Hapres | Journal of Sustainability Research
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Article

The Impact of Uncertainty in Economic Policy on the Load Capacity Factors in China and the United States (US): New Evidence from Novel Fourier Bootstrap ARDL Approach

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ABSTRACT

The body of research on how uncertainty in economic policy affects load capacity factors has expanded quickly in recent years as concerns over the possible detrimental consequences of policy uncertainty on environmental sustainability are growing among scholars and policymakers. In this context, the primary aim of this research is to use annual data from the United States and China collected between 1985 and 2018 to examine the short- and long-term impacts of economic policy uncertainty on the load capacity factor. The study employed the Fourier Autoregressive Distributed Lag method to investigate the long- and short-term effects of energy intensity and economic growth while the Fourier-Toda-Yamamoto causality approach was utilized to assess the causal relationship between the variables. Findings show that whereas economic policy uncertainty temporarily improves environmental quality in China, it only has a long-term detrimental effect on environmental quality in the United States. Additionally, the findings demonstrate that energy intensity in both nations dramatically lowers environmental quality. Furthermore, there is also a causal relationship between economic policy uncertainty and economic growth in the United States along with economic growth and load capacity factor and energy intensity in China. These unidirectional causal relationships demonstrate the existence of a causal relationship. Effective policies should be developed to enhance environmental quality in China and the United States, taking into consideration the findings.

KEYWORDS: environmental quality; economic policy uncertainty; climate change; sustainability

Open Access

Received: 27 January 2024
Accepted: 04 December 2024
Published: 02 January 2025

INTRODUCTION

Environmental problems, which have become a global problem, have reached the size of a climate crisis, and have become a situation that threatens all humanity. Ecological issues that arise because of the usage of fossil fuels, which are seen as necessary for the realization of economic activities and activities, have been the subject of much research. The study of how economic expansion affects the environment paved the way for studies on how economic activity and the environment interact. It is seen that these studies generally focus on the environmental Kuznets curve (EKC) hypothesis [1–5]. The theory of EKC initially revealed an inverted U-shaped link between economic expansion and income inequality, was later adapted to the link between economic growth (GDP) and environmental deterioration by [6,7]. Recently, the impact of economic policy uncertainty and energy intensity on economic growth as well as the environment have been the subject of various studies within the framework of the EKC hypothesis [8–13]. Researchers have become interested in environmental problems due to increasing concerns about economic policy uncertainty, which is assumed to influence some economic metrics, including GDP. Although economic news largely shaped market fluctuations before the 2008 global crisis, the fact that politicians dominated news coverage of the economy following the crisis serves as an illustration of the significance of economic policy uncertainty for the economy [14]. The economic policy uncertainty has grown since the start of the twenty-first century. Recent international occurrences like the global financial meltdown, Brexit, the trade dispute between the US and China, and the COVID-19 epidemic have increased economic policy uncertainty globally and made it more difficult to make economic decisions [12]. This forces those in charge of economic policy to alter their policies, programs, and measures more frequently when they are faced with discontinuities, turbulence, instabilities, and crisis circumstances [11]. In addition to the economic effects of economic policy uncertainty, its ecological effects are also in the form of consumption and investment effects. Consumption effect and investment effect are the two ways that economic policy uncertainty can have an adverse environmental effect. According to the consumption effect, economic policy uncertainty decreases the usage of products with high energy and environmental impact. As the economic policy uncertainty rises, environmental degradation will consequently decline. In the investment effect, a higher level of economic policy uncertainty hinders investment in green energy and renewable energy (RE) projects and Research & Development (R&D) and consequently causes environmental degradation. The positive or negative impact of the economic policy uncertainty on the environment depends on whether the "consumption effect" or "investment effect" dominates [11]. It is also said that in an environment where economic policy uncertainty is present, environmental regulations will not exist or will be at a low level, and therefore environmental quality will decrease [15].

Furthermore, energy intensity raises per-person greenhouse gas (GHG) emissions and energy consumption, both of which are negative for the environment [16]. Reducing energy intensity permits a decrease in production-related emissions while also helping regulate environmental issues [17]. The evolution of energy intensity throughout time can be significantly influenced by structural and technological changes as well as GHG emissions [18]. Public resources allocated to energy R&D can help manage or reduce GHG emissions since technical breakthroughs have an impact on processes that affect environmental quality [19].

A more thorough ecological indicator is required to evaluate environmental sustainability, even though researchers frequently utilize carbon dioxide (CO_2) emissions and ecological footprint as parts of environmental degradation [20,21]. Even though CO_2 emissions, which are used as a measure of environmental degradation, account for a sizable portion of global GHG emissions, they are viewed as insufficient for explaining environmental degradation because they exclude resource stocks like soil, forest, mineral, and oil stocks [22,23]. In light of this claim, researchers concentrated on analyzing the causes of environmental deterioration in terms of ecological footprint [24]. The ecological footprint proposed by [25] compares the regeneration rate of the biosphere with anthropogenic consumption, as well as shows the impact of human-based consumption on the environment.

The load capacity factor which is a more wide-ranging measure that also addresses the supply side of environmental degradation, was developed by [26]. The load capacity factor provides information about the sustainability of a society's natural system and way of life. By simultaneously analyzing biocapacity and ecological footprint, the load capacity factor offers a thorough assessment of environmental sustainability in this situation. The load capacity factor is calculated by dividing the ecosystem's supply side (biocapacity) by its demand side [21]. When the load capacity factor is larger than 1, the available resources are sufficient to meet the demands for human resources, and when it is less than 1, the current environmental circumstances are not sustainable. Sustainability is called into doubt if the load capacity factor is equal to 1 [24].

Given this backdrop, it is reasonable to expect that present energy and related economic and environmental policies may not be compatible in many locations in the direction of reaching the aims of the Sustainable Development Goals. The foundation of sustainable development may be impacted by growing CO_2 emissions and political uncertainties on the future of clean energy. Thus, to fulfill the objectives of the Sustainable Development Goals, realignment at the policy level might be required. The purpose of the work that has been provided now becomes evident. This research endeavors to formulate a policy framework centering on the

Sustainable Development Goals for a subset of instance nations, considering contemporary concerns such as policy uncertainties surrounding the generation of sustainable energy and rising CO_2 emissions. The study's policy-level contribution is that this broad policy-level strategy hasn't been tried in the literature.

The present paper also aims to scrutinize the effects of GDP, economic policy uncertainty, and energy intensity on load capacity factors in China and the US using the Fourier Autoregressive Distributed Lag (FARDL) approach based on the justifications provided above. In this perspective, the current paper contributes to the body of literature in the following ways. First, to the best of our knowledge, this is the initial investigation of how economic policy uncertainty affects the load capacity factor for selecting countries. Second, the demand and supply aspects of environmental degradation were considered by using the load capacity factor in the study. Thirdly, soft breaks in unit root and cointegration phases are considered by using Fourier approaches in the study and this ensures stronger results. Finally, a series of policy recommendations are presented by considering China and the US which are the two most polluting nations in the world. This can contribute to designing sustainable environmental policies for both developed and developing countries.

