The role of natural resources, fintech, political stability, and social globalization in environmental sustainability: Evidence from the United Kingdom

Abstract: Numerous studies illustrate that natural resources, financial technologies, social globalization, and political stability are essential factors that influence environmental sustainability. Therefore, researchers in developed nations must explore these interconnections further, mainly when these nations focus on achieving net zero emissions targets. The present analysis illuminates the connotations among natural resources, political stability, fintech, social globalization, and CO2 emissions in the UK. The current analysis has taken the time frame, 2000Q1 to 2021Q4, and employed the latest approach, i.e., the bootstrap ARDL technique, for estimation. The empirical results revealed that natural resources and social globalization are escalating CO2 emissions. Nonetheless, political stability and fintech lead to decreased CO2 emissions in the specific case of the selected developed nation. The present analysis confabulates a uni-directional connotation between all the chosen economic indicators and environmental degradation in the UK. As per the observed empirical outcomes, developed nations must initiate policies and programs to utilize natural resources efficiently without compromising environmental sustainability. In addition, governments in developed nations should encourage financial technologies and political stability to promote ecological sustainability.

Keywords: Fintech, natural resources, political stability, social globalization, the BARDL

1. Introduction

Climatic change pertains to persistent variations in the temperature, precipitation patterns, and other climatic indicators that influence ecological sustainability. Human activities, including the combustion of fossil fuels like oil, natural gas, and coal, are the primary drivers of these climatic shifts. This process discharges greenhouse gases, such as methane (CH4) and carbon dioxide (CO2), into the surrounding environment (Aslam et al., 2021). Tackling climate change necessitates worldwide collaboration and focused initiatives to diminish GHG emissions, shift towards renewable energy sources, enhance energy efficiency, carbon pricing, carbon captures and storages, international cooperation, and research and innovation. Many countries have officially approved global arrangements, like the Paris Agreement, to limit the increase in worldwide temperatures and attenuate the influences of climate change. However, significant steps are still needed to implement and execute these international regulations effectively (Chien et al., 2021).

The influence of natural resources on economic prosperity has been a long-standing subject of discussion. Renowned economists like David Ricardo and Adam Smith have accentuated the significance of different natural resources, such as gas, minerals, and oil, in promoting economic growth. Recently, regions rich in natural resources, specifically the Middle East, Africa, and Latin America, have been experiencing slower economic growth than countries with fewer natural resource reserves. The concept of natural resource abundance leading to poor economic outcomes in contrast to nations with fewer reserves is called the "resource curse hypothesis," which was termed by Auty in 1993. The resource curse is prevalent in present-day growth and policy conversations. For the last few years, the attention has been shifted toward a sustainable environment. Therefore, we have seen a large amount of literature on the impact of natural resources on CO2 emissions (CE hereafter), for example (Khan et al., 2020; Chen et al., 2023). The theory behind the synthesis is that the inefficient utilization of natural resources can enhance

ecological deterioration. In most developed and developing economies, firms' decisions are profit-driven, and as a result, they do not rely on environmental quality. In addition, fossil fuel combustion from various natural resources, including natural gas, coal, and oil, is one of the strongest drivers of ecological degradation. Overusing and exploiting natural resources can cause environmental deterioration, which could concern policy practitioners in developed nations (Bekun et al., 2019; Hodžić et al., 2023).

In a specific context, fintech increases the process of economic growth through many channels. It includes financial inclusions for all segments of society, which allow people from marginalized communities to access better and more efficient financial services. Fintech also helps decrease the transition costs and operation efficiency for customers and financial institutions. The digital platforms allow small businesses to access loans (Jia et al., 2024). Different fintech tools make it easier for people to access the digital economy and e-commerce. However, there are a few perks associated with fintech. It includes the influence of fintech on ecological sustainability. Most fintech products and services, including data services, cloud computing, and digital transactions, require and consume a substantial amount of energy, which directly causes an increase in CE (Liu et al., 2024).

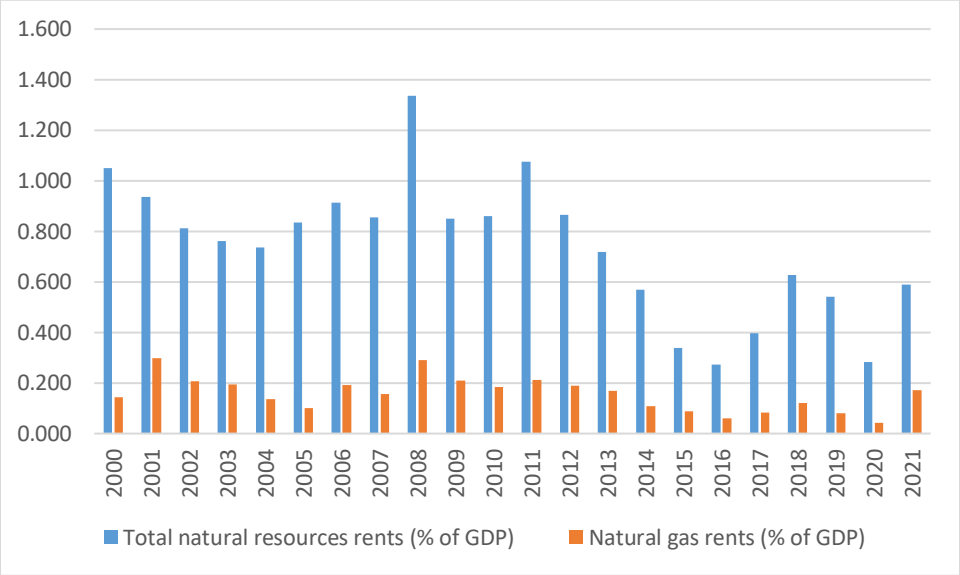
In the recent past, social globalization has been another pertinent dimension in focus due to its detrimental influences on ecological degradation. Social globalization represents the interconnectedness among nations, societies, and individuals; it includes cultural exchange, trade, and communications (Ahmed, 2024). Social globalization can bring an increase in CE through various channels. Social globalization increases competition due to enhanced connectivity among nations and individuals; also, due to the fragmentation of production across borders, the nations have seen more and longer supply chains. Due to an upsurge in connectivity, we see an increased trend in transporting goods over long distances, increasing CE (Yurtkuran, 2021). Social globalization is also interconnected with rapid urbanization. Urbanization is associated with high transportation needs and demand for housing, which causes a surge in CE and wipes out the green spaces to accommodate new housing schemes to accommodate habitats. In addition, due to economic integration, globalization also causes an increase in industrialization in a particular nation or a group of nations. Globalization also escalates international travel and tourism, which is partly responsible for increasing the CE (Sahu and Kumar,2020).

