APAEA

Ali, S., Anwar, H., Solarin, S. A., & Saraç, T. B. (2026). Does Green Finance Improve Environmental Quality? Evidence From G7 Countries. *Energy RESEARCH LETTERS*, *7*(Early View). https://doi.org/10.46557/001c.173557

Peer-reviewed research

Does Green Finance Improve Environmental Quality? Evidence From G7 Countries

Shahid Ali[1,2][a], Haseeb Anwar[3], Sakiru Adebola Solarin[4], Taha Bahadır Saraç[5,6]

[1] Center for Accounting, Finance, and Economics, Multimedia University, Melaka Campus, Malaysia, [2] Department of Economics & Development Strudies, University of Swat, Pakistan, [3] Department of Economics and Development Studies, University of Swat, Pakistan, [4] Center for Accounting, Finance, and Economics, Multimedia University, Cyberjaya Campus, Malaysia, [5] Hitit University Çorum, Türkiye, [6] Department of International Trade and Logistics, Ondokuz Mayıs University, Türkiye

Keywords: Climate change, Environmental performance, Green finance, Quantile regression

JEL Classifications: C21 Cross-Sectional Models - Spatial Models - Treatment Effect Models - Quantile Regressions, Q50 General, Q54 Climate - Natural Disasters and Their Management - Global Warming, Q56 Environment and Development - Environment and Trade - Sustainability - Environmental Accounts and Accounting - Environmental Equity - Population Growth

https://doi.org/10.46557/001c.173557

Energy RESEARCH LETTERS

Vol. 7, Issue Early View, 2026

This study examines the relationship between green finance and environmental performance in G7 economies from 1990 to 2022. Using a quantile regression approach, the results reveal heterogeneous effects of green finance across the conditional distribution of CO_2 emissions. This finding suggests that green finance is particularly effective in mitigating emissions in high-emission countries. The estimates indicate that eco-innovation and energy productivity are important factors in improving environmental performance in G7 economies. However, the intensive exploitation of natural resources and increases in economic activity deteriorate environmental quality.

Introduction

In this paper, we examine how green finance affects environmental performance in G7 economies. Green finance broadly refers to the provision of financial services and activities that incorporate environmental considerations (Kwilinski et al., 2025). Green finance encompasses environmental concerns such as pollution control, biodiversity, and resource efficiency, as well as climate-related initiatives like renewable energy and energy efficiency (Lee, 2020). Green finance aims to support economic growth while reducing environmental harm by promoting investments in eco-friendly projects and sustainable practices (Meng, 2025). We hypothesize that greater green finance reduces carbon dioxide (CO_2) emissions by facilitating the transition toward environmentally sustainable production systems. This hypothesis is motivated by sustainable finance theory, which states that directing capital toward environmentally sustainable projects facilitates the transition to a low-carbon economy (Rabbani et al., 2026). Countries consider environmental, social, and governance (ESG) factors when making investment decisions (Naeem et al., 2023). By directing funds into green and sustainable energy projects, green finance integrates environmental concerns into financial policy, thereby improving environmental performance. Moreover, green finance engages with traditional capital markets to create and provide a range of financial services and products that deliver both competitive financial returns and environmentally friendly outcomes. Investment in green projects is considered one of the most effective strategies for meeting the global need for sustainable environmental performance (Zhang, 2022).

This hypothesis is important for several reasons. The G7 economies account for a substantial share of global economic output and greenhouse gas emissions. These countries are actively formulating and implementing an array of environmental policies, including public investments, carbon pricing mechanisms, emissions trading systems, regulations, and subsidies (Naseer et al., 2025). In recent years, governments and financial institutions worldwide have increasingly embraced green credit policies as a key instrument for advancing sustainable development. These policies are designed to direct capital toward renewable energy, low-carbon technologies, and environmentally sustainable projects, thereby facilitating the transition to a greener and more resilient economy (Dai et al., 2025; Yao et al., 2021). Hence, these countries are showing strong investment momentum in green projects, in line with their commitments under the 2015 Paris Agreement to achieve net-zero emissions by 2050. Establishing the relationship between green finance and environmental sustainability is therefore essential for designing policies that simultaneously promote economic development and environmental sustainability.