The US and China almost produce 45% of the world's total carbon emissions. As a matter of fact, in the ranking of the world's highest CO_2 emissions, China ranks first with 10523.0 mt and 31.1%, while the US ranks second with 4701.1 mt and 13.9% [27]. In addition, these two countries are the first two countries in the world to have the most ecological footprint [28]. The ecological status of the US and China for the period 1985–2018 is shown in Figure 1. While the horizontal line refers to "year", the vertical line refers to values related to ecological status. In the US, the load capacity factor has been below the sustainability limit since 1985 and the current environmental degradation is at an unsustainable level. On the other hand, the ecological deficit in the US has increased by 18% since 1985 (Figure 1). In this regard, the supply of natural resources in the US is insufficient to support the current levels of production and consumption. Looking at the ecological situation of China, it is seen that the load capacity factor is below the sustainability limit of 1. China's ecological deficit has increased by 650% since 1985 (Figure 1). As in the US, the natural resource supply in China is insufficient to sustain current production and consumption patterns. For these reasons, China and the US were included in the study.

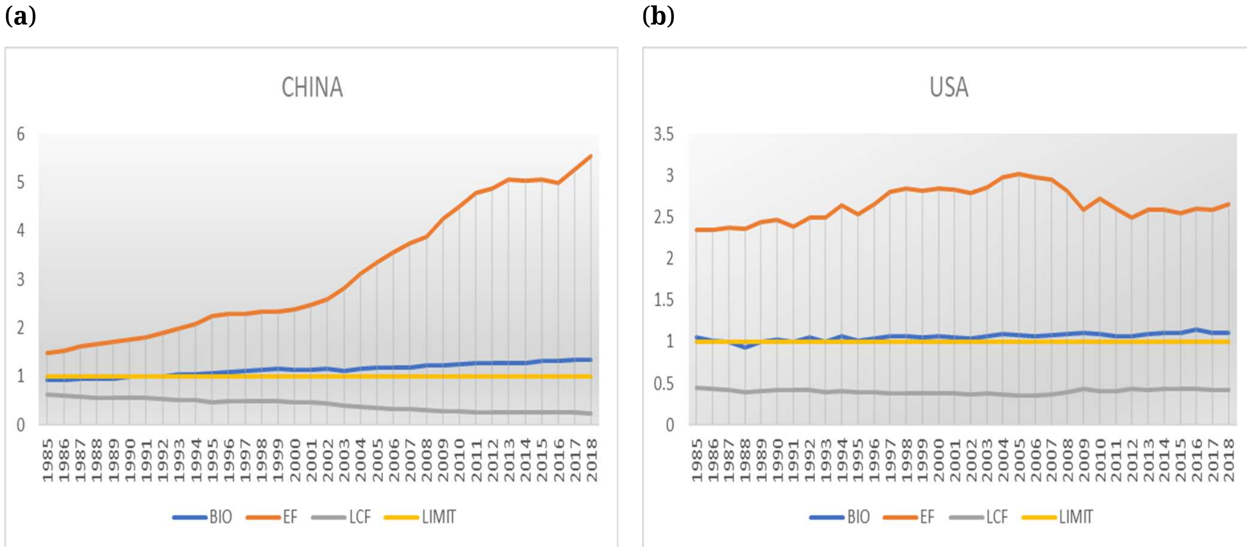

Figure 1. Ecological Status of (**a**) China and (**b**) the USA. Note: BIO (Biological); EF (Ecological footprint), LCF (Load capacity factor), LIMIT (Sustainability limit).

The rest of the study, which consists of four parts, is formed as follows: "Literature review", "Research methodology", "Empirical results and discussion" and finally "Conclusions and policy recommendations".

LITERATURE REVIEW

There has been relatively limited research on the link between economic policy uncertainty and emissions, and the findings are inconsistent, according to this thorough review of the literature. Overall, the lack of studies and the inconsistent reporting of results make it impossible to determine if economic policy uncertainty raises or lowers CO_2 emissions levels. As a result, it is crucial to investigate this matter in several nations to develop suitable policies. Furthermore, despite the paucity of research on clean energy and the preponderance of studies examining the impacts of renewable resources, it is critical to figure out the economic policy uncertainty, energy intensity, and economic growth influence CO_2 emissions. Thus, studies examining how economic policy uncertainty affects pollution or environmental quality typically evaluate pollution or environmental quality using two different variables which are ecological footprint and CO_2 emissions. This section examines research that looks at ecological footprint and CO_2 individually in the context of how economic policy uncertainty affects the environment.

Literature on the Effect of Economic Policy Uncertainty on Ecological Footprint

In a couple of the research evaluating how economic policy uncertainty impacts ecological footprint, a positive link was found between economic policy uncertainty and ecological footprint, while a negative link was found in some studies [29–32]. For this reason, we can divide the studies into two groups. First, economic policy uncertainty increases ecological footprint: Adedoyin et al. [33] investigated the effects of economic policy uncertainty on the ecological footprint of ten nations. As a result of the study, it was stated that by increasing energy consumption, economic policy uncertainty increases ecological footprint and causes environmental degradation. In the study, it was also emphasized that the EKC hypothesis is invalid in these nations. Oryani et al. [34] examined the effects of economic policy uncertainty on ecological footprint with an asymmetric analysis for South Korea, and it was found that economic policy uncertainty increases ecological footprint both in the short and long term. The study also stated that GDP growth raises ecological footprint in the short term but increases environmental quality with the usage of green energy in the long term. In another study, Hussain et al. [35] analyzed the impact of economic policy uncertainty on an ecological footprint for BRICS countries. Findings stated that economic policy uncertainty causes environmental degradation by increasing ecological footprint. Sinha et al. [36] also examined this policy uncertainty by analyzing the components of inequality in access to energy.

Anser et al. [37] scrutinized the link between economic policy uncertainty and ecological footprint for five countries and found that both economic policy uncertainty and GDP growth increase ecological footprint. Likewise, bidirectional causality between GDP growth and ecological footprint has been demonstrated. Similarly, in the study of Xu et al. [38], an analysis was made for E7 nations, and it was stated that economic policy uncertainty increases ecological footprint. The study also emphasized that the EKC hypothesis is invalid in these nations. Another investigation into the link between economic policy uncertainty and the ecological footprint was conducted, by [39] and [40] found that both economic policy uncertainty and GDP growth increase the ecological footprint in China. Second, economic policy uncertainty decreases ecological footprint: Chu and Lu [41] discovered that economic policy uncertainty reduces environmental degradation in G7 nations. The research study also found that environmental deterioration is accelerated by high-energy intensity. Similarly, in the study of Zahra and Badeeb [42], it was found that economic policy uncertainty significantly reduced the ecological footprint in OECD countries. Finally, Esmaeili et al. [43] assessed the impact of economic policy uncertainty on an ecological footprint for 19 energy-intensive countries and concluded that economic policy uncertainty boosts ecological footprint in the short term but depresses it in the long term.