Developing and developed nations have faced many governance challenges recently, including political instability. Political stability is an impetus to reap the benefits of any long-term policy and plan associated with climate action and SDG 13. Political stability enables authorities to adequately implement and monitor environmental regulations (Muhammad and Long, 2021). Political stability paves a way to enhance international cooperation among developed and developing nations to promote ecological sustainability. One such example is the Paris agreement and also recently conducted the COP 28 where the UK has participated actively.

The present study intends to examine the interconnections among four pertinent economic indicators and CE in the United Kingdom. It includes fintech, natural resources, political stability, and social globalization, each of these variables has chosen based on their own significance for the selected nation. There are various interesting reasons to conduct this piece of research for the UK. First in the recent years, the government is taking interest to achieve net-zero emissions. For the said purpose, the policy practitioners are focusing on many strategies and plans, such as investing

and promoting in various kinds of renewable energies, and also electrification, energy efficiency and carbon pricing. The political stability is social globalization are two most pertinent pillars to achieve previously mentioned objectives. In addition, economy should focus on renewable resources and also it is needed to promote the financial technologies. Figure 1 depicts about the context with respect to natural resources in the UK.

Figure 1. Natural resources in the UK – a context



Source: World Development Indicators, the World Bank

The ongoing research brings numerous merits to the recent strand of literature. The study will discuss the natural resource-fintech-CE linkage concerning the UK. In addition, the ongoing research has included two other economic indicators, including political stability and social globalization. The study has applied the latest methodology, i.e., the Bootstrap Augmented Autoregressive Distributive Lag (BARDL) technique. The present research's outcomes assist policy experts in formulating precise strategies for effectively handling the natural resources of the chosen nation.

Organization of the present study: Section 2 sheds light on the prior literature, which considers the connotations of fintech, natural resources, social globalization, political stability, and CE. Next, Section 3 illuminates the explication of the models and methodological framework employed to conduct empirical evaluation. Afterwards, Section 4 demonstrated the outcomes and compared the results with the prior literature. Finally, Section 5 offers plausible policy directions to enhance environmental sustainability in the UK.

2. Literature Review

The prior literature gives the researchers valuable insights into the issues at hand. Jahangir et al. (2023) demonstrate that natural resources are associated with a decline in CE in low-income

nations. Policy practitioners must focus on effectively handling natural resources to promote ecological sustainability. Li et al. (2023) determined that natural resources are responsible for minimizing CE in China. The decrease in natural resource dependence tends to escalate the reduction of carbon emissions by cutting the overall demand for energy and promoting green technologies. Wang et al. (2023) examine the associations between natural resources and CE regarding G-7 nations. The analysis validated an adverse relationship among the observed economic indicators.

Additionally, implementing practical measures concerning natural resources is essential to accomplish carbon neutrality objectives. Du and Wang (2023) researched to confabulate the effect of natural resources on CE and concluded that a favorable correlation is present between natural resources and CE. Additionally, policy experts should prioritize particular strategies concerning natural resources to mitigate the effects of CE. Alhassan and Kwakwa (2023) expound that natural resources have been assessed as an effective strategy for growing CE for Ghana. To ensure ecological sustainability, the research offers policymakers appropriate suggestions for mitigating CE related to the financing and leasing of natural resources. Li et al. (2023) highlighted that natural resources are vital in curbing CE. It is suggested that policy experts specify policies that prefer producing energy obtained from renewable sources.

Adebayo et al. (2023) find that natural resources substantially restrict the CE of BRICS nations. Policy experts should emphasize the distribution of natural resources towards energy innovation to promote a net-zero-carbon economy. Khan et al. (2023) find that the abundance of natural resources facilitates the nation to raise CE for BRI nations. Policy practitioners should strive to strengthen the efficiency of natural resource usage to attain a sustainable ecology. Gyamfi and Adebayo (2023) illustrate the influence of natural resources on CE for E-7 economies and find that natural resources support the growth of CE.