a Corresponding author email: shahid_aerc@yahoo.com

Existing studies generally suggest that green finance contributes to environmental sustainability by supporting investments in clean energy, green innovation, and low-carbon technologies (Jóźwik et al., 2025; Kwilinski et al., 2025; Wang et al., 2022; Zhang, 2022; Zheng et al., 2025). Despite the growing literature on green finance and environmental sustainability, evidence for G7 economies remains limited and inconclusive. Moreover, existing studies rely on average-effect estimators, which may overlook how the environmental impact of green finance varies across different levels of CO_2 emissions.

This study makes two contributions to the literature. First, it provides new evidence on the heterogeneous effects of green finance on environmental quality by employing a quantile-based estimation framework, thereby demonstrating that the environmental benefits of green finance vary across the conditional distribution of CO_2 emissions. Second, the study extends the green finance literature by jointly examining the roles of eco-innovation, energy productivity, natural resource rents, and economic growth in explaining environmental performance in G7 economies.

The remainder of the paper is organised as follows. Section II describes the data, variables, and empirical methodology. Section III presents and discusses the main empirical results, while Section IV concludes the study.

Data and Methodology

To estimate the influence of green finance on environmental degradation, measured by CO_2 emissions, in the presence of other important factors, the baseline model is presented as:

$$CO_{2i,t} = \pi_1 GF_{i,t} + \pi_2 EI_{i,t} + \pi_3 TNR_{i,t} + \pi_4 EP_{i,t} + \pi_5 lnGDP_{i,t} + \varepsilon_{i,t} \quad (1)$$

where CO_2 denotes carbon dioxide emissions; GF denotes green finance; and *EI* denotes eco-innovation (% of total innovation). *TNR*, *EP*, and *lnGDP* represent total natural resource rents, energy productivity, and the natural logarithm of gross domestic product, respectively. Renewable energy RD&D as a percentage of total R&D is used to represent green finance. Consistent with recent studies (Jóźwik et al., 2025; Zheng et al., 2025), this study employs renewable energy RD&D expenditure (% of total R&D) as a proxy for green finance. This indicator captures financial resources directed toward renewable energy development and environmentally sustainable activities, thereby reflecting the role of green finance in supporting environmental objectives. Green finance is commonly measured using indicators such as green bonds, green investment funds, and green credit. However, comparable data on these conventional green finance indicators are unavailable for the full sample period (1990–2022) and across all G7 countries. Eco-innovation is measured using the development of environment-related technological innovations as a percentage of total technologies developed. Total natural resource rents are measured as a percentage of GDP. Energy productivity is measured as GDP per unit of energy use. The data on *GF* and *EI* are obtained from Organisation for Economic Co-operation and Development. (2024) statistics (https://stats.oecd.org). Data on CO_2 emissions, *TNR*, and *EP* are obtained from the World Bank's World Development Indicators (World Bank, 2024) (https://databank.worldbank.org).

Before estimating the model, this study conducts diagnostic tests. For this purpose, four cross-sectional dependence (CD) tests are applied. Moreover, we use the slope heterogeneity test proposed by Pesaran and Yamagata (2008).

This study employs the cross-sectionally augmented Im–Pesaran–Shin (CIPS) test, introduced by Pesaran (2007), to determine the order of integration of the variables. We use the Westerlund (2007) cointegration test to examine the long-run relationship among the variables. This study uses the method of moments quantile regression (MMQR) approach, developed by Machado and Santos Silva (2019), to explore the heterogeneous impact of the explanatory variables on the conditional distribution of CO_2 emissions. The MMQR equation is given as follows:

$$CO_{2i,t}\ (\tau|\gamma_i,\ \delta_t,\ X_{i,t}) = \varphi_i + \lambda_{1,\tau} GF_{i,t} + \lambda_{2,\tau} EI_{i,t} + \lambda_{3,\tau} EP_{i,t} + \lambda_{4,\tau} TNR_{i,t} + \lambda_{5,\tau} lnGDP_{i,t} \quad (2)$$