Literature on the Effect of Economic Policy Uncertainty on CO_2 Emissions

Two categories of studies examine how economic policy uncertainty affects CO_2. Firstly, economic policy uncertainty increases CO_2: Ali et al. [44] assessed the effects of economic policy uncertainty on CO_2 in BRICS countries. The study's findings displayed that economic policy uncertainty raises CO_2 in both the short and long terms. The study also found that while GDP growth temporarily raises CO_2 levels, this effect disappears long term, supporting the EKC theory for these nations. Ahmed et al. [45] tested the link between economic policy uncertainty and CO_2 with an asymmetric analysis for the US. The study's findings indicated that economic policy uncertainty and CO_2 have an inverse connection, indicating that the EKC hypothesis holds valid in the US. Likewise, in another study for the US, [15] found that both economic policy uncertainty and GDP growth increase CO_2. In another study conducted in the US, [46] stated that economic policy uncertainty causes environmental degradation by increasing pollution and increases the negative effect of EI on CO_2. Iqbal et al. [47], in the study conducted for the US, UK, China, and India, found that economic policy uncertainty increases CO_2 both in the short and long term. The study also noted that GDP growth also increases CO_2. Xue et al. [48] studied the link between economic policy uncertainty and CO_2 in France and found that economic policy uncertainty increased CO_2. The study also noted that GDP growth increases CO_2. In the study of [49], the link between economic policy uncertainty and CO_2 in South Africa was examined and it was found that economic policy uncertainty increases CO_2 both in the short and long term. The study also found that GDP growth raises environmental degradation in the short term but slows it down in the long term. This shows that the EKC hypothesis is valid for South Africa. In the study conducted by [50] for MENA nations, it was stated that economic policy uncertainty causes environmental degradation in all countries and the EKC hypothesis is acceptable in all countries. Zakari et al. [51], it was discovered that economic policy uncertainty grew CO_2 in OECD nations, similarly [52], it was determined that economic policy uncertainty raises CO_2 in East Asian nations as well. Secondly, economic policy uncertainty decreases CO_2*:* Anser et al. [37] observed that economic policy uncertainty decreases CO_2 in the short term but raises it in the long term in a study of the top ten carbon emitter countries. In a study for the UK, [53], similarly, it has been found that economic policy uncertainty decreases CO_2 in the short term while growing it in the long term. In the study of [13], the opposite result was found for the US. According to the study, economic policy uncertainty causes a short-term increase in CO_2 but a long-term decrease. Ashena and Shahpari [54] scrutinized the link between economic policy uncertainty and CO_2 with an asymmetric model for Iran. Findings showed that increases in economic policy uncertainty decrease CO_2, while decreases increase CO_2. The study also stated that energy intensity increases CO_2. Adedoyin et al. [55], in Sub-Saharan African countries, stated that economic policy uncertainty reduces CO_2 by reducing energy consumption. Abban et al. [56] also claimed that appropriate policy measures should be advocated to ensure that African economies are on the path to sustainability because they demonstrated the role of renewable resources in CO_2 emissions. In a study that differs completely from the above studies, [57] found that economic policy uncertainty did not have any substantial impact on CO_2 in both the short and long term in China. The study also noted that energy use and GDP growth increase CO_2. Recent literature is given in Table A1 in the Appendix section.

In the current literature, studies scrutinizing the impact of economic policy uncertainty on environmental pollution indicators heavily use CO_2 emissions and ecological footprint. In contrast, no study has been found testing the effect of economic policy uncertainty on load capacity factors. In addition, it is seen that unit root, cointegration, and causality tests based on Fourier functions are not used in the current literature. This research will contribute to the body of knowledge in this field of study. These two flaws will be attempted to be fixed in this study. These circumstances demonstrate how this study differs from other studies and contributes to the body of literature.

RESEARCH METHODOLOGY

Data

Data from annual time series were used to examine the impact of GDP, energy intensity, and economic policy uncertainty on load capacity factors in the US and China for the years 1985–2018 based on the availability of data from both countries. The data used in the study are detailed in Table 1.

Table 1. Description of variables and data source.

Variables		Definition	Sources
Dependent Variables			
LCF	Load capacity factors	Biocapacity/ecological footprint (gha)	[28]
Independent Variables			
EI	Energy intensity	Primary energy consumption per GDP~kWh/$	[58]
EPU	Economic policy uncertainty	Economic policy uncertainty index	[59]
GDP	Economic growth	Constant 2015 US$~per capita	[60]

Model

This study's model was created based on [46,55]. These studies employed ecological footprint and CO_2 emission as dependent variables. Load capacity factors, however, were employed in the study as a dependent variable to assess environmental problems. To avoid the heteroscedasticity issue, all variables' natural logarithms were used in the study. The model created is as follows:

$$\ln LCF_t = v_0 + v_1 \ln GDP + v_2 \ln EI + v_3 \ln EPU + e_t \quad (1)$$

In equation (1), ln is the natural logarithm, t is the time, v_0 is the constant of the model, v_1, v_2, v_3 are the long-term flexibility, and e_t shows the error term. The expected sign of v_1 is negative if there is a scale effect and positive if there is a technical effect [61]. The expected sign v_2 is positive. Because the increase in EI brings with it more non-RE use and increases the negative pressure on the environment. Finally, the expected sign v_3 is negative if the consumption impact is valid and positive if the investment effect is valid. These expected signs are valid if the dependent variables are CO_2 emissions and ecological footprint. If the dependent variable is the load capacity factors, coefficient interpretations should be made as the opposite of CO_2 emissions and ecological footprint.

Cointegration test

In the cointegration analysis literature, several methods have been developed that consider structural breaks through dummy variables [62,63]. These methods have some shortcomings. The first of these is to predetermine the number of breaks. Secondly, only sudden breaks are considered, as the breaks are captured with the help of dummy variables [64]. Based on these shortcomings, [65] developed the FARDL bootstrap cointegration method. This method has several advantages. Firstly, Fourier functions are added to the cointegration equation, and more than one soft and abrupt break is considered. Second, the method allows variables to be I(0) or I(1), which makes testing more useful. Third, the method can produce effective and reliable estimation results even in small samples. Fourth, permanent structural changes are considered by using fractional frequencies in the method [64,65]. Equation (1) can be rewritten as follows according to the unrestricted error correction format based on the FARDL method:

$$\begin{aligned}\Delta \ln LCF_t = {} & d(t) + \lambda_2 \ln LCF_{t-1} + \lambda_3 \ln GDP_{t-1} + \lambda_4 \ln EI_{t-1} \\ & + \lambda_5 \ln EPU_{t-1} + \sum_{i=1}^{P_1} \gamma_i' \Delta \ln LCF_{t-i} + \sum_{i=0}^{P_2} \gamma_i' \Delta \ln GDP_{t-i} \\ & + \sum_{i=0}^{P_3} \gamma_i' \Delta \ln EI_{t-i} + \sum_{i=0}^{P_4} \gamma_i' \Delta \ln EPU_{t-i} + e_t\end{aligned} \quad (2)$$

Equation (2), Δ is the operator that shows the first difference of the variables. P_1, P_2, P_3 and P_4 show the optimal lag length and $d(t)$ shows the deterministic term and can be written as follows.

$$d(t) = \alpha_1 + \mathrm{D}_1 \sin\left(\frac{2\pi kt}{T}\right) + \mathrm{D}_2 \cos\left(\frac{2\pi kt}{T}\right) \quad (3)$$

In equation (3), π= 3.1416, k is the frequency value, t is the trend term and T shows the sample size. k takes a value between the range of 0 and 5.

The null hypothesis showing that there is no cointegration in this study was examined with the F_A, t, and F_B tests in equation (4) following [66,67].

$$\begin{aligned}& H_{0A}: \lambda_2 = \lambda_3 = \lambda_4 = \lambda_5 = 0, \\ & H_{0t}: \lambda_2 = 0, \\ & H_{0B}: \lambda_3 = \lambda_4 = \lambda_5 = 0.\end{aligned} \quad (4)$$

The existence of cointegration is valid if the F_A, t and F_B tests are all significant at the relevant significance level. If any of these three statistics is statistically insignificant, it means that there is no cointegration. Critical values are obtained by bootstrap simulations.

