity among the selected variables in the dataset [74]. In the current study, this was done by applying the BDS test for nonlinearity [75]. The findings of this test are reported in Table 2. The outcomes provide enough evidence to reject the null hypothesis of residual at different inserted dimensions (m), for the entire set of cases measured. The outcomes provide enough evidence of nonlinear association among NAR, GLO, and EGY in all countries. Therefore, the methods that focus on linear assumptions cannot be considered reliable and robust. Those outcomes provide adequate evidence of nonlinear relationships in the dataset.

Table 2. Results of BDS test for nonlinearity.

Country	$m = 2$	p-Value	$m = 3$	p-Value	$m = 4$	p-Value	$m = 5$	p-Value	$m = 6$	p-Value
Natural Resources Rent Equation Residual										
China	37.315	0.000	41.507	0.000	45.242	0.000	50.024	0.000	55.590	0.000
India	46.211	0.000	49.595	0.000	53.241	0.000	57.809	0.000	64.220	0.000
Indonesia	36.192	0.000	41.791	0.000	45.884	0.000	51.871	0.000	58.125	0.000
Malaysia	56.875	0.000	62.212	0.000	67.707	0.000	74.446	0.000	83.163	0.000
Thailand	79.621	0.000	85.632	0.000	92.794	0.000	102.972	0.000	116.824	0.000
Globalization Equation Residual										
China	44.535	0.000	47.897	0.000	51.903	0.000	57.596	0.000	65.344	0.000
India	31.812	0.000	34.797	0.000	37.871	0.000	41.640	0.000	46.516	0.000
Indonesia	20.243	0.000	23.375	0.000	25.665	0.000	29.013	0.000	32.511	0.000
Malaysia	25.847	0.000	27.740	0.000	29.780	0.000	32.335	0.000	35.921	0.000
Thailand	20.872	0.000	23.216	0.000	25.305	0.000	27.980	0.000	31.093	0.000
Energy Consumption Equation Residual										
China	16.954	0.000	18.234	0.000	19.759	0.000	21.927	0.000	24.876	0.000
India	12.111	0.000	13.247	0.000	14.417	0.000	15.852	0.000	17.709	0.000
Indonesia	7.707	0.000	8.899	0.000	9.770	0.000	11.045	0.000	12.377	0.000
Malaysia	9.840	0.000	10.561	0.000	11.337	0.000	12.310	0.000	13.675	0.000
Thailand	7.946	0.000	8.838	0.000	9.634	0.000	10.652	0.000	11.837	0.000

Source: Authors Estimation. Note: m denotes the embedding dimension of the BDS test. p-value is the probability of obtaining results as extreme as the observed results of a statistical hypothesis test, assuming that the null hypothesis is correct.

In the next phase, the present study applied two novel unit root tests: augmented Dickey–Fuller (ADF) and Zivot and Andrew structural break unit root test. These tests were used to affirm the stationary features for NAR, GLO, and EGY in all countries. The findings of both unit root tests are displayed in Table 3. The results of unit root tests confirmed that NAR, GLO, and EGY all showed nonstationary behavior at level series and became stationary at the first different series. Put simply, the outcome confirmed that all variables had a unique order of integration at the first difference series. After the unique order of integration, the present research applied a nonlinear cointegration method called quantile cointegration [76]. This method was used to investigate the long-run nonlinear connection between NAR, GLO, and EGY. The findings are displayed in Table 4. The findings reported α and δ coefficient values for both NAR and GLO models with EGY in all selected top Asian countries. Moreover, the findings of quantile cointegration also reported the critical value at 1%, 5%, and 10%. The results confirmed that all the calculated values were greater than the critical values, suggesting a rejection of the null hypothesis. In general, the outcomes confirmed a long-run nonlinear relationship between NAR with EGY and GLO with EGY in all top Asian countries.

In the final phase, the present research applied nonparametric causality in quantiles [1]. The aim of this method was to examine the causal connection of NAR and GLO with the return and volatility of EGY across different quantile distributions. The findings are reported in Figure 1. Every graph represents return values (mean) and volatility (variance) along with the critical value of 5% and 10%, respectively. Moreover, there are two axes in Figure 1, the horizontal axis (x-axis) explains the quantiles while the vertical axis (y-axis) describes the test results (t-stats value). The blue horizontal line symbolizes the 95% critical value of t-stats, whereas the orange dashed line exemplifies the 90%

critical value of the test. The green dashed line explains the results for energy consumption returns and the yellow dark line describe the results for volatility.