Furthermore, the implementation of investment policies in natural resources can curtail CE. Voumik et al. (2023) illustrate that natural resources manage to reduce the CE for South Asian nations owing to their damaging effect on CE. It is recommended that policy experts design reliable strategies concerning natural resources to benefit from industrial development. Luo et al. (2023) enlighten that natural resources amplify the CE for developing nations. Additionally, the enactment of natural resource conservation policies aids in diminishing CE. Danish et al. (2023) highlight that natural resources are essential in mitigating the CE for the US. Choosing consistent strategies for natural resources management is advised for policy practitioners. Wang et al. (2023) indicate that natural resources play a more vital part in the expansion of CE.

Further, policy experts should focus on preserving natural resources to foster economic prosperity. Akram et al. (2023) state that natural resources persuade the nation to limit CE for G-7 nations. It is preferable to develop accurate strategies regarding natural resources to guarantee ecological sustainability. Raihan (2023) illuminates that natural resources and CE for Uruguay are favorably connected. Keeping a balance in extracting natural resources is recommended to safeguard their sustainability. Liu et al. (2024) confabulated that natural resources expedite the nation towards limiting CE for China. Policy practitioners should concentrate on incentivizing natural resources to foster economic prosperity. Ashraf et al. (2024) explain that natural resources reinforce the nation's concerns about impeding CE for highly contaminated nations. It is recommended that

policy practitioners adopt specific mining techniques regarding the administration of natural resources. Leng et al. (2024) indicate that natural resources significantly encourage CE for low-income nations. Policy partitioners should emphasize adequate supervision and the extraction of natural resources.

Teng and Shen, (2023) assess that fintech substantially expands CE for China. Policy practitioners should promote strategies aimed at fintech expansion to reach carbon neutrality goals. Cheng et al. (2023) describe the interconnection between CE and fintech for China and determine that fintech assists in limiting CE. It is highlighted that policy experts should emphasize to attain fintech development. Firdousi et al., (2023) expound that fintech has been recognized as a productive measure restricting CE for MSCI nations. It is confabulated that policy practitioners must formulate and then execute an industrial strategy based on fintech that encourages sustainable prosperity. Guo & Yin (2024) indicate that fintech expedites the nation towards mitigating CE for China. It is advised that policy experts should promote advancements in fintech to guarantee long-term sustainability. Liu et al. (2024) determine the connection between CE and fintech, that fintech reinforces the nation towards discouraging CE - for China. Based on empirical outcomes, policy experts can use fintech as a measure to support ecological sustainability.

Lu et al. (2023) illuminate that an inverted U-shaped connotation persuades between fintech and CE for BRICS nations. Thus, policy experts are advised to outline specific policies based on fintech to manage ecological deterioration. Song et al., (2023) confabulate that fintech plays an essential role in lowering CE owing to unfavourable connections between them. It is recommended that the effectiveness of digital finance must be escalated to accomplish sustainable goals. Lisha et al., (2023) demonstrate that fintech is prominent in curtailing CE concerning BRICS economies. Based on the empirical outcomes of the study, it is confabulated that policy experts should concentrate on fintech growth to achieve economic prosperity. Sadiq et al. (2024) conclude that fintech is essential in decreasing CE for China. Wei et al. (2024) find that fintech is playing a vital part in lowering CE for BRICS nations. Therefore, policy practitioners should focus on capitalizing on fintech developments to sustain economic development. Xia and Liu (2024) assess that fintech is a significant factor in impeding CE for G-7 nations; thus, implementing fintech as a considerable measure to control ecological destruction is recommended. Song and Hao (2024) highlight the interconnection between fintech and CE. The analysis validated an adverse connotation between the observed economic indicators. Moreover, enacting strategies related to fintech is significant in promoting ecological sustainability. Zhang et al. (2024) conclude that fintech escalates CE for BRICS nations. Policy practitioners should encourage fintech policies utilizing renewable energy sources to ensure higher growth and prosperity.

Purcel (2019) concludes that political stability deals with lowering CE for low-income countries. Hasseb et al. (2019) demonstrate that for developing nations, political stability assists the nations in mitigating CE. Aller et al. (2021) elucidate that political stability accommodates the nations in cutting down CE for developed and developing nations. Muhammad and Long (2021) state that political stability plays a primary part in dwindling CE for B&R nations. Liu et al., (2021) explain that political stability evolves as a driving force in discouraging CE for top contaminated nations. Mrabet et al., (2021) enlighten that for MENA nations, political stability motivates the nation concerning curtailing CE. Benlemlih et al. (2022) exhibit that political stability discourages CE. Adebayo (2022) determines that political stability is a foremost factor in abating CE for Canada. Ayhan et al. (2023) discovered that for high-income nations, political stability leads the nations

towards lowering CE. Kartal et al. (2022) clarify that political instability is a significant element in surging CE for Finland. Sabir (2022) illustrates that political stability reinforces the nation's drive to cut down CE for Thailand.