Causality test

Toda and Yamamoto [68] developed a causality test based on the VAR model in their study. This test, a causality test, eliminates long-term information loss by being applied to the level values of the variables. The Toda-Yamamoto causality test is estimated using a VAR model with the optimal lag length ($p + d_{max}$). Here, p displays the optimum lag length, and d_{max} indicates the highest order of variable integration.

Any structural breaks are not considered by the Toda-Yamamoto test. According to [69], disregarding the structural break could result in skewed causality test outcomes. Considering this, [70] improved the Toda-Yamamoto causality test by including Fourier functions, creating the Fourier Toda-Yamamoto causality test. Nazlioglu et al. [70] stated in their study that single-frequency Fourier Toda-Yamamoto produces stronger results than cumulative-frequency Fourier Toda-Yamamoto in the range of 50 to 100 observations. Since this study was conducted with 34 observations, the single-frequency Fourier Toda-Yamamoto approach was used. A single frequency Fourier Toda-Yamamoto model with a VAR ($p + d_{max}$) lag can be expressed as:

$$y_t = \alpha_0 + \delta_1 \sin\left(\frac{2nkt}{T}\right) + \delta_2 \cos\left(\frac{2nkt}{T}\right) + \beta_1 y_{t-1} + \ldots + \beta_{(p+d_{max})} y_{t-(p+d_{max})+\varepsilon_t} \quad (5)$$

y_t is a vector that includes load capacity factors, GDP, energy intensity, and economic policy uncertainty variables. In the Fourier Toda-Yamamoto approach, the null hypothesis of no causality is tested against the alternative hypothesis ($H_0: \beta_1 = \ldots. = \beta_p = 0$). In this approach, p and k values are determined with the help of information criteria such as AIC, and SIC. Bootstrap simulations are used to obtain critical values.

EMPIRICAL RESULTS AND DISCUSSION

The FARDL approach lets analysis of the existence of cointegration if the dependent variable is I(1) and the independent variable(s) is I(0) or I(1). Therefore, before performing the FARDL cointegration test, it is necessary to ascertain the integration levels of the dependent and independent variables. Augmented Dickey-Fuller (ADF) [71] and Fourier ADF [72] unit root tests were employed to decide the integration level of the variables. The ADF unit root test is combined with Fourier functions in the Fourier ADF unit root test, and potential structural fractures are considered. Table 2 below shows the outcomes of the ADF and Fourier ADF unit root tests. The importance of the Fourier terms must be examined before applying the Fourier ADF unit root test. The Fourier ADF unit root test is used if these terms are significant; otherwise, the ADF unit root test is applied. The findings in Table 2 show that while the Fourier terms in the load capacity factors and GDP variables are significant for the US, energy intensity and economic policy uncertainty are not. Therefore, Fourier ADF for the first two variables and ADF unit root test results for the remaining two variables were considered. According to these results, while load capacity factors, energy intensity, and economic policy uncertainty are I(1), GDP is I(0). Looking at China's results in Table 2, it is seen that the Fourier terms are significant in the load capacity factors and energy intensity variables, while the Fourier terms are not significant for the GDP and economic policy uncertainty variables. Therefore, Fourier ADF results for the first two variables and ADF results for the last two variables should be considered. According to the results, it is seen that load capacity factors, GDP, and economic policy uncertainty are I(1) and energy intensity is I(0).

Table 2. Unit Root Tests.

Panel A: US								
Variables	**Fourier ADF**				**ADF**			
	Level				**Level**		**First Diff.**	
	F test	**Test statistics**	**Optimal frequency**	**Optimal lag length**	**Test statistics**	***p*-values**	**Test statistics**	***p*-values**
$lnLCF$	7.864**	−3.292	3	1	−1.920	0.319	−5.163***	0.000
$lnGDP$	6.648*	−3.756**	6	2	-	-	-	-
$lnEI$	5.416	-	-	-	0.649	0.988	−4.662***	0.000
$lnEPU$	5.416	-	-	-	−2.384	0.153	−4.194***	0.003
Panel B: China								
Variables	**Fourier ADF**				**ADF**			
	Level				**Level**		**First Diff.**	
	F test	**Test Statistics**	**Optimal frequency**	**Optimal lag length**	**Test statistics**	***p*-values**	**Test statistics**	***p*-values**
$lnLCF$	11.331***	2.342	8	4	−0.188	0.930	−3.671***	0.009
$lnGDP$	0.763	-	-	-	−0.721	0.827	−3.870***	0.006
$lnEI$	7.867**	-3.684**	1	2	-	-	-	-
$lnEPU$	2.691	-	-	-	−2.461	0.134	−5.141***	0.000

Note: ***, ** and * indicate 1%, 5% and 10% significance levels, correspondingly. 10%, 5%, and 1% critical values for the F test and Fourier ADF test were obtained from [72].

None of the variables are I(2), as shown by the results of the two unit root tests. Thus, the FARDL method can be used to examine the link between the variables over both the long and short terms. The presence of cointegration was examined and shown in Table 3 before interpreting the long and short-term coefficients between the variables in the FARDL approach. All test statistics for both countries are higher than the pertinent critical values in absolute value, as shown by the results in Table 3. The variables in this situation have a cointegration relationship.

Table 3. FARDL Cointegration Results.

Panel A: US				
Selected Model: FARDL (3, 3, 3, 1)		**Optimal Frequency: 1.40**	**AIC: −5.012**	
Test Statistics		**Bootstrap**		
		0.90	**0.95**	**0.99**
F_A	15.547***	5.705	7.150	10.404
t	−3.986*	−3.655	−4.145	−5.516
F_B	9.574**	5.643	7.453	12.207
Panel B: China				
Selected Model: FARDL (2, 0, 0, 1)		**Optimal Frequency: 4.30**	**AIC: −5.032**	
Test Statistics		**Bootstrap**		
		0.90	**0.95**	**0.99**
F_A	3.565*	3.372	3.986	5.696
t	−3.212**	−2.110	−2.476	−3.387
F_B	4.583**	3.566	4.566	7.527

Note: ***, ** and * indicate 1%, 5% and 10% significance levels, correspondingly. Bootstrap critical values were obtained with 2000 simulations.

After obtaining the cointegration relationship, the long and short-term coefficients were obtained and presented in Table 4 and Table 5, respectively. All factors, as shown by the empirical results in Panel A of Table 4, and as shown by the results in Panel B, except economic policy uncertainty, the other two variables, are statistically significant. Looking at the long-run coefficients, it is seen that a 1% increase in economic growth and decreases in load capacity factors by 1.095 and 0.394, correspondingly, in the USA and China. In other words, environmental quality is declining in both countries because of the increase in GDP. Despite recent investments in RE, non-RE sources are still dominant in production. Therefore, increases in GDP bring with it more production, and more production brings with it more non-RE consumption. As a natural consequence of this, environmental quality deteriorates with increasing economic growth. This result is consistent with [37,45,73–75]. A 1% increase in energy intensity in both the long and short run increases load capacity factors in the US by 0.941 and 1.187, respectively. In China, energy intensity increases environmental degradation by reducing load capacity factors by 1.201 in the long run. As [17] stated, an increase in energy intensity will increase energy consumption and accordingly more pollutant emissions will be released into the atmosphere. Thus, environmental degradation will increase. This finding is consistent with the findings of [41,46,54,76].

