Received: 23 November 2022 | Revised: 14 February 2023 | Accepted: 16 February 2023
DOI: 10.1002/gj.4707

SPECIAL ISSUE ARTICLE

WILEY

Does financial stability matter for environmental degradation?

Dervis Kirikkaleli[1] | **Emrah Sofuoğlu**[2]

[1]Department of Banking and Finance, Faculty of Economic and Administrative Sciences, European University of Lefke, Lefke, Northern Cyprus, Turkey

[2]Department of Economics, Faculty of Economics and Administrative Sciences, Kirsehir Ahi Evran University, Kirsehir, Turkey

Correspondence
Dervis Kirikkaleli, Department of Banking and Finance, Faculty of Economic and Administrative Sciences, European University of Lefke, Lefke, Northern Cyprus, Turkey.
Email: dkirikkaleli@eul.edu.tr

Handling Editor: J. Abbas

There is a body of evidence that financial development contributes to the quality of the environment, either positively or negatively. However, a limited number of studies consider the effect of financial stability or financial risk on environmental degradation. As part of the proposed research, the present study contributes to the existing literature on asymmetric financial stability's impact on Ireland's environmental quality, as a major gap needs to be added to the literature. Based on this aim, the present study explores the effect of financial stability on environmental degradation in Ireland while controlling primary energy consumption, economic growth, and renewable energy in Ireland. The study employs a novel Fourier autoregressive distributed lag model (FARDL) approach for Ireland, covering the period 1990Q1-2019Q4 with quarterly data. FARDL cointegration test results indicate a long-term relationship between financial stability, primary energy consumption, renewable energy consumption, and CO_2 emissions. The outcomes from the long-term coefficient estimation model based on the FARDL model reveal that (i) financial stability leads to a decrease in environmental degradation in Ireland; (ii) renewable energy consumption promotes environmental sustainability; (iii) primary energy consumption has a negative effect on Ireland's environmental quality. These results denote that Ireland should enhance financial stability and promote renewable energy to reduce fossil fuel consumption to achieve net-zero targets by 2050. Ireland to implement long-term financial stability policies to fill the emission gap and achieve a net zero emissions target by 2050. Specific policy recommendations for Ireland's environmental policies are also discussed in the study.

KEYWORDS
environmental degradation, financial stability, Ireland, renewable energy

1 | INTRODUCTION

Adapting and mitigating climate change will also reduce certain assets for businesses and households in the not-too-distant future. Increased flooding and wildfires are some of the adverse consequences of climate change. Businesses can be disrupted, property damage can be done, and assets can be devalued. A significant component of financial risk is uncertainty about emissions, climate change responses, and the economic and financial implications of climate change. Globally, industrial societies have grown increasingly industrialized as a result of fossil fuel consumption (particularly coal, oil, and natural gas), which has resulted in rising CO_2 emissions, despite widespread recognition of climate change as a major economic threat. Climate finance is becoming more popular among scholars and policymakers alike. In the literature, a gap remains in developing effective techniques to measure adverse climate effects. Within this perspective, the present study aims to identify the impact of financial stability on environmental degradation in Ireland while controlling economic growth, primary energy consumption, and renewable energy in Ireland using the dataset from 1990Q1 to 2019Q4.

Reducing emissions, promoting adaptation, and enhancing resilience require both financial resources and sound investments. As well known, economic growth and environmental improvement are boosted by finance. Sound financial systems contribute to a better environment, and sound financial systems can also improve the environment. Economic growth will likely be boosted and the environment will likely be cleaner if the financial sector is more efficient. In a country, foreign direct investment (FDI) and economic growth can be encouraged by a sound and efficient financial sector. By providing incentives for firms to adopt modern technologies in the energy sector, stable financial systems contribute to improved environmental conditions by encouraging environmentally friendly investments. Macroeconomic management faces significant challenges due to climate change and low-carbon economies. These challenges can adversely affect investment and economic growth, revenue and expenditure, debt sustainability, and the valuation of financial assets, as well as harm the balance sheets of governments, households, and companies. In this way, macro-financial risks undermine resilience and limit climate change adaptation. Banks are also exposed to climate-related risks when it comes to credit risk, market risk, and operational risk.