Khan et al. (2019) expound that globalization persuades Pakistan's economy to augment CE. Liu et al. (2020) confabulate that in an example of developed nations social globalization and CE tend to have an inverted U-shaped interconnection. Mehmood (2021) illustrates that globalization plays a crucial part in restricting CE for Singapore. Jahangir (2022) expresses that globalization administers the nation concerning mitigating CE for developing economies. Farooq et al. (2022) illuminate that globalization boosts CE for a group of developed and developing nations. Acheampong (2022) discovered that globalization reinforces the nation's concern about curtailing CE for Ghana. Raza et al. (2022) deduce that globalization is reviewed as an effective mechanism for improving CE for top globalized nations. Huo et al. (2022) argue that globalization expands CE for a group of developing nations. Deng et al. (2022) elucidate that globalization is a significant component in expanding CE. Li et al. (2022) enlighten that for MINT nations, globalization accomplishes the nations regarding mitigating CE. Ke et al., (2022) simplify that globalization is a powerful tool for escalating CE for low-income nations. Abdul et al. (2022) demonstrate that globalization facilitates the escalation in CE for China. Ansari et al. (2022) determine that for low-income nations, globalization supports the nations in discouraging CE. Nan et al. (2022) conclude that globalization assists in abating CE for OECD nations. Jahangir et al. (2023) exhibit that globalization is foremost in boosting CE for low-income nations. Alam et al., (2023) interpret that globalization leads the nation towards accelerating CE for India.

Based on the previously discussed scholarly insights, we could not find any notable study for the UK. Therefore, the present study will contribute to the existing body of literature in various ways. It discusses the connotations between fintech, natural resources, and CE. The research uses the latest methods for obtaining empirical outcomes. Moreover, the research will extend suitable policies for policy practitioners in similar developed nations.

Table 1. Literature review – summery

Author(s)	**Country/countries**	**Method(s)**	**Empirical outcomes**
Muhammad and Long (2021)	BRI	GMM	PS ↓ CE
Adebayo, (2022)	Canada	DARDL	PS ↓ CE
Kartal et al., (2022)	Finland	NARDL	PS ↓ CE
Khan et al., (2019)	Pakistan	DARDL	SG ↑ CE
Mehmood, (2021)	Singapore	ARDL	SG ↓ CE
Abdul et al., (2022)	China	ARDL	SG ↑ CE
Lisha et al., (2023)	BRICS	MMQR	FT ↑ CE
Xia and Liu, (2024)	G-7	MMQR	FT ↑ CE
Zhang et al., (2024)	BRICS	CSARDL/NARDL	FT ↑ CE
Du and Wang, (2023)	China	QARDL	NR ↑ CE
Voumik et al., (2023)	South Asia	CSARDL	NR ↓ CE
Wang et al.,(2024)	G-7	CSARDL	NR ↓ CE

Note: PS – political stability, SG – social globalization, FT- fintech, NR- natural resources.

3. Methodology

3.1. The bootstrap ARDL

The stationary method is a prerequisite to apply before the cointegration procedure while inspecting a time series. However, the ongoing research explores the attributes regarding time series data by employing the latest methods. Preceding analyses in literature exclusively rely on the ADF and structural-based unit roots techniques, which need to be revised concerning the prevalence of structural breaks and their influences reflected in the data. By keeping this in mind, the ZA unit root method permits structural breaks to prevail regarding time series data irrespective of disclosing the precise time the break takes place owing to the fact. Following Nawaz et al., (2019), The ongoing research applies a bootstrap auto-regressive distributive lag (BARDL) bound testing estimator to investigate the long-term cointegrating interconnections. Conversely to the fundamental ARDL approach established by Pesaran et al. (1999), the test efficiently handles the challenge of small sample size and power attributes.

Even though the approach relies on a novel cointegration test, it also reinforces both the t-test and the F-test. However, the conventional ARDL assessment necessitates approving two definite bases. Primarily, the coefficient of the error-correction term (ECT) is a prerequisite to be significant, and secondary, the coefficients of the lagging predictor economic indicators are a prerequisite to be statistically significant. The prime condition regarding the approach tends to be satisfied without upper and lower limits (Bildirici et al., 2023). It inquires if the ECT coefficient is adequately and statistically significant. In the second place, sizeable coefficients are required concerning the lagged explanatory economic indicators we have included in our analysis. Pesaran et al. (2001) suggested that lower and upper limits (critical bounds) are regarded for the second case, yet there are no critical limits/boundaries regarding the first case. If ECTs show any difference – by chance - in the primary scenario, the method can be utilized when the model entails I (1) for all the chosen economic indicators. It confabulates that the explanatory and power characteristics of the conventional ARDL method need to be more effective (Suki et al., 2022).

Moreover, the primary condition is inspected by contemplating chosen economic indicators integrated into order 1 (Suki et al., 2022). The traditional ARDL model has constraints regarding both power and explanatory attributes. While the F test tends to rely on lagged predictors, the bootstrap ARDL model more accurately handles time series analysis. Furthermore, this method elucidates the included economic variables in a dynamic model in an unordered way. The specific method tends to restrict the testing approach that applies an additional F-test about lagged coefficients of predictors to handle these challenges (Bildirici et al., 2023). The bootstrap ARDL method is recommended to deal with multi-explanatory variable dynamic models since it subdues the challenges of ambiguous proof regarding the conventional ARDL bounds-testing techniques by enabling economic indicators with heterogeneous integration order (Huang et al., 2023). Ultimately, the stability test is applied to evaluate the precisions and accuracy of the estimations during the examination. Due to structural variation during the selected time frame, inconsistent results are noticed in time series data.