Conversely, in the US, economic policy uncertainty only increases load capacity factors by 0.025 in the long term. In other words, the long-term effects of economic policy uncertainty are an improvement in the environmental quality of the US. Possible reasons for these findings can be listed as follows. The impact of economic policy uncertainty on the environment may be realized by the fact that the consumption effect is more dominant than the investment effect, that is, with the increase of economic policy uncertainty, energy consumption and the use of pollution-intensive products decreases. In connection with this situation, high economic policy uncertainty levels may reduce investments and aggregate demand, leading to a reduction in production and thus a reduction in energy consumption. When the literature is examined, there are studies showing similarities with the findings [13,41,42]. However, while economic policy uncertainty has no statistically significant effect on load capacity factors in the long term in China, it increases load capacity factors by 0.013 in the short run. That is, economic policy uncertainty only expands environmental quality in the short term. The short-term improvement of the environmental quality of economic policy uncertainty in China can be evaluated due to the consumption effect. However, the insignificance of the effect of economic policy uncertainty on the environment in the long term can be attributed to the stability of the economic policy uncertainty in China, as stated by [73].

Table 4. Long run results.

Panel A: US		
Variables	**Coefficients**	***p*-value**
lnGDP	−1.095***	0.000
lnEI	−0.941***	0.000
lnEPU	0.025**	0.019
Panel B: China		
Variables	**Coefficients**	***p*-value**
lnGDP	−0.394***	0.000
lnEI	−1.201***	0.000
lnEPU	−0.002	0.952

Note: ***, ** and * indicate 1%, 5% and 10% significance levels, correspondingly.

The short-term error correction model and the short-term coefficients were then obtained after the long-run coefficients. The error correction term (ECT) in this situation is negative and statistically significant in both nations. This suggests that any imbalance that develops in the short term will go away over time. Additionally, the US's long-term GDP elasticity is lower than its short-term elasticity. According to the [1] methodology, this result shows that the EKC hypothesis is valid in the US. To put it more clearly, the damage to the environment caused by economic growth in the US will begin to decrease after a certain point. In addition, this finding implies that as the income exceeds a certain threshold, the US has entered the development phase and the damage to the environment has begun to decrease. Numerous sources in the literature support the conclusion that energy intensity has a favorable impact on CO_2 emissions, which is supported by our data [76,77].

Our findings are opposite to the findings of [33] and [38] but in the same line with the findings of [44,45,49].

Table 5. Short run results.

Panel A: US		
Variables	**Coefficients**	***p*-value**
C	29.918***	0.000
$D(lnLCF(-1))$	1.345***	0.000
$D(lnLCF(-2))$	0.720**	0.002
$D(lnGDP)$	−0.754**	0.010
$D(lnGDP(-1))$	1.219***	0.004
$D(lnGDP(-2))$	0.775***	0.008
$D(lnEI)$	−1.187***	0.000
$D(lnEI(-1))$	1.423***	0.000
$D(lnEI(-2))$	0.774***	0.009
$D(lnEPU)$	0.019	0.164
CC	−0.048***	0.000
SS	0.071***	0.000
ECT_{t-1}	−2.628***	0.000
Panel B: China		
Variables	**Coefficients**	***p*-value**
C	1.207***	0.000
$D(lnLCF(-1))$	−0.230*	0.086
$D(lnEPU)$	0.013*	0.079
CC	0.002	0.602
SS	−0.028***	0.000
ECT_{t-1}	−0.393***	0.000

Note: ***, ** and * indicate 1%, 5% and 10% significance levels, correspondingly.

After the interpretation of the long- and short-term coefficients, the causality analysis between the variables was examined. According to the results in Table 6, a unidirectional causality link was obtained from economic policy uncertainty to GDP, and from load capacity factors and GDP to energy intensity in the US. In China, on the other hand, a unidirectional causality link was found from GDP to load capacity factors and from energy intensity to GDP.

Table 6. Causality test results.

Panel A: US	**optimal lag length (p)**	**optimal frequency (k)**	**W~asymp[1]**	**bootstrap p-value**
$lnGDP \rightarrow lnLCF$	2	1	0.230	0.884
$lnEI \rightarrow lnLCF$	2	1	1.654	0.456
$lnEPU \rightarrow lnLCF$	2	1	3.357	0.222
$lnLCF \rightarrow lnGDP$	2	1	4.915	0.120
$lnEI \rightarrow lnGDP$	2	1	3.359	0.219
$lnEPU \rightarrow lnGDP$	2	1	13.771***	0.008
$lnLCF \rightarrow lnEI$	2	1	16.752***	0.003
$lnGDP \rightarrow lnEI$	2	1	31.623***	0.000
$lnEPU \rightarrow lnEI$	2	1	0.351	0.848
$lnLCF \rightarrow lnEPU$	2	1	2.231	0.354
$lnGDP \rightarrow lnEPU$	2	1	1.734	0.434
$lnEI \rightarrow lnEPU$	2	1	2.196	0.355
Panel B: China	**optimal lag length (p)**	**optimal frequency (k)**	**W~asymp[1]**	**bootstrap p-value**
$lnGDP \rightarrow lnLCF$	2	2	5.694*	0.086
$lnEI \rightarrow lnLCF$	2	2	3.490	0.208
$lnEPU \rightarrow lnLCF$	2	2	2.555	0.306
$lnLCF \rightarrow lnGDP$	2	2	0.270	0.877
$lnEI \rightarrow lnGDP$	2	2	9.899**	0.021
$lnEPU \rightarrow lnGDP$	2	2	4.196	0.164
$lnLCF \rightarrow lnEI$	2	2	3.665	0.190
$lnGDP \rightarrow lnEI$	2	2	2.638	0.291
$lnEPU \rightarrow lnEI$	2	2	0.545	0.771
$lnLCF \rightarrow lnEPU$	2	2	0.558	0.766
$lnGDP \rightarrow lnEPU$	2	2	0.090	0.954
$lnEI \rightarrow lnEPU$	2	2	0.781	0.682

Note: ***, ** and * indicate 1%, 5% and 10% significance levels, correspondingly. The bootstrap p-value was obtained using 10.000 simulations. [1] Wald test statistics in the Fourier Toda Yamamoto model.

CONCLUSION AND POLICY RECOMMENDATIONS

The main purpose of this study is to analyze the long and short-term effects of economic policy uncertainty in the USA and China on load capacity factors with the FARDL approach. According to their findings, the variables in the USA and China have a cointegration connection and reduce the environmental quality in the USA in both the long and short term by reducing energy intensity and load capacity factors. Looking at China, only GDP and energy intensity affect load capacity factors in the long run, whereas economic policy uncertainty does not affect load capacity factors. Short-term results show that only economic policy uncertainty has a positive impact on load capacity factors.

Several policy recommendations are offered for both the US and China considering the study's findings. As a result of the link between economic policy uncertainty and rising CO_2 emissions in the USA and China, policymakers should reduce policy uncertainty as their first course of action. This action necessitates changing energy financing considering environmental policies' socioeconomic effects. For this reason, financial resources must be progressively shifted by policymakers to renewable energy alternatives. The case countries will be able to move closer to accomplishing the Sustainable Development Goal in such a situation. Furthermore, the validity of the EKC hypothesis in the US implies that environmental quality will begin to improve after a certain point with the increase in income. Therefore, the US government should not ignore environmental policies while supporting the increase in economic growth. For this, a circular economy approach should be adopted in the economy and the dependence on fossil resources in energy, which is the main input of the production procedure, should be reduced. Looking at the environmental quality-economic growth relationship in China, it is seen that economic growth deteriorates the environmental quality. For China, economic growth is very significant for the welfare of the growing population and the development of the country. Therefore, China should maintain its economic growth. However, if China continues to grow in this way while ignoring environmental quality, it will not be a surprise to face serious environmental problems. To prevent this situation, China, like the US, should immediately save its economy from fossil resource dependence and adopt a circular economy perspective in the economy. In addition, China's current economic growth is an indicator of excessive and uncontrolled use of natural resources. This implies that China does not have a sustainable economic structure. To prevent this, the Chinese government should develop certain strategies to prevent wasteful use of natural resources. For example, tax exemptions can be applied to companies that use natural resources more efficiently, and subsidies can be provided.