Main Results

Table 1 presents the results of the cross-sectional dependence tests. Most second-generation unit root tests, such as the cross-sectionally augmented IPS (CIPS) test, and cointegration approaches assume slope heterogeneity and cross-sectional dependence. This study employs the CD tests developed by Pesaran (2021) and Juodis and Reese (2021). The findings reveal cross-sectional dependence among the countries. The significant delta and adjusted delta statistics also indicate that the model exhibits slope heterogeneity.

One of the most important prerequisites for regression analysis is variable stationarity. The empirical results of the CIPS unit root test, presented in Table 2, confirm that the variables have mixed orders of integration. We find that CO_2, *GF*, and *EI* are integrated of order zero, while *TNR*, *EP*, and *lnGDP* are integrated of order one. The results of the Westerlund test, presented in the lower part of Table 2, show that there is cointegration between the dependent variable and the explanatory variables included in the model.

Table 3 presents the heterogeneous effects of the explanatory variables on CO_2 emissions estimated using the MMQR method. The empirical findings indicate that *GF*, *EI*, *TNR*, *EP*, and *lnGDP* are important determinants of CO_2 emissions in G7 countries. The MMQR results reveal heterogeneous effects of green finance across the conditional distribution of CO_2 emissions. The negative and significant scale coefficient suggests that the emission-reducing effect of green finance becomes stronger at higher quantiles. This finding suggests that green finance is particularly effective in mitigating emissions in high-emission countries. By directing resources toward environmentally sustainable projects, green finance enables the transition to a low-carbon economy.

The negative and significant scale coefficient of eco-innovation suggests that eco-innovation (*EI*) promotes envi-

Table 1. Diagnostic check

Variables	Panel A. Cross section dependence test	
	CD Pesaran (2021)	CDw Juodis and Reese (2021)
CO_2	18.800***	-2.870***
GF	9.340***	0.790
EI	24.710***	-3.490***
TNR	6.580***	1.040
EP	25.390***	-3.540***
lnGDP	23.220***	9.250***
	Panel B. Slope heterogeneity test	
Model	**Delta (Δ)**	**Adj.Delta (adjΔ)**
CO_2 = f(*GF*, *EI*, *TNR*, *EP*, *lnGDP*)	11.064***	12.464***

Note: ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively. CO_2, *GF*, *EI*, *TNR*, *EP*, and *lnGDP* denote carbon emissions, green finance, eco-innovation, total natural resource rents, energy productivity, and the natural logarithm of gross domestic product, respectively.

Table 2. Unit root test and cointegration

Variables	Level	First Difference
CO_2	-2.4178**	---
GF	-2.772***	---
EI	-3.940***	---
TNR	-1.985	-5.602***
EP	-1.242	-5.325***
lnGDP	-1.760	-4.798***
	Westerlund test for cointegration	
Variance ratio	-1.6327*	

Note: ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively. CO_2, *GF*, *EI*, *TNR*, *EP*, and *lnGDP* refer to carbon emissions, green finance, eco-innovation, total natural resource rents, energy productivity, and the natural logarithm of gross domestic product, respectively.

ronmental sustainability. The coefficient of *EI* is negative and significant at the medium and highest quantiles ($Q_{0.5}$ and $Q_{0.9}$), which suggests that the emission-reducing effect of eco-innovation becomes stronger at higher quantiles. This finding highlights the importance of eco-innovation in improving environmental quality in the G7 nations. The positive coefficient of total natural resource rents (*TNR*) at all quantiles indicates that higher natural resource rents are associated with greater CO_2 emissions. Hence, the intensive exploitation of natural resources deteriorates environmental quality.