Equation (1) illustrates the conventional ARDL bound testing method by employing four economic indicators;

$$COE = \sum_{a=1}^{d} \beta_a \; n_{t-a} + \sum_{b=0}^{e} \alpha_b o_{t-b} + \sum_{c=0}^{f} \theta_c v_{t-c} + \sum_{a=1}^{g} \phi_t H_{t,m} \; + \; \varepsilon_t \quad (1)$$

Especially, a, b, c, and m are lagged values of the included economic indicators considering values between 0 to d, 0 to e, 0 to f, and 0 to g. t is used to signify Ttime, CE is the response economic indicator, although o_t and n_t is the predictor economic indicators. Based on Carrion-i-Silvestre et al. (2009), the term $H_{t,m}$ is a dummy variable regarding the break year. The dynamics of lag predictor economic indicators are denoted by α and θ, ϕ_t is the value for the dummy coefficient, and εt implies the residual value with the constant deviation. In addition, the ECT for the model under consideration is mentioned in the following expression.

$$COE = \; \rho n_{t-1} + \sigma o_{t-1} + \varphi v_{t-1} + \sum_{a=1}^{d-1} \Phi_a \, n_{t-1} + \sum_{b=1}^{e-1} \vartheta_b \, o_{t-b} + \sum_{a=1}^{f-1} \partial_c \, v_{t-c} + \sum_{a=1}^{g} u_a \, H_{t,m} + \varepsilon_t \; (2)$$

By glancing at equation (2), we are keen to focus on these indicators$\Phi_{a:\,Asa}, \vartheta_b, \partial_c, u_a$. Employing a constant term (g) engenders the conditional model in the following way:

$$COE = g + \; \rho n_{t-1} + \sigma o_{t-1} + \varphi v_{t-1} + \sum_{a=1}^{d-1} \Phi_a \, n_{t-1} + \sum_{b=1}^{e-1} \vartheta_b \, o_{t-b} + \sum_{a=1}^{f-1} \partial_c \, v_{t-c} + \sum_{a=1}^{g} u_a \, H_{t,m} + \varepsilon_t \; (3)$$

To discover the connotations between the observed economic indicators $n_t, \; ot, v_t$, it is mandatory to reject the null hypotheses: i) The F-1 method inspects ECTs employed regarding the present analysis. $H0$: $\rho = \; \sigma = \;$ φ = 0, although H1: Any of the $(\rho, \sigma, \varphi)$is not zero. ii) The predictors are found by employing the F-2 test. H0; $\rho = \; \sigma = 0$ against H1: one (ρ, σ) is not zero. iii) Lagged economic indicators relied on predictors exhibited as $H0; \; \rho = 0$ opposed to $H1; \; \rho$ is distinct from zero. The Bound approach critical outcomes are established by applying the conventional ARDL approach for the two pertinent tests, i.e., the t-test and F test. However, the approach does not consider F-2 test outcomes about deferred coefficients. The basic advantage of the BARDL approach is that it upgrades the ordinary ARDL method by incorporating boundaries and critical values. Accordingly, to accomplish the analysis, we have employed integral values.

3.2. Data description

3.2.1. Outcome variable:

Climate change has posited a challenge for low- and high-income economies. Even though developed economies do not have resource constraints, challenges are still there to implement effective programs and policies. Therefore, it is the need of the hour to invest in research and innovations on climate action. Keeping in mind the same narrative, in the ongoing investigation, the outcome variable is CO2 emissions, indicated by CE. It is a proxy to measure the carbon emission in kt.

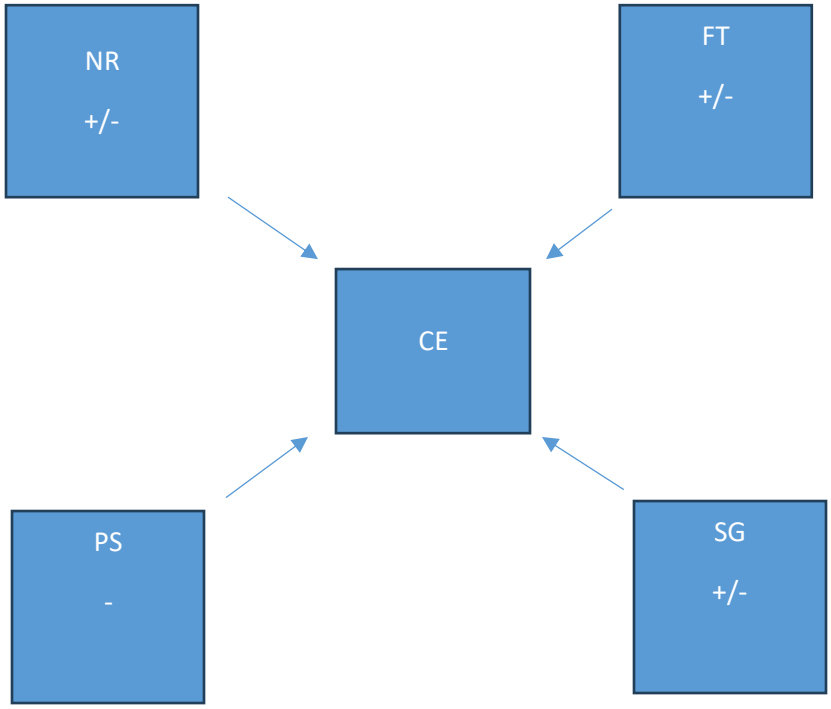
3.2.2. Explanatory variables

The ongoing research has used four explanatory economic indicators, which are confabulating four distinct points of view to control ecological degradation. For instance, the first explanatory variable is natural resource, which is represented by NR, and it is the total rents coming from various natural resources, and the data source is the World Development Indicators. The second variable is fintech, an index extracted from the CrunchBase Database (Croutzet and Dabbous, 2021). It signifies the

role and importance of new and advanced technologies in controlling environmental pollution. In the recent era, economies have come across various challenges associated with governance. Along the same lines, we have included political stability in our investigation. Political stability is the political risk index; relevant information is extracted from the PRS group. Basically, in the present era, economies are interconnected on various grounds, and we cannot ignore the role of social globalization in controlling ecological degradation. The social globalization data is collected through the KOF Swiss Institute. The period under consideration is 2000 Q1 to 2021 Q4. In Figure 2, we have discussed the expected interconnections among chosen economic indicators. Even though the prior scholarly work elucidates mixed (positive and negative) interconnections for all the chosen economic indicators with CE, we have reported the most evident connotations.