Economic policy uncertainty can positively affect environmental quality by decreasing investments and production. However, this situation is not sustainable. Economic policy uncertainty can positively impact environmental quality through its consumption effect. This is achieved through investment and the reduction of pollution-intensive products. However, while reducing the damage to the environment, and unemployment, some other economic problems may arise. In this context, uncertainty should be carried out in a way that does not affect economic activities or the environment. RE and environmentally friendly energy should be used in economic activities, policies should be transparent and closed to sudden changes, and at the same time, institutions that are in harmony with the environment and that will be less affected by uncertainties should be established. Again, encouraging domestic and foreign investors to use clean energy so that investments and production are not interrupted, and tax advantages and subsidies are provided and sustained will contribute to the elimination of possible disruptions that may arise from uncertainties. The fact that energy intensity has a detrimental influence on environmental quality in both China and the US indicates that both nations heavily rely on non-renewable sources of energy for their energy needs. This situation necessitates the implementation of various measures for policymakers in both countries. To boost the proportion of RE sources in the energy supply, policymakers should create incentive programs. For example, some privileges such as ease of financing and tax exemptions should be provided to companies using energy obtained from RE sources in both countries. In addition, governments should increase the share of the R&D budget for renewable technologies in their current GDP. In addition, support packages should be introduced to subsidize the expenses of institutions and researchers developing environmentally friendly technologies.

This concise policy framework now possesses the requisite degree of generalizability to enable its application to other countries. Numerous nations are searching for ways to meet the 2030 and 2050 Zero-Carbon emission targets. On the other hand, policy uncertainty about energy sources (fossil, nuclear, and renewable) may face nations at the legislative and public levels. Concerns about policy realignment in these nations can be addressed by using the policy framework that the study suggests as a benchmarking technique. The primary benefit of this framework is its adaptability, which allows it to be tailored to the unique characteristics of the intended nation. The study was able to add to the body of knowledge in energy economics because of its generalizability.

This study was conducted under certain limitations. First, only the US and China are covered. Secondly, the study's results were obtained for both countries separately by using time series techniques. Future research can be done using the load capacity factor, a broad environmental indicator, and panel data techniques for different country groups.

DATA AVAILABILITY

The dataset of the study is available from the authors upon reasonable request.

AUTHORS' CONTRIBUTIONS

Conceptualization, NKA and SC; Methodology, SC; Software, MA; Validation, NKA, ST and SC; Formal Analysis, MA, ST; Investigation, NKA; Resources, SC, MA, ST; Data Curation, SC; Writing—Original Draft Preparation, SC, MA, ST; Writing—Review & Editing, NKA, SC, MA, ST; Visualization, NKA; Supervision, NKA; Project Administration, SC; Funding Acquisition, MA, ST.

CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

FUNDING

This research was funded by the Basic Research Programme at the National Research University Higher School of Economics (HSE).

APPENDIX

Table A1. Summary of the related studies.

Reference	Region/s & Time Period	Dependent Variable	Independent Variables	Method/s
[33]	US, UK, France, Italy, Spain, Australia, Thailand, China (Hong Kong), Germany, Japan (1995–2015)	EF	GDP, EU, EPU, ITA	FMOLS, DOLS
[34]	South Korea (1990–2019)	EF	EC, EPU, ECI, GDP	NARDL
[35]	BRICS countries (1992–2020)	EF	EPU, ES, GDP	AMG, CS-ARDL
[37]	Brazil, Mexico, Russia, Columbia, China (1995–2015)	EF	GDP, EN, REN, EPU	FMOLS, DOLS, AMG
[38]	E7 countries (1992–2020)	EF	EPU, GDP, REN	FMOLS, DOLS, AMG
[39]	China (2000:1–2017:12)	EF	EPU, GPR, GDP	TVP-VAR
[41]	G7 countries (1997–2015)	EF, CO_2	GDP, EI, REN, EPU, ECI	FMOLS
[42]	UK, US, Germany, Canada, Australia (1997–2017)	EF	EPU, REN	NARDL
[43]	19 Energy Intensive Countries (1997–2018)	EF	EPU	ARDL, CS-ARDL
[44]	BRICS countries (1997–2020)	CO_2	GDP, EPU, GE	CS-ARDL
[45]	US (1985–2017)	CO_2	GDP, REN, EPU	NARDL
[46]	US (1985–2017)	CO_2	EPU, GDP, EI	D-ARDL
[48]	France (1987–2019)	CO_2	GDP, EPU, CEC	A-ARDL
[13]	US (1985:1–2019:12)	CO_2	EPU, IPI, REN	Boostrap-ARDL
[49]	South Africa (1960–2020)	CO_2, EF	EPU, REN, EN, GDP, ECI	D-ARDL
[50]	MENA countries (1970–2020)	CO_2	EPU, GDP, EC	A-ARDL, A-NARDL
[15]	US (1960–2016)	CO_2	GDP, EPU, EP	ARDL
[47]	US UK, China, India (2000–2021)	CO_2	EPU, GDP, REN	ARDL
[51]	OECD countries (1985–2017)	CO_2	EPU, EU, GDP	PMG-ARDL
[52]	East Asia Countries (1997–2020)	CO_2	EPU, GDP, REN	Pedroni, FMOLS
[53]	UK (1985–2017)	CO_2	EPU, EU, GDP	ARDL
[54]	Iran (1971–2018)	CO_2	GDP, EPU, EI	NARDL

Note: EU: Energy Use, ITA: International Tourist Arrivals, EC: Energy Consumption, ECI: Economic Complexity Index, ES: Energy Structure, EN: Non-Renewable Energy, REN: Renewable Energy, EI: Energy Intensity, GE: Green Energy, CEC: Clean Energy Consumption, IPI: Industrial Production Index.