Table 3. Results of unit root test.

Variables	ADF (Level)	ADF (Δ)	ZA (Level)	Break Year	ZA (Δ)	Break Year
Panel A: Natural Resources Rents						
China	0.184	−3.853 ***	−1.075	2008 Q2	−11.594 ***	1996 Q2
India	−1.483	−4.549 ***	−2.049	2010 Q1	−9.593 ***	2015 Q3
Indonesia	−2.044	−3.069 ***	−1.531	1984 Q4	−7.591 ***	2008 Q1
Malaysia	−0.338	−5.124 ***	−0.916	1999 Q2	−10.583 ***	2004 Q4
Thailand	−1.684	−4.616 ***	−2.021	2012 Q3	−6.005 ***	2016 Q4
Panel B: Globalization						
China	−0.472	−4.146 ***	−2.473	2014 Q1	−6.483 ***	2001 Q2
India	1.271	−3.892 ***	0.583	2009 Q1	−4.584 ***	2006 Q2
Indonesia	0.325	−4.093 ***	−0.482	2001 Q2	−6.482 ***	1995 Q3
Malaysia	−0.937	−5.483 ***	−1.486	1997 Q4	−7.482 ***	1984 Q1
Thailand	−2.081	−3.918 ***	−2.483	1988 Q4	−5.002 ***	2015 Q4
Panel C: Energy Consumption						
China	−0.931	−5.382 ***	−1.583	1976 Q4	−6.413 ***	2007 Q1
India	−2.081	−10.413 ***	−2.321	1984 Q4	−11.275 ***	2007 Q2
Indonesia	−1.226	−6.147 ***	−1.894	2000 Q3	−6.326 ***	2014 Q2
Malaysia	−0.269	−5.091 ***	−0.943	2016 Q2	−5.961 ***	1992 Q1
Thailand	−0.852	−4.381 ***	−1.035	2017 Q1	−5.039 ***	2011 Q3

Note: The values in the table specify statistical values of the ADF and ZA tests. The asterisks ***, **, and * represent level of significance at 1%, 5%, and 10%, respectively.

Table 4. Results of the quantile cointegration test.

China					
Modelling between Energy and Natural Resources					
Model	Coefficient	Supremum Norm Value	Critical Value at 1%	Critical Value at 5%	Critical Value at 10%
EGY_t vs. NAR_t	α	3503.962	1688.804	1260.819	442.479
	δ	702.358	368.555	206.518	180.155
Modelling between Energy and Globalization					
Model	Coefficient	Supremum Norm Value	Critical Value at 1%	Critical Value at 5%	Critical Value at 10%
EGY_t vs. GLO_t	α	1209.021	582.712	435.038	152.675
	δ	242.344	127.168	71.258	62.161
India					
Modelling between Energy and Natural Resources					
Model	Coefficient	Supremum Norm Value	Critical Value at 1%	Critical Value at 5%	Critical Value at 10%
EGY_t vs. NAR_t	α	4736.817	1448.406	792.264	388.926
	δ	1289.183	482.926	287.88	207.423
Modelling between Energy and Globalization					
Model	Coefficient	Supremum Norm Value	Critical Value at 1%	Critical Value at 5%	Critical Value at 10%
EGY_t vs. GLO_t	α	6444.329	1970.523	1077.857	529.124
	δ	1753.904	657.009	391.654	282.195

Table 4. *Cont.*

Model	Coefficient	Supremum Norm Value	Critical Value at 1%	Critical Value at 5%	Critical Value at 10%
Indonesia					
Modelling between Energy and Natural Resources					
Model	Coefficient	Supremum Norm Value	Critical Value at 1%	Critical Value at 5%	Critical Value at 10%
EGY_t vs. NAR_t	α	2878.828	1892.718	1156.16	776.155
	δ	1688.849	975.646	572.689	249.982
Modelling between Energy and Globalization					
Model	Coefficient	Supremum Norm Value	Critical Value at 1%	Critical Value at 5%	Critical Value at 10%
EGY_t vs. GLO_t	α	4641.523	3051.622	1864.071	1251.391
	δ	2722.924	1573.03	923.344	403.046
Malaysia					
Modelling between Energy and Natural Resources					
Model	Coefficient	Supremum Norm Value	Critical Value at 1%	Critical Value at 5%	Critical Value at 10%
EGY_t vs. NAR_t	α	6497.219	1892.942	1275.087	704.464
	δ	3677.977	1464.707	850.557	442.59
Modelling between Energy and Globalization					
Model	Coefficient	Supremum Norm Value	Critical Value at 1%	Critical Value at 5%	Critical Value at 10%
EGY_t vs. GLO_t	α	2315.195	674.524	454.36	251.026
	δ	1310.597	521.928	303.084	157.711
Thailand					
Modelling between Energy and Natural Resources					
Model	Coefficient	Supremum Norm Value	Critical Value at 1%	Critical Value at 5%	Critical Value at 10%
EGY_t vs. NAR_t	α	4434.05	2267.235	1617.547	1241.176
	δ	1871.99	1301.375	636.36	389.006
Modelling between Energy and Globalization					
Model	Coefficient	Supremum Norm Value	Critical Value at 1%	Critical Value at 5%	Critical Value at 10%
EGY_t vs. GLO_t	α	4968.139	2540.327	1812.383	1390.678
	δ	2097.475	1458.128	713.011	435.863

