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Original Research

Sustaining Our World: Unraveling the Impact of Financial Inclusion, Urbanization, and Natural Resource Depletion on Environmental Degradation

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Abstract

This study examines the dynamic impact of financial inclusion (FIN), urbanization (URP), and natural resource depletion (NR) on environmental degradation (CO_2 emissions) in the group of seven economies (G7) between 2000 and 2021. The study applies TOPSIS to develop a composite index for FIN, focusing on three dimensions that determine the degree of financial inclusion. The CS-ARDL model analysis indicates that a 1% increase in financial inclusion substantially enhances environmental sustainability by reducing carbon emissions by 0.4% in the long run and 0.04% in the short run. However, a 1% increase in urbanization and natural resource depletion leads to an escalation of CO_2 emissions by 0.89% and 0.29%, respectively, in the long run, while having a relatively smaller impact on the environment in the short run. Furthermore, by testing the non-linear association between FIN and CO_2, we find the presence of a financial inclusion-based Environmental Kuznets Curve (EKC). To ensure the reliability of the result, we utilize two additional second-generation econometric models: AMG and CCEMG. The casual dimensions have revealed that FIN, URP, and NR have bidirectionally Granger caused environmental degradation. The study results discussed various policies based on the FIN, URP, and NR outcomes to improve environmental quality for sustainable development.

Keywords: environmental degradation, financial inclusion, TOPSIS, G7 economies, urbanization, natural resource depletion

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Introduction

Environmental degradation, manifested through rising global temperatures and climate change, has become a central focus for scholars and policymakers in recent decades. Global greenhouse gas emissions have risen 50% since 1990, leading to negative impacts on biodiversity, agriculture productivity, and overall environmental health. Urgent action is required to avert catastrophic climate change, making it imperative for global emissions to peak and subsequently decline within the next four years [1]. Therefore, the United Nations' Sustainable Development Goals (SDGs) and the latest COP-27 call for collaborative efforts among nations to achieve carbon neutrality [2]. Thus, environmental sustainability is taking relatively more attention in formulating inclusive growth policies, and any effort to reduce environmental degradation must include financial inclusion (FIN) measures. The concept of FIN emerged in the early 2000s, and its absence upsurge poverty. FIN fosters economic growth and plays a significant role in fighting against environmental challenges [3].

In terms of global CO_2 emissions, the Group of Seven (G7) economies contribution is approximately 28% and has allocated over $725 billion to environmentally conscious initiatives during 2020 and 2022 [4]. While the study by Bhatti et al. [5] reveals that by 2100, greenhouse gas emissions will increase in all G7 countries, the G7 has allocated only 2.58% of its fiscal stimulus to emission-reducing measures [1]. Thus, assessing financial inclusion's impact on CO_2 emissions is of significant interest to the G7, as its role in justifying climate hazards is unknown [6]. The group has agreed to cease plastic pollution by 2040, initiate the phase-out of fossil fuels, and target 150 GW of renewable energy, along with an increase of over 1TW in photovoltaics by 2030. Therefore, the action of the G7 may significantly reduce global CO_2 emissions to a greater extent.

There is a wide-standing discussion about whether, to what level, and under which settings financial inclusion, along with urbanization and natural resource depletion, can significantly reduce CO_2 emissions. These are serious policy questions, as countries have to determine whether it is imperative to rank financial inclusion and ultimately detect which kind of financial inclusion is essential to reduce CO_2 emissions. So far, the existing works have not yet come to a clear, stable conclusion regarding the degree of the effect of financial inclusion on CO_2 emissions. The difference in the results is attributed to the following reasons to a greater extent: a) method adopted (e.g., within country versus cross-country panel data analysis); b) availability of data on financial inclusion (e.g., we are still lacking data on access, usage, and quality indicators) which is limiting the facility's ability to access its impacts; and c) the financial inclusion measure chosen. As point c) is of greater importance, the available literature has been summarized based on two different ways of measuring financial inclusion: individual indicators and the composite index of FIN.

Various individual indicators of financial inclusion, such as the number of ATMs, commercial bank branches, and account holders, have been utilized as proxies for FIN to investigate their influence on environmental degradation. Ozturk and Ullah [7] conducted a study to examine the impact of ATMs and debit card usage on CO_2 emissions in One Belt and Road Initiative economies from 2009 to 2017. Likewise, Amin et al. [8] investigated the influence of nine financial inclusion measures on the CO_2 emissions of the world's top emitters from 1980 to 2014. Similarly, Ozili [9], focusing on two supply-side indicators of FIN, examined the relationship between FIN and environmental sustainability in non-EU economies and found a positive relationship. While some other studies have utilized composite indices of financial inclusion to examine the impact of FIN on environmental degradation [10, 11]. Amin et al. [8] conducted a study examining the influence of nine financial development indices developed by the International Monetary Fund on the CO_2 emissions of the world's leading emitters from 1980 to 2014. The findings derived from the quantile regression estimator suggest that financial development has varied effects on carbon emissions across different quantiles.

On the other hand, substantial evidence in the current body of literature underscores the direct impact of diverse human activities on the environment. Urbanization and natural resource depletion are argued to be essential factors determining environmental quality. According to Chen et al. [12], urbanization has a multidimensional impact on a nation's CO_2 emissions. The substantial rise in the urban population has resulted in an increased energy demand of over 15%, leading to significant environmental challenges [13]. Moreover, environmental sustainability revolves around the responsible utilization of diverse natural resources [14]. Around 80% of global energy consumption is sustained through the extraction and utilization of fossil fuels. Approximately 90% of global biodiversity loss and half of CO_2 emissions are attributed to the extensive extraction of natural resources.

From the above discussion, few empirical studies have examined the dynamic impact of financial inclusion, urbanization, and natural resource depletion on CO_2 emissions. To the best of our understanding, only Liu et al. [15] attempted to examine the influence of financial inclusion on the environmental degradation (ecological footprint) of G7 economies. However, Khan and Ozturk [16], Yang et al. [17], and Zaidi et al. [18] argue that the impact of FIN on CO_2 emissions is yet less known, and integrating urbanization and natural resource depletion in determining environmental sustainability remains relatively unexplored within the same environmental policy.