REFERENCES

1. Narayan PK, Narayan S. Carbon dioxide emissions and economic growth: Panel data evidence from developing countries. Energy Policy. 2010;38:661-6.
2. Lin B, Omoju OE, Nwakeze NM, Okonkwo JU, Megbowon ET. Is the environmental Kuznets curve hypothesis a sound basis for environmental policy in Africa? J Clean Prod. 2016;133:712-24.
3. Dong K, Sun R, Dong X. CO_2 emissions, natural gas and renewables, economic growth: Assessing the evidence from China. Sci Total Environ. 2018;640:293-302.
4. Akram R, Chen F, Khalid F, Ye Z, Majeed MT. Heterogeneous effects of energy efficiency and renewable energy on carbon emissions: Evidence from developing countries. J Clean Prod. 2020;247:119122.
5. Zeraibi A, Ahmed Z, Shehzad K, Murshed M, Nathaniel SP, Mahmood H. Revisiting the EKC hypothesis by assessing the complementarities between fiscal, monetary, and environmental development policies in China. Environ Sci Pollut Res. 2022;29:23545-60.
6. Grossman G, Krueger A. Environmental Impacts of a North American Free Trade Agreement. Cambridge (US): National Bureau of Economic Research; 1991.
7. Grossman GM, Krueger AB. Economic Growth and the Environment. Q J Econ. 1995;110:353-77.
8. Shahbaz M, Solarin SA, Sbia R, Bibi S. Does energy intensity contribute to CO_2 emissions? A trivariate analysis in selected African countries. Ecol Indic. 2015;50:215-24.
9. Amuakwa-Mensah F, Adom PK. Quality of institution and the FEG (forest, energy intensity, and globalization)-environment relationships in sub-Saharan Africa. Environ Sci Pollut Res. 2017;24:17455-73.
10. Adams S, Adedoyin F, Olaniran E, Bekun FV. Energy consumption, economic policy uncertainty and carbon emissions; causality evidence from resource rich economies. Econ Anal Policy. 2020;68:179-90.
11. Anser MK, Apergis N, Syed QR. Impact of economic policy uncertainty on CO_2 emissions: evidence from top ten carbon emitter countries. Environ Sci Pollut Res. 2021;28:29369-78.
12. Borozan D, Borozan B. The asymmetric effect of economic policy uncertainty on energy consumption. Energy Eff. 2022;15:1-13.
13. Syed QR, Bouri E. Impact of economic policy uncertainty on CO_2 emissions in the US: Evidence from bootstrap ARDL approach. J Public Aff. 2022;22:1-9.
14. Baker SR, Bloom N, Davis SJ. Policy uncertainty: a new indicator. Available from: https://cep.lse.ac.uk/pubs/download/cp362.pdf. Accessed on 11 Sep 2024.
15. Wang Q, Xiao K, Lu Z. Does economic policy uncertainty affect CO_2 emissions? Empirical evidence from the United States. Sustainability. 2020;12(21):9108.
16. Kilinc-Ata N, Alshami M. Analysis of how environmental degradation affects clean energy transition: evidence from the UAE. Environ Sci Pollut Res. 2023;30(28):72756-68.

17. Pata UK, Isik C. Determinants of the load capacity factor in China: A novel dynamic ARDL approach for ecological footprint accounting. Resour Policy. 2021;74:102313.
18. Kilinc-Ata N, Proskuryakova LN. Empirical analysis of the Russian power industry's transition to sustainability. Utilities Policy. 2023;82:101586.
19. Balsalobre D, Álvarez A, Cantos JM. Public budgets for energy RD&D and the effects on energy intensity and pollution levels. Environ Sci Pollut Res. 2015;22:4881-92.
20. Kilinc-Ata N. The asymmetric impact of economic growth, energy consumption, population, and R&D on carbon emission in Turkey: Evidence from ARDL and non-linear ARDL. In: Castanho RA, editor. Handbook of research on sustainable development goals, climate change, and digitalization. Hershey (US): IGI Global; 2022. p. 200-15.
21. Fareed Z, Salem S, Adebayo TS, Pata UK, Shahzad F. Role of Export Diversification and Renewable Energy on the Load Capacity Factor in Indonesia: A Fourier Quantile Causality Approach. Front Environ Sci. 2021;9:1-9.
22. Fikru MG, Kilinc-Ata N. Do mineral imports increase in response to decarbonization indicators other than renewable energy? J Clean Prod. 2023;435:140468.
23. Ulucak R, Apergis N. Does convergence really matter for the environment? An application based on club convergence and on the ecological footprint concept for the EU countries. Environ Sci Policy. 2018;80:21-7.
24. Akadiri SS, Adebayo TS, Riti JS, Awosusi AA, Inusa EM. The effect of financial globalization and natural resource rent on load capacity factor in India: an analysis using the dual adjustment approach. Environ Sci Pollut Res. 2022;29:89045-62.
25. Rees WE. Ecological footprints and appropriated carrying capacity: what urban economics leaves out. Environ Urban. 1992;4:121-30.
26. Siche R, Pereira L, Agostinho F, Ortega E. Convergence of ecological footprint and energy analysis as a sustainability indicator of countries: Peru as case study. Commun Nonlinear Sci Numer Simul. 2010;15:3182-92.
27. BP. BP Statistical Review of World Energy 2022: 71st ed. Available from: https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2022-full-report.pdf. Accessed on 11 Sep 2024.
28. Global Footprint Network (GFN). Available from: https://data.footprintnetwork.org/?_ga=2.8285360.368432842.1677489157-2011084777.1635584313#/. Accessed on 12 Sep 2022.
29. Chen F, Ahmad S, Arshad S, Ali S, Rizwan M, Saleem MH, et al. Towards achieving eco-efficiency in top 10 polluted countries: The role of green technology and natural resource rents. Gondwana Res. 2022;110:114-27.
30. Rafei M, Esmaeili P, Balsalobre-Lorente D. A step towards environmental mitigation: How do economic complexity and natural resources matter? Focusing on different institutional quality level countries. Resour Policy. 2022;78:102848.

31. Balsalobre-Lorente D, Ibáñez-Luzón L, Usman M, Shahbaz M. The environmental Kuznets curve, based on the economic complexity, and the pollution haven hypothesis in PIIGS countries. Renew Energy. 2022;185:1441-55.
32. Dogan B, Chu LK, Ghosh S, Truong HH, Balsalobre-Lorente D. How environmental taxes and carbon emissions are related in the G7 economies? Renew Energy. 2022;187:645-56.
33. Adedoyin FF, Nathaniel S, Adeleye N. An investigation into the anthropogenic nexus among consumption of energy, tourism, and economic growth: do economic policy uncertainties matter? Environ Sci Pollut Res. 2021;28:2835-47.
34. Oryani B, Moridian A, Rezania S, Vasseghian Y, Bagheri M, Shahzad K. Asymmetric impacts of economic uncertainties and energy consumption on the ecological Footprint: Implications apropos structural transformation in South Korea. Fuel. 2022;322:124180.
35. Hussain M, Arshad Z, Bashir A. Do economic policy uncertainty and environment-related technologies help in limiting ecological footprint? Environ Sci Pollut Res. 2022;29:46612-19.
36. Sinha A, Balsalobre-Lorente D, Zafar MW, Saleem MM. Analyzing global inequality in access to energy: Developing policy framework by inequality decomposition. J Environ Manage. 2022;304:114299.
37. Anser MK, Syed QR, Lean HH, Alola AA, Ahmad M. Do economic policy uncertainty and geopolitical risk lead to environmental degradation? Evidence from emerging economies. Sustainability. 2021;13(11):5866.
38. Xu P, Hussain M, Ye C, Wang J, Wang C, Geng J, et al. Natural resources, economic policies, energy structure, and ecological footprints' nexus in emerging seven countries. Resour Policy. 2022;77:102747.
39. Jiao Y, Xiao X, Bao X. Economic policy uncertainty, geopolitical risks, energy output and ecological footprint—Empirical evidence from China. Energy Rep. 2022;8:324-34.
40. Jiang T, Yu Y, Jahanger A, Balsalobre-Lorente D. Structural emissions reduction of China's power and heating industry under the goal of "double carbon": A perspective from input-output analysis. Sustain Prod Consum. 2022;31:346-56.
41. Chu LK, Le NTM. Environmental quality and the role of economic policy uncertainty, economic complexity, renewable energy, and energy intensity: the case of G7 countries. Environ Sci Pollut Res. 2022;29:2866-82.
42. Zahra S, Badeeb RA. The impact of fiscal decentralization, green energy, and economic policy uncertainty on sustainable environment: a new perspective from ecological footprint in five OECD countries. Environ Sci Pollut Res. 2022;29:54698-717.
43. Esmaeili P, Rafei M, Balsalobre-Lorente D, Adedoyin FF. The role of economic policy uncertainty and social welfare in the view of ecological footprint: evidence from the traditional and novel platform in panel ARDL approaches. Environ Sci Pollut Res. 2023;30(5):13048-66.