As per the previously discussed literature review, natural resources can increase or decrease the CE. Natural resources influence CE through various channels, including the overuse and over-exploitation of natural resources, bringing an increase in CE. In addition, firms are triggered by profit motives. Thus, producers indulge in various activities that increase CE and vice versa. In this age of digitalization, fintech has brought many merits to the masses. It helps everyone access advanced financial services at their doorstep and thus paves the way to financial inclusion. However, some perks are associated with FT, i.e., FT, and related services consume energy and upsurge CE. On the other hand, due to FT, we cannot ignore the decrease in transaction and transportation costs; remote working also helps abate CE. Political stability is another pertinent variable we have included in our analysis. It is a well-discussed fact that political stability is perhaps the most significant factor in promoting ecological sustainability, as in the presence of political instability and chaos, no economy can fulfill any target associated with climate action. To combat climate change, policy makers must devise long-term policies and plans. In this economic and social integration era, economies are interconnected on various grounds. Nonetheless, it increases consumption, trade, and tourism, and it can increase (decrease) CE. Figure 2 sums up the same interconnections.

Figure 2. Expected interconnections between chosen economic indicators and CE



Source: Based on prior literature review.

4. Results and interpretations

Table 2. Descriptive analysis for the variables in our model

Description	CE	NR	FT	PS	SG
Mean	9.11	4.01	4.09	5.76	4.32
Median	6.77	2.18	2.15	3.01	2.31
Max	12.81	6.20	7.91	8.28	7.21
Min	4.14	2.66	1.65	2.71	1.11
SD	1.09	0.65	0.23	0.67	0.27

Table 2 elucidates the descriptive analysis of the included economic variables in the present study. The outcomes tend to disclose that all economic indicators have positive means, although CE possesses the highest mean value, 9.11, and NR includes the lowest mean value, 4.01. Meanwhile, the analysis noticed that CE has the highest SD and FT has the lowest SD. Further action would be evaluating the stationary attributes of NR, FT, PS, and SG. Disclosing the cointegration approach suitable for investigating the cointegration connotations between CE and their factors relies on inspecting the economic indicators' order of integration. The ongoing research employs the ADF unit root method, which permits a particular unspecified structural break in the series to overcome the challenges (Kim and Perron, 2009).

Table 3. The unit root test results – to check the order of integration

Variables	ADF (level)	ADF(Δ)	ZA (Level)	Break year	ZA(Δ)	Break year
CE	-1.512	-5.213***	-1.607	2002Q2	-4.221***	2006Q4
NR	-1.210	-4.551***	-1.114	2010Q3	-6.309***	2018Q3
FT	-1.665	-3.661***	-1.220	2012Q1	-6.318***	2015Q2
PS	-1.741	-4.881***	-1.341	2017Q4	-4.491***	2010Q2
SG	-1.998	-6.510***	-1.510	2019Q2	-3.611***	2013Q4

***, **, and * confabulate the level of significance at 1%, 5%, and 10%.

The method considers that while the economic indicators tend to possess varied orders of integration, they tend to be stationary at the level or the first difference. The said method is suitable for small sample size analysis. Due to the lack of explicative power, traditional unit root methods such as the PP and ADF methods either significantly or unsubstantially accept the alternative hypothesis (Dickey and Fuller, 1981; Ng and Perron, 2001). The ADF unit root method handles the particular challenges.

The analysis applies the ADF unit root and structural-break unit root methods to inspect the stationarity of the coefficients. The estimated outcomes of the ADF and Zivot unit root methods are represented in Table 3. The outcomes of the ADF denote that included economic indicators are not stationary at the level. Nonetheless, the results of ADF in the prevalence of structural fractures could bring forth misleading deduction. The structure-based unit root method is employed to address the challenges.

Table 4. The BARDL cointegration analysis

BARDL cointegration test						Diagnostic tests			
Estimated model	No of lags	Break year	F_{Joint}	T_{DEP}	T_{IND}	R^2	Q stat	LM(2)	JB test
Model	2,2,2,2,2	2010Q3	19.12	-9.210	-6.708	0.910	3.109	1.371	0.776

Consequently, the Zivot unit root method outcomes confabulate that all included economic indicators are integrated at first difference along with structural breaks. It specifies that all of the economic indicators confabulate long-run cointegration. The ongoing research employs the bootstrap ARDL method to discover the long-run cointegration between NR, FT, PS, SG, and CE. Table 4 revealed the estimated results of the bootstrap ARDL cointegration approach.