Therefore, this study is primarily motivated to fill this gap. Greater access to financial services is recognized as a vital catalyst for achieving the numerous targets outlined in the SDGs. Hence, comprehending the role of financial inclusion in mitigating environmental degradation is paramount. Particularly, the G7 economies, ranking among the top ten countries with the greatest environmental changes, have raised concerns and catalyzed this research. Therefore, the specific focus is to analyze how these factors contribute to the environmental quality of G7 economies. First, studies have often investigated the effects of FIN, NR, and urbanization on CO_2 emissions independently, with few incorporating financial inclusion, urbanization, and corruption within a unified framework. Second, although previous research has reasonably explored the influence of various socioeconomic indicators on environmental sustainability, there is limited discussion, to the best of our knowledge, on the non-linear association between financial inclusion and environmental sustainability in G7 economies.

Our study contributes to this less-explored question by examining the effect of financial inclusion, urbanization, and natural resource depletion on environmental degradation in the G7 economies. Our study emphasizes three key contributions. First, we selected eight financial inclusion indicators across three dimensions – service penetration and access, usage, and access barriers – based on quality aspects of relevance, credibility, timeliness, and accessibility. These dimensions assess the financial system's robustness from both supply and demand perspectives. The Financial Inclusion Index (FIN) is derived using the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS). TOPSIS provides four primary advantages over other weighting and aggregation methods: 1) provides a spontaneous and straightforward interpretation of results; 2) considers both positive and negative criteria; 3) TOPSIS is flexible and can be adapted to various decision-making situations by incorporating different distance metrics and normalization techniques; and 4) effectiveness. TOPSIS has been successfully applied in various fields, including finance, environmental management, engineering, and healthcare. Second, we explore the association between stated variables using second-generation CS-ARDL, and for robustness, two additional advanced estimation methods, namely, AMG and CCMG, are employed. Third, to the best of our knowledge, this is the first study that explores the non-linear association between FIN and CO_2 emissions in the case of G7. In conclusion, this study contributes significantly by computing a comprehensive composite index, employing advanced econometric techniques, extending the analysis of various factors, exploring pathways, and investigating non-linear relationships and the potential for a financial inclusion-based EKC.

The subsequent sections of this paper are structured as follows: Section two offers an in-depth exploration of the theoretical and empirical literature, presenting the development of hypotheses. Section three provides an overview of the econometric and estimation models and the research methodologies used to assess the composite financial inclusion index. Section four presents the empirical results of the study. Finally, Section 5 concludes by discussing the notable policy implications derived from the findings.

Review of Literature

Financial Inclusion and Environmental Degradation (CO_2)

Financial inclusion and CO_2 emissions have received significant scholarly attention in recent years, led by the ambition toward sustainable economic development. Financial inclusion, referring to the access and usage of formal and informal financial services, is considered a critical factor for fostering economic growth and reducing poverty [19]. It stimulates economic activity, thus facilitating the transition towards market-oriented economies. Simultaneously, this expansion in economic activity can lead to an upsurge in energy consumption and potentially contribute to increased CO_2 emissions, posing challenges to environmental sustainability. Many scholars have argued about the casual association between financial inclusion, human development, economic growth, and environmental sustainability [15, 20-22]. According to Wang et al. [23], a strong and direct link exists between financial development and economic growth, suggesting that financial inclusion contributes to environmental degradation. On a related note, Alfalih and Hadj [24], focusing on both low and high-regime scenarios, examine the correlation between financialization, sustainability, and natural resources. In a recent study by Liu et al. [15], examining the nexus between financialization and sustainability concerns of the G7 over the last two decades, they argued that FIN significantly contributes to sustainability challenges. In their study, Amin et al. [8] studied the impact of nine different proxies for financial development (FIN) on the carbon emissions of the world's top ten emitters within the framework of the Environmental Kuznets Curve (EKC). Their study suggests a mixed association between FIN and carbon emissions. Similarly, Khan et al. [25] conducted a study to examine the complex relationship among energy consumption, financial development, and ecological footprints in the Belt and Road Initiative (BRI) region. Their study provides compelling evidence supporting four key hypotheses: finance push emissions, pollution heaven, the Environmental Kuznets Curve (EKC), and energy push emissions. Contrarily, certain scholars argue that financial inclusion can play a pivotal role in promoting the attainment of carbon neutrality and carbon peak. The study of Usman et al. [26], investigating the correlation between financial development and environmental degradation within the top 15 largest emitters, reveals that there are negative associations between the study variables, implying that financial inclusion may play a role in mitigating environmental degradation. In addition, Liu et al. [27] and Chaudhry et al. [28] also verified the adverse influence of financial development on CO_2 emissions in the top five Asian emerging economies and OIC countries, respectively. Based on the above discussion, H1 is proposed.

H1: Higher levels of financial inclusion positively influence the environmental degradation (CO_2 emissions) of the G7.

Natural Resource Depletion and CO_2

The importance of natural resource depletion in relation to the impact of fiscal decentralization and financial inclusion on environmental sustainability has been overlooked in existing literature [20]. Dhiaf et al. [29] proposed that it is possible to achieve substantial reductions in environmental impact by effectively managing waste and optimizing the utilization of natural resources. In recent literature, Danish and Khan [30] investigate the factors influencing environmental sustainability, considering natural resources and other economic indicators. The findings strongly support the idea that natural resources are pivotal in mitigating environmental degradation within the BRICS region. Moreover, these results align with the well-established concept of the environmental Kuznets Curve. Zafar et al. [31] undertook a research endeavor centered on the US economy to explore the significance of natural resources for the environmental footprint (EFP) from 1970 to 2015. The empirical findings provide evidence that the decrease in environmental footprint in the US economy is linked to the presence of natural resources.

On the contrary, Nathaniel et al. [32], found that within the BRICS region, both natural resources and economic growth contribute to a rise in the ecological footprint. Ahmed et al. [33] investigated the dynamic relationship between natural resource depletion and environmental pollution in emerging economies from 1984 to 20 using the second-generation estimation technique. Their findings confirm that natural resources are ineffective in sustaining environmental pollution. Similarly, Yi et al. [34] studied the environmental concern of the US economy; findings indicate that both in the long-term and short-term, the depletion of natural resources has been a driving factor for increased CO_2 emissions. Gupta et al. [35] emphasized that economic development triggers a surge in the demand for natural resources, leading to a range of environmental risks. The findings highlight that technological advancements, sustainable utilization, and responsible management of natural resources play a significant role in curbing EFP and addressing environmental issues, such as haze pollutants like PM2.5. In Emir and Karlilar's [36] research, the focus is shifted towards examining the utilization of hydropower energy as well as the interplay between natural resources and the environment within the Turkish economy. This study utilizes the newly developed residual least squares (RLS) estimation method. The results underscore a significant and favorable relationship between natural resources and environmental footprint (EFP) in the Turkish context. According to Hussain et al. [13], the exhaustion of natural resources directly affects both CO_2 emissions and energy consumption. Specifically, the study demonstrates that a 1% rise in the depletion of natural resources within countries involved in the Belt and Road Initiative (BRI) corresponds to a 0.0286% increase in CO_2 emissions and a 0.012% increase in energy utilization. Based on these studies, we have developed H2.