The coefficient of *EP* is negative across all quantiles of CO_2 emissions. This implies that greater economic output per unit of energy consumed (energy productivity) contributes to lower CO_2 emissions. This effect holds regardless of whether a country is a low-, medium-, or high-carbon emitter. This finding highlights the environmental benefits of improved energy efficiency.

Conclusion

The Group of Seven (G7) countries are highly advanced OECD member economies. These seven major economies account for a significant share of global economic output and pollution. These countries have achieved strong economic performance over the past few decades. At the same time, they contribute substantially to environmental degradation. The United Nations has identified environmental degradation as one of the major global threats over the past 20 years, while the international community has sought effective strategies to reduce greenhouse gas (GHG) emissions and protect future generations. Countries use green finance as a remedial strategy to address worsening environmental conditions. This study examines the impact of green finance on environmental performance in G7 economies. The results demonstrate that green financing helps reduce CO_2 emissions in G7 economies. Green finance provides the required capital to implement green projects, thereby improving environmental quality. Financial capital directed toward renewable energy sectors can stimulate sustainable economic growth while reducing environmental pollution and mitigating ecological degradation. The analysis includes additional factors such as eco-innovation, resource rents, energy productivity, and national income to examine their influence on environmental performance. The estimates suggest that an increase in resource rents worsens environmental performance in G7 economies.

Table 3. Estimates of quantile regression–MMQR (dependent variable: CO_2)

Variable	Quantiles				
	Location	Scale	$Q_{0.1}$	$Q_{0.5}$	$Q_{0.90}$
GF	0.005 [0.018]	-0.032*** [0.009]	0.053** [0.021]	0.003 [0.018]	-0.042** [0.023]
EI	-0.305*** [0.083]	-0.097** [0.043]	-0.161 [0.101]	-0.312*** [0.084]	-0.450*** [0.108]
TNR	1.023*** [0.201]	0.025 [0.105]	0.986*** [0.246]	1.025*** [0.201]	1.060*** [0.262]
EP	0.705*** [0.050]	-0.053** [0.026]	-0.626*** [0.060]	-0.709*** [0.050]	-0.784*** [0.065]
lnGDP	17.787*** [1.514]	1.437* [0.790]	15.654*** [1.846]	17.890*** [1.533]	19.925*** [1.975]
Constant	-168.703*** [15.693]	-11.347 [8.187]	-151.860*** [19.169]	-169.513*** [15.833]	-185.584*** [20.468]

Note: ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. Values in brackets are standard errors. CO_2, *GF*, *EI*, *TNR*, *EP*, and *lnGDP* denote carbon emissions, green finance, eco-innovation, total natural resource rents, energy productivity, and the natural logarithm of gross domestic product, respectively.

Based on the findings, this study suggests that G7 countries should design and implement environmental policies aimed at reducing carbon emissions. Greater emphasis should be placed on investments in renewable energy to reduce carbon emissions. Furthermore, eco-innovation and energy productivity can contribute significantly to environmental improvement, particularly when financial resources are strategically channelled into green projects and low-carbon development initiatives rather than being used as general revenue.

Submitted: February 02, 2026 AEDT. Accepted: July 14, 2026 AEDT. Published: November 25, 2026 AEDT.

This is an open-access article distributed under the terms of the Creative Commons Attribution-ShareAlike 4.0 International License (CCBY-SA-4.0). View this license's legal deed at https://creativecommons.org/licenses/by-sa/4.0 and legal code at https://creativecommons.org/licenses/by-sa/4.0/legalcode for more information.