Table 5. The BARDL model results

Variables CE	Long run		Short run	
	Coeff	t values	Coeff	t values
Cons	0.609**	1.961	0.451	1.009
NR	0.238***	4.566	0.187**	1.921
FT	-0.198***	-5.776	-0.108**	-2.001
PS	-0.109***	-4.510	-0.091***	-5.221
SG	0.061***	4.212	0.021***	3.608
D_{2009Q2}	-0.088***	-3.781	-0.351	-1.121
Ect_{-1}	-	-	-0.428***	-4.512
Long run R2	0.942	-	-	-
Long run adj -R2	0.672	-	-	-
Long run DW	2.091	-	-	-

***, **, and * confabulate the level of significance at 1%, 5%, and 10%.

The tests, i.e., F-test and t-test (Table 6), deny the null hypothesis and disprove the presence of cointegration, specifying that all economic indicators are cointegrated in the long run. The most suitable lag length is chosen by utilizing the Akaike Information Criteria. Moreover, the explicative power (R^2) value of 0.942% illustrates that all regressor factors appropriately consider the response economic indicator, CE. It is also denoted through the JB statistics that the model's errors tend to be distributed normally. Additionally, serial correlation is not a compelling challenge in the model. It is determined that CE, NR, FT, PS, and SG tend to have a long-run interconnection. After discovering the cointegration between the chosen economic indicators, the analysis explores the short- and long-term outcomes of the bootstrap ARDL method. The long-term result of the bootstrap ARDL method is revealed in Table 5.

Regarding Table 5, the first two columns represent long-run outcomes depicting that PS tends to have an unfavorable impact on CE, indicating that a 1% increase in PS abates CE by 0.109%. It is well-observed fact that politically stable nations are able to execute long-term policies and programs focused on climate action. It can be noticed from the preceding analyses. Purcel (2019) concluded that political stability facilitates the nations in lessening CE for developing nations. Hasseb et al. (2019) exhibit that political stability effectively discourages CE for ASEAN nations. Aller et al. (2021) detect that political stability reinforces the nation in narrowing CE for low and high-income nations. Muhammad and Long (2021) discover that for B&R nations, political stability is reviewed as a pivotal component in restricting CE. Mrabet et al. (2021) illustrate that political stability deals with shrinking CE for MENA nations.

Moreover, the research reviews that FT is exerting a negative influence on CE. It depicts that a 1% escalation in FT brings a curtailment of 0.198% in CE. The FT is helping economies to grow and bring new technologies to the doorstep of a vast segment of society. It encourages online payments and provides various ways and knowledge at the individual and national level, which ultimately help to abate CE. The outcome can also be validated from the prior analysis. Cheng et al. (2023) illustrate that fintech participates in contracting CE for China. Guo & Yin (2024) determine that fintech persuades the nation concerning diminishing CE for Sub-Saharan Africa. Awais et al.

(2023) depict that fintech is pivotal in shrinking CE. Liu et al. (2024 illustrate that fintech assists the nation in abating CE for China. Nonetheless, Teng and Shen, (2023) confabulate that fintech accomplishes the nations concerning escalating CE in the Chinese economy.

Additionally, the research has assimilated SG into the analysis.SG tends to have a favorable interconnection with CE. It illuminates that a 1% expansion in SG brings an upsurge of 0.061% in CE. Numerous analyses tend to validate similar results. Khan et al. (2019) explain that for Pakistan, globalization accommodates the nation in growing CE. Farooq et al. (2022) highlight that globalization is pertinent in surging CE for low and middle-income nations. Huo et al. (2022) assess that globalization is reviewed as a driving force in escalating CE for low-income nations. Deng et al. (2022) express that globalization motivates the nation to up surge CE. Abdul et al. (2022) deduce that globalization enhances China's level of CE.

Furthermore, the research noted that NR is favorably correlated with CE. It illustrates that a 1 % increment in NR yields an escalation of 0.238% in CE. The outcomes can also be validated from prior analysis. Safdar et al. (2022) determine that natural resources play a pertinent part in growing CE for South Asian nations. Baloch et al. (2019) exhibit that natural resources exert a mixed – positive and negative – influence on CE for the BRICS block. However, Li et al. (2023) express that natural resources are a substantial component in abating CE for the Chinese economy. Wang et al. (2023) illustrate that natural resources expedite the G-7 nation concerning encouraging CE. Du and Wang (2023) demonstrate that natural resources deal with boosting CE. Alhassan and Kwakwa (2023) discovered that natural resources function as a critical element in enhancing CE for a low-income nation.

To overcome the aftermaths of the global financial crisis (2007–2008), the UK's government has set up a fiscal incentive deal; therefore, while employing the bootstrap ARDL approach, the present study has taken the year 2009 as a dummy variable. Since 2009, the UK's economic development has escalated by 11 % owing to the fact. Consequently, since 2009, the UK's economy has experienced steady development. The results depict that the dummy economic indicator coefficient substantially influences ecological sustainability.

The R^2 illustrates the model's efficiency and has a value of 0.942 concerning overall variance in CE. In addition, the value of the Durbin-Watson test depicts no evidence of autocorrelation in the model. Along the same lines, Table 4 illustrates the BARDL model's empirical results, which conform to the empirical insights of the previously mentioned long-run observed outcomes.