H2: Natural resource depletion positively influences environmental degradation (CO_2 emissions) in the G7.

Urbanization and CO_2 Emission

Over the past few decades, considerable efforts have been made to examine the effects of urbanization on the environment. In theory, the influence of urbanization on carbon dioxide (CO_2) emissions is contingent upon the mechanisms by which urbanization affects environmental sustainability. The direct effect of urbanization can either decrease or increase environmental degradation due to economic expansion while simultaneously leading to reductions in environmental pollution through advancements in knowledge and technology. According to Wang et al. [37], a nonlinear association between urbanization and CO_2 emissions is characterized by an inverted U-shape. The relationship between urbanization and environmental quality is also contingent upon the economic development stage of the host nation. The impact of urbanization on environmental quality is rationalized and delineated by the particular phase of economic advancement [38]. Examining the impact of urbanization from 1996 to 2018 on CO_2 emissions in China's economy, Lee et al. [39] investigated how foreign direct investment reshapes the causal relationship between urbanization and CO_2 emissions. The result indicated that a rise in urbanization increases CO_2 emissions, but after achieving a certain level of foreign capital, this effect becomes weaker; they also found that with a more developed financial system and government sector, urbanization helps to reduce environmental degradation.

Luqman et al. [40] scrutinize CO_2 emissions in 91 cities, dissecting the trends by examining the influences of urban extent, population density, and per capita emissions. Their findings demonstrate that although urban CO_2 emissions are on the rise worldwide, the primary contributors differ depending on the level of development. Developing countries witness rapid growth in urban areas and per capita emissions; developed countries exhibit slower growth rates, while developed countries exhibit slower growth. Bhatti et al. [41] explored how changes in socioeconomic factors, such as urbanization, affect primary air pollutant particulate matter, suggesting that there is a positive correlation. The impact of urbanization and economic growth on carbon emissions is exacerbated when there is a U-shaped relationship between CO_2 and growth [42]. Likewise, Cheng and Hu [38] mployed the STIRPAT model to investigate the effects of China's urbanization on CO_2 emissions from 1997 to 2018. Their results indicated that both urbanization and urban sprawl have increased CO_2 emissions. Thus, based on these studies, we proposed H3.

H3. Urbanization positively influences environmental degradation (CO_2 emissions) in G7.

Data, Variables, and Econometric Model

Data and Variables

Drawing upon previous research examining the influence of diverse indicators on environmental quality, measured by CO_2 emissions per capita in metric tons, this study has compiled data pertaining to multiple factors affecting environmental quality. These factors encompass financial inclusion, natural resource depletion, urbanization, corruption, industrial growth, and economic growth. Data on these indicators for G7 economies was collected and compiled to explore the relationship among the variables under investigation. The study utilizes balanced panel data annually, covering 2000-2021. Moreover, detailed information regarding the data description and measurement of financial inclusion is provided in Appendix A1.

Methodology

Theoretical Framework and Estimation Strategy

Based on the existing body of literature, we have developed a comprehensive theoretical framework that postulates the relationship between various factors and environmental quality, measured explicitly by CO_2 emissions. This framework considers financial inclusion (FIN), urbanization (URP), natural resource depletion (NR), economic growth (GDPP), industrial growth (IND), and corruption (CORP) as critical determinants shaping the environmental quality of G7 economies. Therefore, financial inclusion may affect environmental quality through various economic activities, such as trade, agriculture, investment, industrial productivity, etc. Economic activities are facilitated by the enormous use of natural resources, which directly influence the environment. According to the Environmental Kuznets curve scale effect, an increase in GDP reduces green growth at the initial stage of development because it requires extensive use of natural resources. In the context of sustainable development goals, the discussions surrounding the impact of financial inclusion have become increasingly complex in recent years. As a result, it is crucial to forecast the policy direction that will guide initiatives in financial inclusion, considering theoretical perspectives related to carbon emissions. By doing so, we can effectively align efforts toward achieving sustainable development objectives [18].

The Calculation Technique of the G7 Financial Inclusion Index

The objective of this section is to use an effective and efficient technique to compute the financial composite index for G7 economies. In this regard, a comprehensive analysis of different indexing methods has been conducted, including factor analysis, the variance coefficient method, the improved entropy method [18, 21], and the Technique for Order of Preference by Similarity to the Ideal Solution (TOPSIS) method. Each approach has been considered and evaluated to determine its suitability for the task at hand. Considering the objective weighting impact of the TOPSIS method on the available indicators, we employed TOPSIS to compute the composite index of FIN for the G7 nations. TOPSIS has found extensive applications in diverse domains of Multiple Attribute Decision Making with more than 13000 citations due to its robust mathematical foundation, simplicity, and ease of application, and it has been widely used in decision-making [43]. We calculate the FIN index using the following steps:

First, we used the Mini-Max Normalization method, considering the effect of each indicator on financial inclusion and ensuring the contribution of each indicator to the composite index. The missing values are obtained by interpolation.

a) For dimensions with positive impact:

$$\mathrm{NV_{ij}} = \frac{\mathrm{X_{ij}} - \min\left(\mathrm{X_{1j}}, \ldots\ldots, \mathrm{X_{ij}}\right)}{\max\left(\mathrm{X_{1j}}, \ldots\ldots, \mathrm{X_{ij}}\right) - \min\left(\mathrm{X_{1j}}, \ldots\ldots, \mathrm{X_{ij}}\right)} \quad (1)$$

b) For dimensions with negative impact:

$$\mathrm{NV_{ij}} = \frac{\max\left(\mathrm{X_{1j}}, \ldots\ldots, \mathrm{X_{ij}}\right) - \mathrm{X_{ij}}}{\max\left(\mathrm{X_{1j}}, \ldots\ldots, \mathrm{X_{ij}}\right) - \min\left(\mathrm{X_{1j}}, \ldots\ldots, \mathrm{X_{ij}}\right)} \quad (2)$$