44. Ali S, Jiang J, Ahmad M, Usman O, Ahmed Z. A path towards carbon mitigation amidst economic policy uncertainty in BRICS: an advanced panel analysis. Environ Sci Pollut Res. 2022;29:62579-91.
45. Ahmed Z, Cary M, Shahbaz M, Vo XV. Asymmetric nexus between economic policy uncertainty, renewable energy technology budgets, and environmental sustainability: Evidence from the United States. J Clean Prod. 2021;313:127723.
46. Danish U, Ulucak R, Khan SUD. Relationship between energy intensity and CO_2 emissions: Does economic policy matter? Sustain Dev. 2020;28:1457-64.
47. Iqbal M, Chand S, Ul Haq Z. Economic policy uncertainty and CO_2 emissions: a comparative analysis of developed and developing nations. Environ Sci Pollut Res. 2022;30:15034-43.
48. Xue C, Shahbaz M, Ahmed Z, Ahmad M, Sinha A. Clean energy consumption, economic growth, and environmental sustainability: What is the role of economic policy uncertainty? Renew Energy. 2022;184:899-907.
49. Udeagha MC, Muchapondwa E. Investigating the moderating role of economic policy uncertainty in environmental Kuznets curve for South Africa: Evidence from the novel dynamic ARDL simulations approach. Environ Sci Pollut Res. 2022;29:77199-237.
50. Ayad H, Sari-Hassoun SE, Usman M, Ahmad P. The impact of economic uncertainty, economic growth, and energy consumption on environmental degradation in MENA countries: Fresh insights from multiple thresholds NARDL approach. Environ Sci Pollut Res. 2022;30:1806-24.
51. Zakari A, Adedoyin FF, Bekun FV. The effect of energy consumption on the environment in the OECD countries: economic policy uncertainty perspectives. Environ Sci Pollut Res. 2021;28:52295-305.
52. Khan Y, Hassan T, Kirikkaleli D, Xiuqin Z, Shukai C. The impact of economic policy uncertainty on carbon emissions: evaluating the role of foreign capital investment and renewable energy in East Asian economies. Environ Sci Pollut Res. 2022;29:18527-45.
53. Adedoyin FF, Ozturk I, Agboola MO, Agboola PO, Bekun FV. The implications of renewable and non-renewable energy generating in Sub-Saharan Africa: The role of economic policy uncertainties. Energy Policy. 2021;150:112115.
54. Ashena M, Shahpari G. Policy uncertainty, economic activity, and carbon emissions: a nonlinear autoregressive distributed lag approach. Environ Sci Pollut Res. 2022;29:52233-47.
55. Adedoyin FF, Zakari A. Energy consumption, economic expansion, and CO_2 emission in the UK: The role of economic policy uncertainty. Sci Total Environ. 2020;738:140014.
56. Abban OJ, Hongxing Y, Nuta AC, Dankyi AB, Ofori C, Cobbinah J. Renewable energy, economic growth, and CO_2 emissions contained Co-movement in African oil-producing countries: A wavelet based analysis. Energy Strateg Rev. 2022;44:100977.
57. Ata NK. Assessing the future of renewable energy consumption for United Kingdom, Turkey and Nigeria. Foresight STI Gov. 2018;12(4):62-77.

58. Our World in Data. Available from: https://ourworldindata.org/grapher/energy-intensity. Accessed on 12 Sep 2022.
59. Economic Policy Uncertainty (EPU). Available from: https://www.policyuncertainty.com/. Accessed on 12 Oct 2023.
60. World Bank Group. World Bank Indicators. Available from: https://databank.worldbank.org/source/world-development-indicators. Accessed on 12 Sep 2022.
61. Pata UK, Balsalobre-Lorente D. Exploring the impact of tourism and energy consumption on the load capacity factor in Turkey: a novel dynamic ARDL approach. Environ Sci Pollut Res. 2022;29:13491-503.
62. Gregory AW, Hansen BE. Residual-based tests for cointegration with regime shifts in models. J Econom. 1996;70:99-126.
63. Hatemi-J A. Tests for cointegration with two unknown regime shifts with an application to financial market integration. Empir Econ. 2008;35(3):497-505.
64. Ozgur O, Yilanci V, Kongkuah M. Nuclear energy consumption and CO_2 emissions in India: Evidence from Fourier ARDL bounds test approach. Nucl Eng Technol. 2022;54:1657-63.
65. Yilanci V, Bozoklu S, Gorus MS. Are BRICS countries pollution havens? Evidence from a bootstrap ARDL bounds testing approach with a Fourier function. Sustain Cities Soc. 2020;55:102035.
66. Pesaran MH, Shin Y, Smith RJ. Bounds testing approaches to the analysis of level relationships. J Appl Econom. 2001;16:289-326.
67. Mcnown R, Sam CY, Goh SK. Bootstrapping the autoregressive distributed lag test for cointegration. Appl Econ. 2018;50:1509-21.
68. Toda HY, Yamamoto T. Statistical inference in vector autoregressions with possibly integrated processes. J Econ. 1995;66:225-50.
69. Enders W, Jones P. Grain prices, oil prices, and multiple smooth breaks in a VAR. Stud Nonlinear Dyn Econom. 2016;20:399-419.
70. Nazlioglu S, Gormus NA, Soytas U. Oil prices and real estate investment trusts (REITs): Gradual-shift causality and volatility transmission analysis. Energy Econ. 2016;60:168-75.
71. Dickey DA, Fuller WA. Distribution of the estimators for autoregressive time series with a unit root. J Am Stat Assoc. 1979;74(366a):427-31.
72. Enders W, Lee J. The flexible Fourier form and Dickey–Fuller type unit root tests. Econ Lett. 2012;117:196-99.
73. Raza Abbasi K, Fatai Adedoyin F. Do energy use and economic policy uncertainty affect CO_2 emissions in China? Empirical evidence from the dynamic ARDL simulation approach. Environ Sci Pollut Res. 2021;28:23323-35.
74. Kilinc-Ata N, Proskuryakova LN. The contribution of energy policies to green energy transition in the Asia-Pacific region. Renew Energy. 2024;237:121797.
75. Fikru MG, Kilinc-Ata N, Belaïd F. Climate policy stringency and trade in energy transition minerals: An analysis of response patterns. Resour Policy. 2024;96:105236.

76. Kilinc-Ata N, Alshami M, Munir K. How do strategic mineral resources affect clean energy transition? Cross-sectional autoregressive distributed lag (CS-ARDL) approach. Miner Econ. 2023;36(4):643-54.
77. Kilinc-Ata N, Barut A, Citil M. Do military expenditures have an impact on the adoption of renewable energy in OECD nations? Evidence from a panel cointegration test approach. Int J Energy Sect Manag. 2024;18(6):1745-66.

How to cite this article:
Kilinc-Ata N, Camkaya S, Akca M, Topal S. The Impact of Uncertainty in Economic Policy on the Load Capacity Factors in China and the United States (US): New Evidence from Novel Fourier Bootstrap ARDL Approach. J Sustain Res. 2025;7(1):e250002. https://doi.org/10.20900/jsr20250002