The Republic of Ireland's economy is highly developed and centred on high-tech, life sciences, finance, and agribusiness services. It ranks first for high-value FDI flows in the Index of Economic Freedom (fifth). According to the World Bank, Ireland's GDP per capita in 2021 was US $99,841, ranking fourth out of 187 countries worldwide. Almost half of the world's top 50 banks have international operations in Ireland, including 250 of the world's leading financial firms. Ireland is the fourth largest provider of wholesale financial services in the European Union. The provisional estimate of Ireland's greenhouse gas emissions for 2021 is 61.53 million tons of carbon dioxide equivalent (Mt CO_2eq), which is 4.7% higher (or 2.76 Mt CO_2eq) than in 2020. The emissions reported for 2020 decreased 3.4% from the previous year. COVID restrictions on transport contributed to the increase in emissions, showing Ireland is still far from meeting future targets and achieving a climate-neutral economy.

As a key component of economic growth and environmental improvement, finance plays an important role. The quality of the environment can be improved by having a sound financial system. By adopting eco-friendly and efficient technologies, financially stable sectors reduce CO_2 emissions. Therefore, it is likely that economic growth will increase as well as a cleaner environment as the financial sector becomes more efficient (Dasgupta et al., 2001; Feyen et al., 2020). In response to climate-related financial risks, financial sector balance sheets may weaken and macro-financial risks may rise, especially when shocks occur. These shocks can be caused by disasters, sudden changes in policy, technology, or even consumer preferences. As a result of the effects of climate change on firms, organizations, and financial institutions, the financial system is potentially compromised by losses in capital that reduce profitability and increase liquidity risks.

Financial stability is a vital and potentially important factor in reducing CO_2 emissions in the environment as well as rapid economic growth. Financial sectors can impact energy consumption and CO_2 emissions by stimulating technological progress in energy (Kirikkaleli et al., 2022; Su et al., 2023; Wahab et al., 2022). Studies generally focus on the impact of financial development, which refers to private sector credit growth, fixed capital investments, and money supply (M2). However, financial stability considers different subcomponents, such as contract viability, expropriation, profits repatriation, and payment delays. This is one of the uniqueness of this study. The uniqueness of this study is to show how financial stability can be used as a policy tool to fight against climate change. Cutting fossil fuel consumption is not the only solution to lower CO_2 emissions because there is still an emission gap to achieve net zero targets by 2050 (Sofuoğlu & Kirikkaleli, 2022). Financial stability policies might be an effective strategy to close this emission gap for Ireland. Therefore, the motivation of this study is that financial stability can be considered as a long-term strategy to achieve sustainable development goals and net-zero emission goals by increasing environmental quality. Finally, to see the impact of financial stability, primary energy consumption, and renewable energy consumption on CO_2 emissions, we applied Fourier autoregressive distributed lag model (FARDL) analysis, which obtains robust results in small observations and considers structural breaks.

This study tests the validity of four hypotheses below:

Hypothesis 1. Financial stability increases environmental sustainability.

Hypothesis 2. Economic growth reduces environmental sustainability.

Hypothesis 3. Primary energy consumption reduces environmental sustainability.

Hypothesis 4. Renewable energy consumption increases environmental sustainability.

The present study contributes to the existing environmental economics and finance concept by investigating the asymmetric and long-run effect of financial stability on environmental degradation in Ireland using up-to-date time series data from 1990Q1 to 2019Q4. Second, the present study uses novel econometric approaches, which are Fourier augmented Dickey-Fuller (ADF) unit root, FARDL bounds test, and FARDL long-term coefficient estimator. It is likely that the cointegration relationship is not linear; in fact, most studies focus on the linear long-run relationship. A limited number of studies have been conducted on Fourier-based models, in contrast to traditional linear approach tests. In this study, we tested the cointegration model using the FARDL bounds test. In this way, we consider the structural breaks and obtain robust empirical results. Third, the present study uses a unique dataset from the International Country Risk Guide (ICRG). To the best of the authors' knowledge, this is the first study to examine the impact of financial stability on environmental quality by using ICRG data for Ireland. Finally, the findings suggest specific policy implications that Ireland and the rest of the world might enhance environmental sustainability through economic and environmental measures.