Where NV_{ij} is the normalized value of the Xi indicator of the jth country, unlike PCA, a linear dimensionality reduction technique, TOPSIS does not assume linearity and can capture complex relationships effectively. TOPSIS evaluates the relative performance of each dimension and assigns weights based on their proximity to an ideal solution. It calculates the distance between each dimension and the ideal solution (the maximum or minimum value, depending on the nature of the dimension). The calculation process comprises various stages through the following system of equations:

The study obtained performance ratings denoted as *yij*(= 1, 2, ..., *I; j* 1, 2, ..., *J*). These ratings were then used to construct the performance rating matrix Y.

$$Y = \begin{bmatrix} y_{11} & y_{12} & \cdots & y_{1j} \\ y_{21} & y_{22} & \cdots & y_{2j} \\ \cdots & \cdots & \cdots & \cdots \\ y_{I1} & y_{I2} & \cdots & y_{Ij} \end{bmatrix} \quad (3)$$

$$\text{and } v_{ij} = W_j * x_{ij};\ (i = 1,2 \ldots . I; j = 1,2, \ldots .. J) \quad (4)$$

Where $x_{ij} = \frac{y_{ij}}{\sqrt{\sum_{i=1}^{I} y_{ij}}}$ and W_j is the weight of jth indicators included in the financial inclusion system of G7. Then, after calculating the distance of each alternative from positive and negative ideal solutions by applying Euclidean distance theory, the final composite index is obtained through Equation (5).

$$V_i = \frac{S_i^-}{S_i^- - S_i^*} \quad (5)$$

Model and Estimation Strategy

To examine the impact of financial inclusion, urbanization, and natural resource depletion on the environmental quality of G7 economies, this study presents the following proposed model:

$$CO2_{it} = \alpha_o + \alpha_1 FIN_{it} + \alpha_2 GDDP_{it} + \alpha_3 URP_{it} + \alpha_4 NR_{it} + \alpha_5 IND_{it} + \alpha_6 CORP_{it} + \mu_{it} \quad (6)$$

Where *α's* are the slopes of the explanatory variables, "i" represents the cross sections (G7), followed by "t" shows the period from 2000 to 2021. Equation (6) reveals that environmental degradation is a function of FIN. GDPP, URP, NR, IND, and CORP. We have derived Equation (7) by squaring the variable FIN in Equation (6) in order to estimate the non-linear impact of financial inclusion on the environmental conditions within the G7 nations. The squared value of FIN may result in either a positive or negative effect on CO_2 emissions.

$$CO2_{it} = \beta_o + \beta_1 FIN_{it} + \beta_2 (FIN)^2{}_{it} + \beta_3 GDDP_{it} + \beta_4 URP_{it} + \beta_5 NR_{it} + \beta_6 IND_{it} + \beta_7 CORP_{it} + \Omega_{it} \quad (7)$$

Strategic Approach for Estimation

Step 1: Cross-Sectional Dependency and Slope Homogeneity

Given the significance of cross-sectional dependence and slope homogeneity in panel data analysis, real-world linkages encompass a range of channels, including economic, political, and social, along with others like cooperative activities and bilateral trade within the governance structure. Therefore, before estimating the coefficients, it is crucial to determine the presence of CSD in the selected variables, following the slope homogeneity test across panels. To address this issue, we employed Breusch and Pagan's LM and Pesaran et al.'s [44] test using Equations (8) and (9), respectively. The following procedure outlines the analysis process.

$$the\ ICD_{lm} = T \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \hat{\rho}^2{}_{ij} \quad (8)$$

$$CD = \sqrt{\frac{2T}{N(N-1)}} \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} \hat{\boldsymbol{\rho}}_{ij} \quad (9)$$

where $\hat{\boldsymbol{\rho}}_{ij}$ is the sample estimate of the pair-wise correlation residuals. T represents the time, while N represents the cross sections. In Equation (10), t and i denote time and cross-sections. As a result, the relationship between stochastic variation is determined. Using Equation (9) the cross-sectional dependence of Pesaran et al. [44] is calculated, and Equation (8) along with Equation (10) is used to get the result of the Breusch and Pagan Lagrange multiplier (LM) test. In both tests, the null hypothesis of "No CD" is tested. If the p-values of both tests are significant at a 5% threshold, it provides sufficient evidence to reject the null hypothesis against the alternative hypothesis. The results of the CD and LM tests can be found in Table 3.

$$y_{it} = \alpha_{it} + \Omega_{it} x_{it} + \varepsilon_{it} \quad (10)$$

Step 1.1. Slope Homogeneity Test

When analyzing panel data, assessing the uniformity of slopes across countries is essential, as assuming slope homogeneity can lead to misleading results. The outcomes of the slope homogeneity test are presented in Table 4. The null hypothesis for slope homogeneity is "No slope homogeneity" tested. For robustness, this study uses Blomquist and Westerlund [45], which is an extension of Pesaran and Yamagata [46] and was developed by relaxing the assumptions of heteroskedasticity and autocorrelation. This test demonstrates a restrictive N (0,1) distribution. Our results from a modest Monte Carlo simulation indicate minimal size distortion across all examined trials while maintaining satisfactory statistical power. Therefore, this test represents a valuable addition to the existing range of homogeneity tests.

$$S = \sum_{i=1}^{N} (\alpha_i - \alpha_{WFE}) \frac{\acute{X}_i M_t X_i}{\sigma_i^2} (\alpha_i - \alpha_{WFE}) \quad (11)$$

$$\bar{\Delta} = \frac{1}{\sqrt{N}} \left(\frac{N^{-1} S - K}{\sqrt{2k}} \right) \quad (12)$$

$$\bar{\Delta}_{adj} = \sqrt{N} \left(\frac{N^{-1} S - K}{\sqrt{\frac{2k(t-k-1)}{r+1}}} \right) \quad (13)$$

From the above equations, *S* is the Swamy *t* statistics, $\bar{\Delta}_{adj}$ and $\bar{\Delta}$ are the biased adjusted values of Δ and test statistics, and α_i represents the weighted fixed effect following the coefficient of Pooled OLS α_{WFE} of the Pooled estimator.

Step 2: Unit Root Test

Primary versions of unit root tests do not accommodate cross-sectional interdependence and slope variability when conducting panel data analysis. Consequently, it is crucial to conduct unit root tests to ensure that the estimated models account for stationarity and prevent spurious regression. To tackle the problem of non-stationarity, this study utilizes the LLC unit root test developed by Levin et al. [47]. Furthermore, the study utilizes the CIPS technique proposed by Pesaran [48] to address the issues of CD and SH. Both tests are conducted to evaluate the null hypothesis of a unit root against the absence of a unit root.