References

Dai, Q., He, J., Guo, Z., Zheng, Y., & Zhang, Y. (2025). Green finance for sustainable development: analyzing the effects of green credit on high-polluting firms' environmental performance. *Humanities and Social Sciences Communications*, *12*, 854. https://doi.org/10.1057/s41599-025-05218-8

Jóźwik, B., Sarigül, S. S., Dogan, M., Çetin, M., Avci, P., & Güt, A. (2025). Green Finance and Ecological Footprint: Empirical Evidence from 13 Leading Countries in Green Financial Development. *Sustainability*, *17*(23), 10509. https://doi.org/10.3390/su172310509

Juodis, A., & Reese, S. (2021). The Incidental Parameters Problem in Testing for Remaining Cross-Section Correlation. *Journal of Business & Economic Statistics*, *40*(3), 1191–1203. https://doi.org/10.1080/07350015.2021.1906687

Kwilinski, A., Lyulyov, O., & Pimonenko, T. (2025). The role of green finance in attaining environmental sustainability within a country's ESG performance. *Journal of Innovation & Knowledge*, *10*(2), 100674. https://doi.org/10.1016/j.jik.2025.100674

Lee, J. W. (2020). Green Finance and Sustainable Development Goals: The Case of China. *Journal of Asian Finance Economics and Business*, *7*(7), 577–586. https://doi.org/10.13106/jafeb.2020.vol7.no7.577

Machado, J. A. F., & Santos Silva, J. M. C. (2019). Quantiles via moments. *Journal of Econometrics*, *213*(1), 145–173. https://doi.org/10.1016/j.jeconom.2019.04.009

Meng, K. (2025). The role of green finance in promoting economic sustainability. *International Journal of Agricultural and Environmental Information Systems*, *16*(1). https://doi.org/10.4018/IJAEIS.393080

Naeem, M. A., Karim, S., Rabbani, M. R., Bashar, A., & Kumar, S. (2023). Current state and future directions of green and sustainable finance: a bibliometric analysis. *Qualitative Research in Financial Markets*, *15*(4), 608–629. https://doi.org/10.1108/QRFM-10-2021-0174

Naseer, M. M., Hunjra, A. I., Palma, A., & Bagh, T. (2025). Sustainable development goals and environmental performance: Exploring the contribution of governance, energy, and growth. *Research in International Business and Finance*, *73*(Part B), 102646. https://doi.org/10.1016/j.ribaf.2024.102646

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

Pesaran, M. H. (2021). General diagnostic tests for cross-sectional dependence in panels. *Empirical Economics*, *60*(1), 13–50. https://doi.org/10.1007/s00181-020-01875-7

Pesaran, M. H., & Yamagata, T. (2008). Testing slope homogeneity in large panels. *Journal of Econometrics*, *142*(1), 50–93. https://doi.org/10.1016/J.JECONOM.2007.05.010

Rabbani, M. Z., Bashar, A., Hawaldar, I. T., Khan, I., Aldawsari, H., Zulfikar, Z., & Mansour, S. (2026). Sustainable finance in a new era: Trends, themes, theories, and innovations through bibliometric and narrative insights. *Sustainable Futures*, *11*, 101943. https://doi.org/10.1016/j.sftr.2026.101943

Wang, K. H., Zhao, Y. X., Jiang, C. F., & Li, Z. Z. (2022). Does green finance inspire sustainable development? Evidence from a global perspective. *Economic Analysis and Policy*, *75*, 412–426. https://doi.org/10.1016/j.eap.2022.06.002

Westerlund, J. (2007). Testing for Error Correction in Panel Data. *Oxford Bulletin of Economics and Statistics*, *69*(6), 709–748. https://doi.org/10.1111/j.1468-0084.2007.00477.x

World Bank. (2024). *World Development Indicators* [Database]. https://databank.worldbank.org/source/world-development-indicators

Yao, S., Pan, Y., Sensoy, A., Uddin, G. S., & Cheng, F. (2021). Green credit policy and firm performance: What we learn from China. *Energy Economics*, *101*, 105415. https://doi.org/10.1016/j.eneco.2021.105415

Zhang, Y. (2022). How economic performance of OECD economies influences through green finance and renewable energy investment resources? *Resources Policy*, *79*, 102925. https://doi.org/10.1016/j.resourpol.2022.102925

Zheng, M., Wu, L., Feng, G. F., & Chang, C. P. (2025). The impact of green finance on sustainable development: an investigation into national ESG performance. *Journal of Applied Economics*, *28*(1). https://doi.org/10.1080/15140326.2025.2528672