2 | LITERATURE SURVEY

Studies in energy economics and environmental economics generally test the validity of the Environmental Kuznets Curve (EKC) hypothesis and thus observe the improvement of environmental quality in economic development stages. However, the impact of financial indicators on environmental sustainability has recently started to draw attention in the literature (Battiston et al., 2021; Musa et al., 2021; Ozturk & Ullah, 2022; Sethi et al., 2020).

The findings in the literature regarding the impact of financial instability on the environment may vary according to the financial infrastructures of the countries. Many studies found a positive relationship between financial stability and environmental sustainability. The recent survey of Kirikkaleli et al. (2022) explored the impact of financial stability on environmental degradation in Norway using the nonlinear ARDL approach. They underlined that financial stability causes a reduction in environmental degradation in Norway in the long run. Kirikkaleli et al. (2022) argued that 'since financial stability in Norway reduces environmental degradation by incorporating climate-related risks into the financial stability monitoring framework, it can contribute to lowering carbon emissions to a greater extent'. Shahbaz (2013) answered the question of Does financial instability increases environmental degradation? He argued that there is a strong linkage between financial development and the environment in Pakistan and concluded that good governance could be achieved by improving the finance sector, and this can improve the environmental pollution in Pakistan for the case of China, the findings of Zhang (2011) were in line with the findings of Shahbaz (2013) and Zhang (2011), underlining that financial development brings a better environment in China. Richard (2010) examined developed and developing countries and found that financial stability decreases CO_2 emissions. Nasreen et al. (2017) found that financial stability has a significant negative impact on environmental pollution. Likewise, Safi et al. (2021) found that financial stability, exports, and renewable energy considerably lower carbon emissions in the short and long term. Abid (2016) investigated the impact of various indicators of political stability on the environment. According to the empirical results, political stability, government effectiveness, democracy, and corruption control increase environmental quality. However, studies also find that financial stability increases environmental degradation. These studies generally confirm that an advanced financial system increases investment through cheaper credits, improves the functioning of companies by stimulating savings, and contributes to adopting environmentally friendly technologies (Morris, 2010).

Some studies also found a negative relationship between financial stability and environmental sustainability. According to Yang et al. (2020), financial stability causes a considerable increase in CO_2 emissions. Danish Saud et al. (2018) discuss that financial sector development increases CO_2 emissions through increased energy consumption. On the other hand, the study of Ozturk and Acaravci (2013) reveals no strong interaction between the environment and financial development in Turkey. Similarly, Enkvist et al. (2010) determine that the global financial crisis has a minor impact on environmental sustainability. Baloch et al. (2018) determined that financial instability has no significant impact on environmental sustainability in Saudi Arabia.

Energy consumption is one of the biggest determinants of CO_2 emissions as most of the energy demand is met by fossil fuels. For this reason, many studies have found that energy consumption reduces environmental sustainability by increasing CO_2 emissions (Arouri et al., 2012; Hossain, 2011; Jalil & Feridun, 2011; Jayanthakumaran et al., 2012). A positive relationship between economic growth and CO_2 emissions is also found in many studies that determine a positive relationship between energy consumption and CO_2 emissions (Apergis & Payne, 2010; Asif et al., 2015; Khan et al., 2019; Nguyen & Wongsurawat, 2017; Soytas et al., 2007). Renewable energy is undoubtedly one of the most important factors that increase environmental quality. In this context, many studies in the literature show that renewable energy increases environmental sustainability by reducing CO_2 emissions. (Bhattacharya et al., 2017; Ikram et al., 2020; Mirziyoyeva & Salahodjaev, 2022; Safi et al., 2021; Saidi & Omri, 2020; Wang et al., 2020; Zoundi, 2017).

This study contributes to an essential research gap in environmental studies. The current literature generally focuses on the relationship between financial development and environmental sustainability. However, few studies examined the environmental impact of financial stability. Financial stability considers various indicators, such as contract viability (expropriation, profits repatriation, and payment delays). Therefore, it also represents institutional quality. To fill this gap and show the impact of financial stability, we form an empirical model including financial stability, primary energy consumption, economic growth, and CO_2 emissions.