EGY From NAR **EGY From GLO**

(i) China

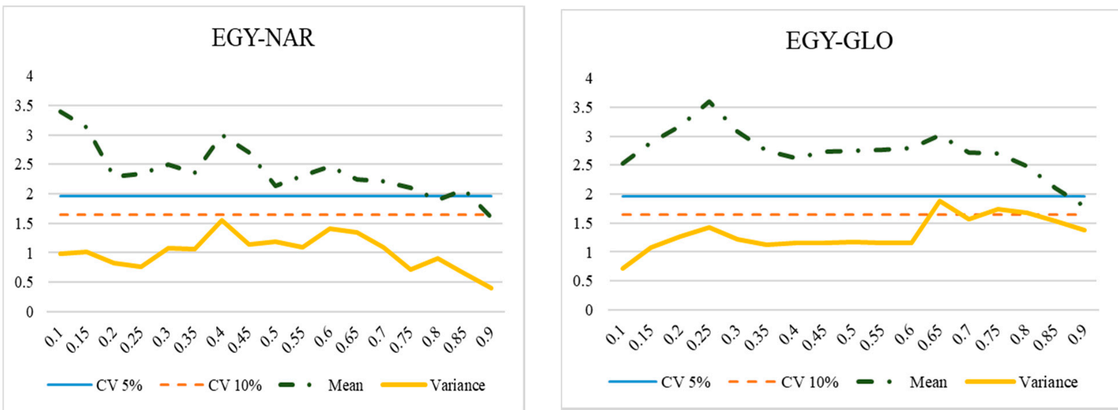
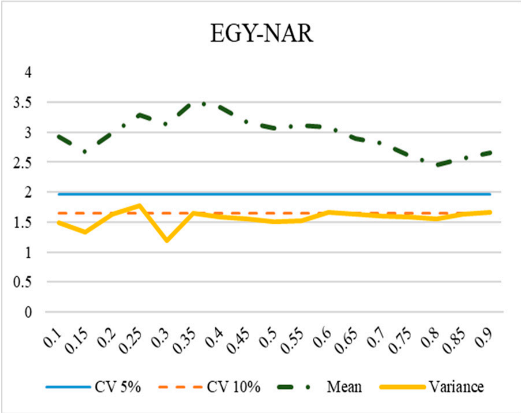
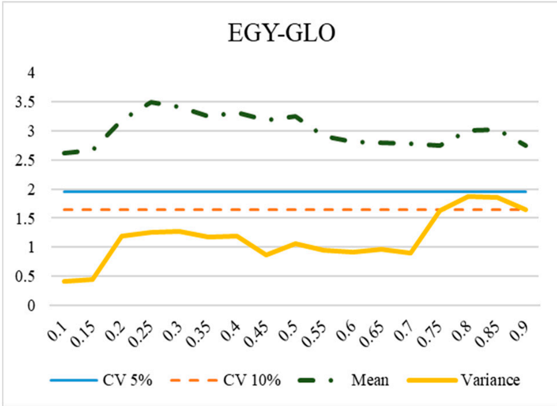