Step 3: Panel Cointegration Test

Unit root tests serve two primary purposes. First, they determine whether the variables under consideration are integrated at level I (0) or first difference I (1). The standard OLS estimation can be applied with I (0). Second, the first generation's econometric model cannot be used when the variables are integrated at the first difference. In this case, it becomes compulsory to validate the existence of cointegration before estimating the coefficients. This study utilizes the test proposed by Westerlund [49] along with other cointegration approaches, i.e., Kao [50] and Pedroni [51, 52], which account for CD and SH to examine the long-run relationship among the variables of interest. Table 6 tabulates the findings of the cointegration tests.

Step 4: CS-ARDL

Following the unit root test and cointegration results, we utilized the CS-ARDL model, a second-generation econometric model introduced by Chudik and Pesaran [53], to examine the short-term dynamics and long-term associations among the variables under investigation. Moreover, the CS-ARDL methodology provides a significant advantage by incorporating the unrestricted ECM obtained from the ARDL regression. This feature enables a distinct differentiation between the shorter-term and longer-term dynamics within the model, enhancing the analytical capabilities of the study. The CS-ARDL model can also establish the relationship between endogenous and exogenous variables. It allows for lagged dependent variables, lagged independent variables, and other exogenous variables to be included in the model. Including lagged variables captures the dynamics and potential feedback effects between the variables. Table 7 presents the result of CS-ARDL. The equation form below presents the CS-ARDL model:

$$\Delta CO2_{it} = \beta \Delta A_{it} + \sum_{t=2}^{T} C_t \Delta D_t + \delta_{it} \rightarrow \hat{C}_t = \hat{\delta}_t \tag{14}$$

$$CO2_{it} = \partial_i + \beta_i^{\cdot\cdot} A_i + C_i + D_i \hat{\delta}_t + \delta_{it} \hat{\beta}_{AMG} = N^{-1} \sum_i \hat{b}_i \tag{15}$$

Step 5: Robustness Test AMG and CCEMG

To ensure the robustness of the CS-ARDL estimation, the study incorporates the CCEMG developed by Pesaran [54] and the AMG estimator proposed by Eberhardt and Bond [55]. These methods exhibit superior performance in estimating, even when faced with unit root issues and unknown common factors. The CCEMG method is particularly advantageous as it allows for the inclusion of heterogeneous slope coefficients among group members. On the other hand, the AMG estimator serves as an alternative to CCEMG and effectively accounts for unobserved common effects within the model. It calculates group-specific estimates and obtains a straightforward average across the panel. The utilization of the Common Correlated Effect Mean Group considers the interdependence of variables across all cross-sections, thus eliminating cross-sectional dependence spillovers. The results of the robustness analysis are presented in Table 8.

Step 6: Analysis of Causality

Given that the CS-ARDL model cannot determine the direction of causality, it is essential to employ the methodology proposed by Dumitrescu and Hurlin [56] to explore the causal dimensions. This methodology differentiates coefficients across cross-sections beyond the conventional Granger Causality Test. The significance of conducting a causal analysis in this study cannot be overstated, as the failure to do so raises concerns regarding the logical outcomes and practical implications for policymaking. To account for cross-sectional dependence, the study employs the Dumitrescu and Hurlin [56] methodology, which encompasses two tests: $\bar{W}$ and $\bar{Z}$. The null hypothesis assumes there is no causal relationship between the variables. Rejecting this null hypothesis suggests the existence of either unidirectional or bidirectional causal connections between the variables.

Results and Discussion

Table 1 presents the summary of statistics for the chosen variables, serving as an initial step in the analysis. Regarding CO_2 emissions, the average estimate for the G7 countries is 10.171 metric tons per capita, with a standard deviation value of 4.481. FIN has an average of 0.571 with an SD of 0.234, natural resource depletions have a minimum average of 0.368, and GDPP has the highest among the variables. Table 2 shows a significantly positive correlation among CO_2 and GDPP, URP, IND, and CORP. CO_2 and GDPP have a more robust correlation with a value of 0.639, while CO_2-FIN has a negative correlation, which supports the study of Liu et al. [15].

To avoid drawing misleading conclusions and proposing ineffective policy measures, it is crucial to account for cross-sectional dependence (CD). Relying solely on conventional, first-generation econometric models may lead to irrelevant outcomes. Thus, the examination begins with tests for CD and slope homogeneity (SH). The test results are presented in Table 3 for CD and Table 4 for SH. The findings indicate that the presence of CD in the series cannot be rejected, suggesting considering cross-sectional dependencies. Additionally, we tested both models specified in Equations (6) and (7) for slope homogeneity. We found evidence to support the alternative hypothesis of heterogeneous slopes using the approaches proposed by Pesaran and Yamagata [46] and Blomquist and Westerlund. This confirms that the slopes across the models are not uniform.

After evaluating the presence of cross-sectional dependence (CD) and slope homogeneity (SH), the study conducted appropriate tests for unit roots and cointegration. The LLC and CIPS tests were employed to examine unit roots, and the outcomes are detailed in Table 5. The results indicate that the series exhibit unit roots in their levels but become stationary after differencing. Armed with this understanding, the next step involves conducting panel cointegration tests to obtain more robust insights into the aspects mentioned earlier. We employed both first and second-generation cointegration methodologies, namely Kao [50], Pedroni [51, 52], and Westerlund [49]. The results of these tests are summarized in Table 6. The empirical evidence provided by these approaches strongly supports the alternative hypothesis of cointegration, leading us to reject the null hypothesis. This confirms the existence of long-term associations among the considered variables in the G7 economies from 2000 to 2021.

Then we utilized the CS-ARDL estimation method for Equations (6) and (7), introduced by Chudik and Pesaran (2015). Analyzing the results presented

Table 1. Summary Statistics.

		Mean	SD	Median	p25	p75	99th Perc.
CO_2	154	10.171	4.481	9.063	6.328	15.421	20.172
FIN	154	0.571	0.234	0.629	0.422	0.735	1.002
GDPP	154	40024.834	7435.613	38269.006	34183.664	43536.914	60698.012
URP	154	79.349	5.834	79.948	77.13	81.57	91.782
NR	154	0.368	0.603	0.077	0.015	0.526	2.642
IND	154	23.135	4.191	22.452	19.284	27.011	30.981
CORP	154	1.442	0.543	1.560	1.283	1.824	2.255

Note: Table 1 shows the summary of descriptive statistics of the dependent, independent variables. All variables are defined in Appendix 1.