The ECM_{t-1} reveals a coefficient of 0.42. It illuminates that the "speed of adjustment" would be 42 % for attaining the long-run equilibrium in the model. Further, to authenticate the stability of the various coefficients, we have executed the stability approach after evaluating (both short and long-term) the empirical outcomes of the bootstrap ARDL method. Structural variation expedites data instability concerning time series analysis. Consequently, to confirm the estimated model's stability, it is mandatory to employ a stability test. Table 6 elucidates that the particular model is not affected by any of the econometric challenges such as heteroscedasticity, non-normal data, model specification biases, or serial correction. Moreover, CUSUM and $CUSUM_{sq}$ authenticate the long-term stability regarding the empirically estimated outcomes.

Table 6. Long-run stability test

Test	F stats	Prob
2_{Normal}	1.671	0.681
2_{Serial}	1.209	0.412
2_{ARCH}	1.276	0.522
2_{Hetero}	1.608	0.371
2_{RESET}	1.517	0.349
CUSUM	Stable	-
CUSUMSQ	Stable	-

***, **, and * confabulate the level of significance at 1%, 5%, and 10%.

Table 7. The Granger causality analysis

Null hypothesis	F stats	Prob
NR has no causation with CE	8.651	0.000
CE has no causation with NR	0.281	0.761
FT has no causation with CE	12.371	0.000
CE has no causation with FT	0.441	0.000
PS has no causation with CE	12.327	0.000
CE has no causation with PS	0.412	0.571
SG has no causation with CE	14.011	0.000
CE has no causation with SG	0.241	0.551

***, **, and * confabulate the level of significance at 1%, 5%, and 10%.

Table 7 demonstrates that all the chosen economic indicators, i.e., NR and FT, PS, and SG, tend to have uni-directional casualty for the selected time period.

5. Conclusion and policy recommendations

Globally, various economic conditions and factors influence the rate of ecological deterioration. Accordingly, the research focuses on exploring the impact of NR, FT, SG, and PS on CE for the case of a developed nation, the UK, between 2000Q1 and 2020Q4 by employing the bootstrap ARDL technique. It can be noted from the outcome that NR and SG led the nation towards surging CE, but FT and PS inclined the nation towards restricting CE.

The empirical outcomes confabulate a few insightful guidelines for policy practitioners. First, the ongoing research has elucidated that fintech is one of the pertinent factors to abate CE in the UK. Fintech can revolutionize every sphere of life, including the Earth's environment. In the modern era, due to fintech, most organizations have inclined towards digital payments, which decrease paper-based processing and payments. Fintech, therefore, put forward the reduction in CE. Policy think tanks and governments must promote fintech. There are various ways to achieve this. It includes regulatory support, i.e., the local government at the county level, which should provide tax incentives or subsidies to opt for green fintech solutions. It is also pertinent to raise public awareness at the national level through social and mass media to use fintech to reduce CE. It is better to start this process at the school level by giving knowledge-based awareness to students. We need to raise environmentally conscious adults. Another way to promote the use of fintech is

to start different projects and collaborations between fintech and environmental organizations. It will help the stakeholders to develop innovative and sustainable solutions. In addition, the financial intermediaries should provide easier access to loans for green products and services.

The empirical finding confabulates that the UK faces the "resource curse paradox ."It means that natural resources are not used efficiently, and the nation cannot harness the benefits of natural resources fully. It must be an essential step for policy practitioners to use the available natural resources efficiently. The top three natural resources in the UK are natural gas, oil, and coal. To reverse the previously mentioned connotations between NR and CE, augmenting renewable energy sources, i.e., wind, solar, hydroelectric, and geothermal power, is essential. The most significant benefit of these resources is to decrease the economy's dependence on fossil fuels. In order to promote carbon sequestration and storage, there is a need to encourage afforestation and reforestation at county levels as well as at the national level. Adopting agriculture practices that can increase carbon sequestration and abate CE is also essential. Agroforestry is one of the possible strategies in this regard.

It has become a well-known synthesis that an economy can achieve macroeconomic targets and environmental sustainability with political stability. Even though the UK is one of the most influential proponents of the Paris Agreement, it still needs to reach the promised target, and it takes more time for the nation to achieve these milestones. Unfortunately, the last two years have not been perfect concerning governments and terms. In the presence of political uncertainty or short-term governance, policy practitioners need help taking concrete steps and devising long-term plans. Politically stable nations can encourage businesses and individuals to adopt environmentally friendly technologies. Also, stable governments can focus and invest in solar parks, tidal energy, and wind farms. Therefore, it is the need of the hour to focus on political stability to achieve any target related to environmental sustainability.

In the present era of information and technology, the most essential form of globalization is social globalization. It could be used effectively to escalate interconnectedness among societies worldwide. Therefore, it is pertinent to promote “eco-friendly” social globalization in various ways. There is a need to share knowledge and technology transfer among the UK and other nations across the globe. It includes using and adopting renewable energy technologies and environmentally friendly transportation. Even though the UK has one of the best commuting systems in the world, there is still no harm in taking inspiration for eco-friendly transportation from the neighboring EU nations, especially France and Sweden. In addition, social globalization can aid cross-cultural understanding and cultural exchange, which helps raise awareness about environmental challenges and their solutions. Through social globalization, governments need to take different initiatives, for instance, corporate social responsibility and eco-labeling. Promoting and focusing on “environment friendly” social globalization also helps the UK government engage with diaspora communities and leverage their networks and expertise to raise overall awareness about climate change.

The empirical findings of the study are for the UK and similar developed nations; however, in the future, we propose to do the same kind of analysis for the EU nations as well as make two groups of nations, the developed and developing nations, and compare their outcomes for an effective and countries specific policies.

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