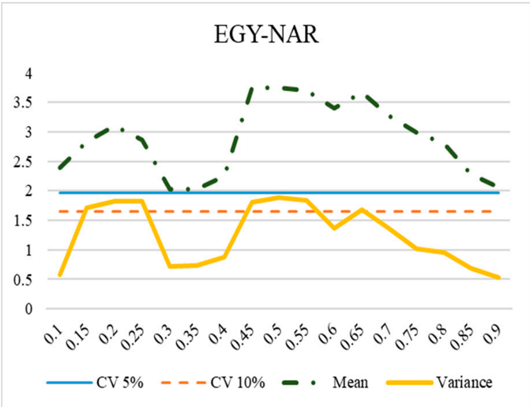
Figure 1. *Cont.*

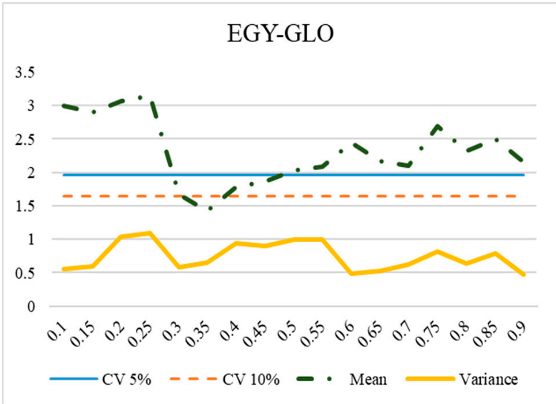
(ii) India



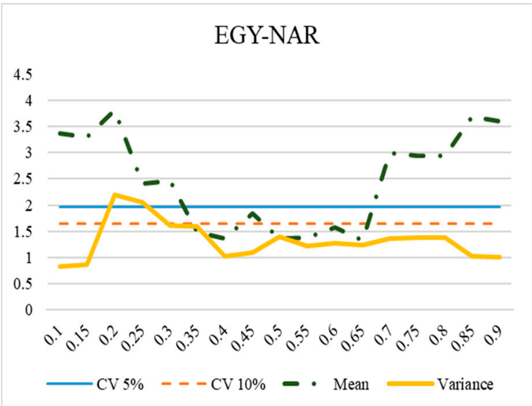


(iii) Indonesia





(iv) Malaysia



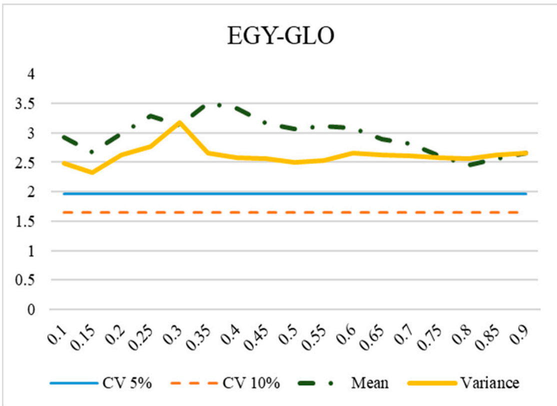


Figure 1. *Cont.*

(v) Thailand

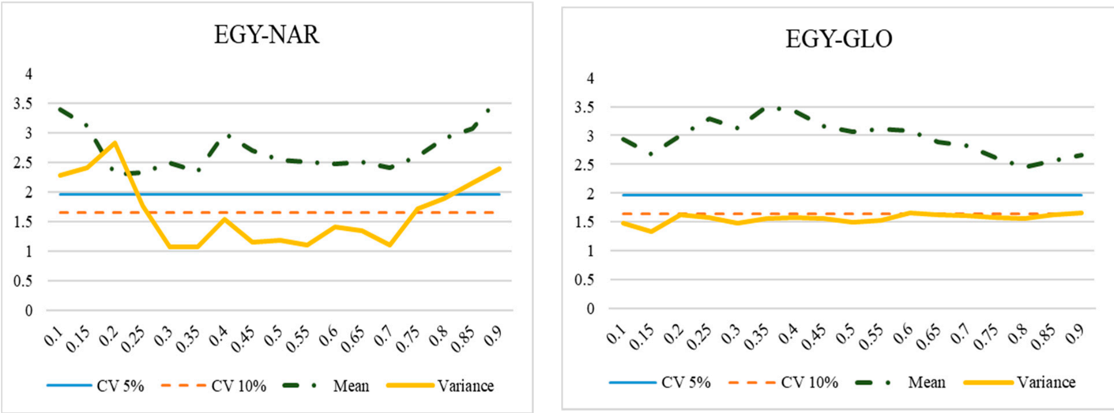


Figure 1. Results from nonparametric causality in quantiles.