Table 2. Pairwise correlations.

Variables	CO_2	FIN	GDPP	GDPP	URP	IND	CORP
CO_2	1.000						
FIN	-0.098*	1.000					
GDPP	0.629*	-0.102	1.000				
URP	0.290*	0.002	0.282*	1.000			
NR	0.282*	-0.191	0.294*	0.071	1.000		
IND	0.260*	-0.076	-0.377*	0.175*	0.273*	1.000	
CORP	0.384*	-0.195*	0.361*	**0.538***	0.387*	0.193*	1.000
VIF		1.17	1.78	1.68	1.59	1.5	1.36
1/VIF		0.84	0.56	0.59	0.66	0.67	0.74

Note: Table 2 shows the Pairwise correlations result of dependent and independent variables. *, ** and *** show significance at 10%, 5% and 1%, respectively. All variables are defined in Appendix 1.

in Table 7 for Equations (6) and (7), in the CS-ARDL model, the coefficient of the Error Correction Term (ECT) quantifies the rate at which the lagged dependent variable (CO_2) adjusts or corrects itself. The negative value of the ECT (-0.093) confirms the existence of a tendency for long-run correction. Furthermore, it is statistically significant at the 1% level, indicating that the gap adjustment will be completed within a year at a speed of 9% in the long run if the model exhibits disequilibrium. Furthermore, the result reveals that all

Table 3. Cross-Sectional Dependence Tests.

Variable	Breusch-Pagan LM	Pesaran scaled LM	Pesaran CD
CO_2	821.831***	39.437***	18.275***
FIN	618.301***	77.477***	33.167***
GDPP	652.812***	29.523***	12.609***
URP	745.109***	33.868***	14.755***
FRR	786.587***	40.936***	17.503***
IND	336.599***	56.582***	22.793***
CORP	836.510***	68.926***	35.553***

Note: Table 3 shows the three different Cross-Sectional Dependence Tests, Breusch-Pagan LM, Pesaran scaled LM, and Pesaran CD. *, ** and *** show significance at 10%, 5% and 1%, respectively. All variables are defined in Appendix 1.

Table 4. Slope Homogeneity tests.

Pesaran and Yamagata 2008			Blomquist and Westerlund 2013		
	Value	P value		Value	P value
Linear Model					
$\tilde{\Delta}$	7.192***	0.000	$\tilde{\Delta}_{HAC}$	3.263***	0.043
$\tilde{\Delta}adj$	9.015***	0.000	$(\tilde{\Delta}_{HAC})_{adj}$	4.7***	0.006
Non-linear Model					
$\tilde{\Delta}$	7.231***	0.000	$\tilde{\Delta}_{HAC}$	3.353***	0.033
$\tilde{\Delta}adj$	9.065***	0.000	$(\tilde{\Delta}_{HAC})_{adj}$	4.772***	0.005

Note: The p-values are marked with *** are 1% level of Significance. $\tilde{\Delta}_{HAC}$ and $(\tilde{\Delta}_{HAC})_{adj}$ Denote the „Heteroscedasticity and Autocorrelation Consistent" variants of the slope homogeneity tests as the „simple" and „mean-variance bias adjusted" versions, respectively.

Table 5. Unit Root Tests.

Variable	LLC		CIPS	
	At level	At Ist differece	At level	At Ist differece
CO_2	−4.229***	−10.550***	−4.504***	−5.927***
FIN	-4.7522**	-7.3255***	−4.284***	−6.284***
GDPP	-3.1353	-9.7608***	−3.944	−5.210***
URP	-13.6496	-9.7608**	−3.843***	−5.028***
NR	8.0060	-10.8490**	−4.109***	−5.760***
IND	−5.144***	−8.992***	−4.21***	−5.762***
CORP	-9.7199	-12.9748	−4.002***	−5.882***

Note: Table 5 shows the unit root test results of cross-sectionally augmented Im-Pesaran-Shin (CIPS) and Levin, Lin, and Chu (LLC). *, ** and *** show significance at 10%, 5% and 1%, respectively.
All variables are defined in Appendix 1.

Table 6. Cointegration results.

(Pedroni, 1999, 2004)					
Within-dimension	Statistics	Prob.	Between-dimension	Statistic	Prob.
Panel v-Statistic	-0.341	0.633	Group rho-Statistic	2.883	0.998
Panel rho-Statistic	1.843	0.967	Group PP-Statistic	-4.019***	0.000
Panel PP-Statistic	1.843***	0.000	Group ADF-Statistic	-2.648***	0.004
Panel ADF-Statistic	-1.563**	0.0590	(Westerlund, 2007)		
				Z-Value	P-Value
	(Kao, 1999)		Gt	-2.452	0.000
	t-Statistic	Prob.	Ga	3.170	0.654
ADF	-2.362	0.027	Pt	-1.057	0.000
			Pa	-0.574	0.998

Note: Table 6 shows Cointegration tests results. *, ** and *** show significance at 10%, 5% and 1%, respectively. All variables are defined in the Appendix 1.

explanatory variables (FIN, GDPP, URP, NR, IND, and CORP) correlate statistically significantly with CO_2 emissions. The positive coefficients of GDPP, URP, NR, IND, and CORP in the short run and long run show that the increase in these variables contributes to CO_2 emissions; these results align with the theory and existing extensive literature.

This study's findings reveal a statistically significant negative correlation between financial inclusion and CO_2 emissions, which is consistent with the results reported by Usman et al. [26]. However, this finding contradicts the findings of Liu et al. [15], who assessed financial inclusion using financial development and sustainability through ecological footprint. A long-term increase of 1% in FIN leads to a significant decrease of 40% in CO_2 emissions, while in the short term, it results in a 3% reduction. These findings imply that a more robust financial system, as indicated by higher financial inclusion, significantly improves environmental quality, explicitly reducing CO_2 emissions, in the G7 economies. The inverse relationship between FIN and CO_2 emissions further supports the notion that greater financial inclusion in G7 economies is environmentally sustainable and effective for promoting green growth. This relationship is validated by the negative coefficient of financial inclusion, a promising finding within the G7 context. It suggests that the development of economic systems plays a crucial role in mitigating CO_2 emissions, emphasizing the potential of financial initiatives to contribute to environmental sustainability. The outcomes underscore the importance of financial policies and strategies in promoting sustainable environmental outcomes. Based on these findings, we reject the null hypothesis suggesting a positive impact of financial inclusion on carbon emissions. This indicates that G7 countries have a robust financial system that supports carbon neutrality, sustainable development, and green growth.

As financial inclusion increases, investors become more influential, leading companies to adopt socially responsible practices and stricter investment decision-making processes. This creates incentives for companies to engage in environmentally-friendly practices and pursue green innovations, which not only attracts private investments but also leads to a significant reduction in CO_2 emissions. Consequently, financial inclusion can play a crucial role in accomplishing development, adaptation, and mitigation objectives.

Our primary focus is on the FIN and non-linear forms of financial inclusion (FIN^2). The coefficient of FIN^2 has a positive impact on carbon emissions, e.g. $\frac{\partial CO2}{\partial FIN^2\, it} > 0$, as shown in Table 7, indicates the U-shaped relationship between $CO2$ and FIN. The presence of a negative linear coefficient and a positive quadratic coefficient indicates the existence of a U-shaped relationship, Tariq and Xu [57], and an inverted U-shaped relationship if the quadratic coefficient of FIN is negative and the linear coefficient is positive, Renzhi and Baek [58]. More analytically, it means an increase in financial inclusion (FIN) downturns CO_2 emissions. The FIN^2 demonstrates statistical significance in both the short run and long run, with a significance level of 5%. The finding supports the study of Renzhi and Baek [58] on the existence of an EKC between FIN and CO_2 emissions in G7 countries. The existence of a financial-based EKC, U-shaped relationship suggests that, to a certain point, the improved financial system of developed countries supports reducing CO_2 emissions due to improved access to sustainable financing and increased awareness of environmental issues. However, the quadratic coefficient indicates that there is a turning point or threshold beyond which further increases in FIN cause an increase in environmental degradation. Conversely, the alternate perspective reveals that the depletion of natural resources significantly and positively impacts environmental degradation in G7 economies. This finding aligns with the research conducted by Byaro et al. [59] and Khan et al. [60], which suggests that the overuse of natural resources can lead to environmental harm and contribute to increased carbon dioxide emissions in G7 countries. The outcomes of CS-ARDL demonstrate that an increase of 1% in natural resource depletion leads to an increase in carbon emissions in G7 economies in both time frames in the long run and short run by approximately 29% and 19%, respectively.

Shifting our focus to the influence of URP on environmental degradation, the coefficient of urbanization exhibits a positive and statistically significant relationship, both in the long-term and short-term analyses, at a significance level of 5%. This finding suggests that urbanization has a positive impact on CO_2 emissions. The coefficient value implies that a 1% increase in URP in the G7 increases CO_2 emissions by 89% and 28% in the long run and short run, respectively. The findings aligned with those of Chen et al. [12].

An intriguing observation arises from the empirical findings, as both the long-term and short-term results demonstrate positive associations with GDPP, IND, and CORP. Specifically, a 1 percent change in industrial development relates to an 18% long-term increase, and corruption exhibits a 52% long-term increase in CO_2. In the short term, the corresponding increases are 14% for industrial development and 42% for corruption. The results follow the existing body of literature from Liu et al. [27], Tariq and Xu [57], and Zaidi et al. [18], providing further confirmation and consistency.

To validate the results obtained from CS-ARDL, we use two additional second-generation estimation techniques, CCEMG and AGM. The outcomes presented in Table 8 align with the results derived from the CS-ARDL methodologies, affirming the robustness of our empirical findings. The results of the Pairwise Dumitrescu Hurlin Panel Causality Test are displayed in Table 9. This test addresses the limitations of traditional causality tests, which are inadequate when confronted with cross-sectional dependence and varying slopes within the data. Therefore, we employ the Dumitrescu Hurlin Panel Causality Test, which efficiently identifies causal relationships while considering cross-sectional correlation and slope heterogeneities. Moreover, understanding the direction of causality is crucial for policymakers to guide the formulation of effective policies [33]. The results reveal that CO_2 emissions are mutually influenced by FIN, GDDP, URP, NR, and IND, whereas CORP exhibits no causal relationship with CO_2. Furthermore, GDDP, NR, and IND show bidirectional causality with FIN, while CORP and URP have a unidirectional relationship with FIN. Interestingly, URP demonstrates bidirectional causality

Table 7. CS-ARDL Estimations, Dependent Variable CO_2.

Variables	Long Run		Variables	Short Run	
	Linear	Non-Linear		Linear	Non-Linear
FIN	-0.401***	-0.216**	ΔFIN	-0.032**	-0.040**
	(0.025)	(0.009)		(0.003)	(0.006)
FIN^2		0.791**	ΔFIN^2		0.178**
		(0.205)			(0.019)
GDPP	0.980**	0.151	ΔGDPP	0.698**	0.231
	(0.120)	(0.162)		(0.110)	(0.025)
URP	0.899**	0.981**	ΔURP	0.281**	0.018**
	(0.110)	(0.069)		(0.019)	(0.009)
NR	0.290**	0.392**	ΔNR	0.191**	0.031**
	(0.018)	(0.055)		(0.040)	(0.001)
IND	0.183**	0.221*	ΔIND	0.145**	0.066
	(0.026)	(0.070)		(0.012)	(0.193)
CORP	0.525**	0.798***	ΔCORP	0.420**	0.237**
	(0.043)	(0.126)		(0.027)	(0.072)
			ECT (-1)	-0.093** (0.021)	-.0781*** (0.013)

Note: Table 7 shows Cross-Sectionally Augmented Auto Regressive Distributed Lagged (CS-ARDL) long and short run estimations of the impact of financial inclusion and carbon emissions. *, ** and *** show significance at 10%, 5% and 1%, respectively. All variables are defined in the Appendix 1.

Table 8. Robustness results of CCEMG and AMG Estimations.

Variables	Coefficient	St-Errors		Coefficient	St-Errors
CCEMG Results			AMG results		
FIN	-0.071***	0.018	FIN	-0.089**	0.020
GDDP	0.310***	0.010	GDDP	0.420***	0.021
URP	0.691**	0.281	URP	0.130***	0.115
NR	0.458***	0.575	NR	0.169***	0.894
IND	0.149**	0.110	IND	0.003**	0.073
CORP	0.786**	0.161	CORP	0.621***	0.219
Constant	5.808***	1.978	Constant	3.240**	1.978

Note: Table 8 reports the Common Correlated Effects Mean Group (CCEMG) and Augmented Mean Group (AMG) model of the impact of financial inclusion and carbon emissions. *, ** and *** show significance at 10%, 5% and 1%, respectively. All variables are defined in the Appendix 1.