In the case of China, the effect of NAR returns was significant for all lower, middle, and upper quantiles of the provisional distribution of EGY. The effect became strong and more significant in the lower quantiles with the t-stat value of approximately 3.4. The current study observed no causal effect of returns of NAR on the volatility of EGY in the case of the China. Moreover, the causal effect on volatility was not asymmetric, because they were insignificant for the upper, middle, and lower quantiles of the conditional distribution. On the other hand, the effect of GLO returns was also significant for all quantiles of distribution on the returns of EGY. The effect became more noteworthy in the low quantiles with the t-stats coefficient of approximately 3.56. However, the current research found no causal connection between returns of GLO and volatility of EGY. Put simply, the findings confirmed that returns of NAR and GLO had a significant causal impact on the returns of EGY at all quantiles.

In the situation of India, the impact of NAR returns was noteworthy for all quantiles of the returns of EGY. Moreover, the impact was strong and more significant at lower and middle quantiles of the returns of EGY. However, the present research did not find any causal effect of NAR returns on the volatility of EGY. In addition, the effect of returns of GLO was significant on the returns of EGY, however, the effect of the returns of GLO was significant on the volatility of EGY only at the upper quantiles at the 10% level of significance. In general, the returns of NAR and GLO had significant causal impact on the returns of EGY across all quantiles. The findings of causality from NAR and GLO to EGY are very interesting in the case of Indonesia. The findings confirmed that the returns of NAR had causal impact on the return and volatility of EGY at lower to middle quantiles. On the other hand, the influence of returns of GLO had a causal impact on the returns of EGY but there was no evidence of a causality from returns of GLO to volatility of EGY in Indonesia. In the case of Malaysia, the effect of NAR returns was substantial on the returns of EGY only at the extreme quantiles (i.e., lower and upper). However, the returns of NAR had a significant causal impact on the volatility of EGY on the lower middle quantiles. On the other hand, the effect of GLO returns had a significant causal impact on the returns and volatility of EGY. Put simply, the returns of NAR had a causal impact on EGY returns only, whereas the returns of GLO had a causal connection with EGY returns and volatility. In the case of Thailand, the returns of NAR were significant for all quantiles of returns of EGY. Moreover, the effect was strong and more prominent at both extreme quantiles (i.e., lower and higher). However, the study found no causal connection between the returns of NAR and volatility of EGY. On the other hand, the effect of GLO on EGY returns was significant across all quantiles of distribution. The effect was more powerful at the lower middle quantiles. In addition, the study found no causal impact of GLO returns on the volatility of EGY in Thailand.

5. Conclusions

Natural resources enable direct foreign investment to a country, and that has a tendency to improve the standard of living of the locals [11,12], however, it also adversely affects the potential growth of the country in the long term [13], thus making the host country intensely dependent on the consumption and extraction of the natural resources; this is referred to as a resource curse [14–18].

Moreover, most researchers are in agreement with respect to the adverse association between economic development and natural resources of a country [19–21]. Researchers also suggest that by improving institutional quality, having a good incentive program to the personnel engaged in the respective activities [22], and strengthening the political stability [23], the country can counter the phenomenon of being trapping in a resource curse.

Keeping this in mind, the current research aimed to investigate the causal effect of natural resources and globalization on the returns and volatility of the utilization of energy in top Asian economies. The findings of nonparametric methods of causality in quantile confirmed that the returns of NAR and GLO had a significant causal effect on the returns of EGY in the selected sample. These results are consistent with the earlier studies of Shahbaz et al. [41] and Shahbaz et al. [42] that investigated the globalization–energy link and Bekun, et al. [68] and Kwakwa, et al. [33] that examined the natural resource–energy association. On the other hand, the present study found no causal connection from the returns of NAR and GLO to volatility of EGY in any of the studied Asian countries.

The results shed greater insights on the level of energy dependence in the process of globalization and the utilization of natural resources in Asian economies. Knowing the positive role of globalization and natural resources in the growth of prospering countries [77–79], the findings of the current study implied higher challenges for government practitioners and policy makers, given the worldwide emphasis on energy conservation. The study suggested the need of implementing adequate environmental reforms and eco-friendly business practices to support energy efficiency in the course of integrating industries and allocating investments in local and foreign businesses. Moreover, the change of energy mix from coal-based to renewables can also satisfy the inevitable need of energy in industries without disrupting environmental sustainability. The current research is limited to only top Asian countries. Moreover, the present research is also limited to bivariate analysis, therefore, future research could apply multivariate advanced econometrics such as nonlinear ARDL, quantile ARDL, and a multiple wavelet coherence approach.

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