Table 9. Panel causality results.

Variables	CO_2	FIN	GDPP	URP	NR	IND	CORP
CO_2	…	3.48(0.05)	4.16(0.07)	9.12(0.00)	4.05(0.09)	4.49 (0.03)	2.10(0.84)
FIN	5.89(0.00)	…	5.46 (0.06)	13.56(0.00)	8.76(0.03)	6.20 (0.08)	4.69(0.01)
GDPP	6.30(0.01)	8.45(0.02)	…	6.39(0.00)	**3.05(0.48)**	4.28 (0.05)	**2.41(0.92)**
URP	6.33(0.00)	**3.71(0.17)**	4.84(0.01)	…	**2.99(0.51)**	4.88 (0.01)	8.63(0.00)
NR	7.75(0.00)	10.31(0.00)	8.73(0.00)	9.27(0.00)	…	4.64(0.03)	6.62(0.00)
IND	4.19 (0.07)	5.52(0.00)	6.80(0.00)	5.52(0.00)	**1.14(0.25)**	…	7.03(0.00)
CORP	**2.05(0.80)**	**3.58(0.21)**	**1.69(0.55)**	9.68(0.00)	**1.68(0.53)**	**2.96(0.52)**	…

Note: Table 9 shows Pairwise Dumitrescu Hurlin Panel Causality Tests. Values in parenthesis are probability values of Wald test of panel causality test

with all the variables under study. CORP, on the other hand, lacks any causal relationship with CO_2 and GDDP entirely. Similarly, CO_2 and FIN reciprocally contribute to the depletion of natural resources in the G7 countries. Alongside these significant causal connections, we also examine additional relationships between variables, such as the unidirectional causality between corruption and GDP.

Conclusion and Policy Implication

The primary objective of this study was to evaluate the dynamic influence of financial inclusion, urbanization, and natural resource depletion on CO_2 emissions in G7 economies from 2000 to 2021. Analysis reveals that an increase in financial inclusion leads to a significant reduction of 40% in CO_2 emissions in the long run and a 3% reduction in the short run. Corruption, economic growth, and industrial growth were incorporated to account for their potential effects as control variables. One percent increase in GDPP, URP, NR, IND, and CORP raises CO_2 emissions by 0.98%, 0.89%, 0.29%, 0.18%, and 0.53%, respectively. This highlights the need for policymakers and the state to enhance the financial system in alignment with the SDGs outlined in Agenda 2030 of the UNs. Strong actions and attention are required to mitigate these environmental concerns effectively.

The study offered two distinct outcomes. First, financial inclusion does not contribute to environmental degradation through CO_2 emissions in G7 economies. Therefore, G7 economies should prioritize and promote financial inclusion to achieve sustainable development goals. Based on this finding, the study recommends that countries devise and implement financial agreements, treaties, and policies to enhance and facilitate financial inclusivity supported by transparent economic systems. Additionally, establishing contracts could ensure the effectiveness and accountability of these measures. Policymakers can focus on expanding financial services access and promoting inclusive economic growth. FIN-based EKC suggests developing comprehensive programs to improve financial literacy, encourage sustainable production, consumption, and structure; focusing on sustainable investment.

Recognizing the significance of financial systems in pursuing carbon neutrality, international financial institutions such as the IMF and World Bank play a crucial role in promoting and enhancing existing economic systems. To foster intercountry sustainable development, countries are encouraged to facilitate the exchange of financial expertise and collaborate in developing strategies that strengthen their financial systems towards sustainability goals. Secondly, in pursuit of sustainable development, our policy aims to address the environmental challenges posed by economic growth, urbanization, natural resource depletion, industrial growth, and corruption. By implementing robust measures and promoting sustainable practices, we strive to reduce CO_2 emissions by prioritizing resource efficiency, promoting renewable energy, adopting eco-friendly technologies, fostering responsible urban planning, and combating corruption. Through these concerted efforts, we aim to achieve a greener and more sustainable future for our society and the environment. These economies should cut down on the subsidies provided to the fossil fuel industry to attain carbon neutrality, as 28% of CO_2 emissions are related to fossil fuels.

Data availability constraints limit the study. The data on financial inclusion is only available for a limited number of indicators, and comprehensive data encompassing the dimensions of accessibility, usage, and quality, along with their respective indicators, is not available for all G7 countries. Consequently, the analysis focused on eight indicators related to financial inclusion in the G7 countries. Future research endeavors could involve expanding the study to include a broader range of indicators and panels and incorporating more up-to-date data to delve deeper into the topic.

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Ethics Approval

I have not submitted my manuscript to multiple journals for consideration. This research has not been publicly disclosed. The results are presented transparently and truthfully, without any falsification or improper manipulation of data. The authors follow the specific guidelines of their field for collecting, choosing, and handling data. No data, text, or theories from other sources are presented as if they were the plagiarism.

Consent to Participate

All authors agree with the content of the submission, and all agree to continue to support the follow-up work.

Consent for Publication

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Availability of Data and Materials

The data set used for our research is openly accessible. Any additional information or data related to this study can be provided upon reasonable request to the corresponding author.

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Appendix A1

Variable's Definitions			
Variables	Symbol	Definition	Source
Carbon Emissions	CO_2	CO_2 emissions (metric tons per capita)	WDI
Financial Inclusion	FIN	Number of ATMs and bank branches per 100,000 adults, Bank deposits to GDP (%), Insurance company assets to GDP (%), Life insurance premium volume to GDP (%), non-life insurance premium volume to GDP (%), and Outstanding international private and public debt securities to GDP (%)	Authors calculation
Economic Growth	GDPP	GDP per capita constant 2015$ is gross domestic product divided by midyear population	WDI
Urbanization	URP	Urban population (% of total population) refers to people living in urban areas as defined by national statistical offices	WDI
Natural Resource Depletion	NR	Natural resource depletion (% GNI) is the sum of net forest depletion, energy depletion, and mineral depletion	WDI
Industrial Development	IND	Industry (including construction), value added (% of GDP)	WDI
Corruption	CORP	Control of Corruption captures perceptions of the extent to which public power is exercised for private gain, ranging from approximately -2.5 to 2.5.	WDI