3 | DATA AND METHODOLOGY

This article aims to capture the effect of financial stability on environmental degradation in Ireland for the period of 1990 to 2019 while controlling economic growth, primary energy consumption, and renewable energy in Ireland. The present study used the quadratic match sum method by converting the dataset from annual to quarterly. We use the Fourier ADF unit root test, FARDL cointegration test, and FARDL long-term coefficient estimator for the empirical analysis. Fourier tests are recently developed innovative econometric techniques. They also obtain robust findings in small observations. Financial stability can be affected by various problems such as economic crises, political instabilities, and natural disasters. These shocks can affect the trends of the series. The FARDL test minimizes these errors since it considers these changes via structural breaks. On the other hand, the literature has a variety of cointegration tests, and each test has a unique potential for revealing information about long-term relationships. The reason why Fourier is better than the traditional ARDL bound testing method is that we do not need to add dummies to the model for the structural breaks. Based on this aim, the following equation is estimated;

$$LCO_{2it} = \beta_1 LFRI + \beta_2 LGDP + \beta_3 LPEC_{it} + \beta_3 LRE + \varepsilon_{it}, \tag{1}$$

where LCO_2, LFRI, LGDP, and LRE stand for production-based CO_2 emissions, financial risk index, economic growth, primary energy consumption, and renewable energy consumption, respectively. The design of the methodological part is as follows. First, we applied unit root tests to see whether the series has a unit root. After applying unit root tests, we use FARDL cointegration test to decide whether there is a long-term statistically significant relationship between the variables. After detecting long-term cointegration, we observe the impact of independent variables on CO_2 emissions by applying a long-term coefficient test based on FARDL model. We also apply other long-term coefficient tests (FMOLS and DOLS tests) for robustness checks to see whether the empirical findings are consistent. FARDL analysis gives robust results in small observations and considers structural breaks. Therefore, using the FARDL method for small observations is more advantageous than traditional cointegration methods because there is no need to perform additional structural break tests.

Standard cointegration tests cannot be applied where the variables are integrated to varying degrees. Instead, the ARDL cointegration test was suggested by Pesaran et al. (2001). ARDL approach enables independent variables to be integrated at different degrees if the dependent variable is I(1). This test utilities 'F and t statistics. The cointegration relationship is tested by comparing the test statistics with the lower and upper limits defined as I(0) and I(1). If the test statistic exceeds the critical upper bound values, the basic hypothesis of no cointegration is rejected' (Pata & Aydin, 2020). Equation (2) shows the ARDL model for this study.

The cointegration relationship between the variables is examined by contrasting the test statistics with the lower and higher bounds designated as I(0) and I(1). The fundamental hypothesis that there is no cointegration is rejected if the test statistic is higher than the crucial upper bound values. Equation (2) displays the ARDL model for the study.

$$\begin{aligned}\Delta LCO2\mathrm{t} = {} & \beta 0 + \beta 1 LCO2\mathrm{t} - 1 + \beta 2 LFRI\mathrm{t} - 1 + \beta 3 LGDP\mathrm{t} - 1 + \beta 4 LPEC\mathrm{t} \\ & - 1 + \beta 5 LRE\mathrm{t} - 1 + \sum\nolimits_{\mathrm{i}=1}^{\rho-1} \varphi \mathrm{i}' \Delta LCO2\mathrm{t} - \mathrm{i} + \sum\nolimits_{\mathrm{i}=1}^{\rho-1} \gamma \mathrm{i}' \Delta LFRI\mathrm{t} \\ & - \mathrm{i} + \sum\nolimits_{\mathrm{i}=1}^{\rho-1} \delta \mathrm{i}' \Delta LGDP\mathrm{t} - \mathrm{i} + \sum\nolimits_{\mathrm{i}=1}^{\rho-1} \emptyset \mathrm{i}' \Delta LPEC\mathrm{t} - \mathrm{i} \\ & + \sum\nolimits_{\mathrm{i}=1}^{\rho-1} \vartheta \mathrm{i}' \Delta LRE\mathrm{t} - \mathrm{i} + e\mathrm{t}.\end{aligned} \tag{2}$$

'Δ represents the first difference operator, ρ represents the lag length and e_t shows the independent identically distributed disturbance term with zero mean and finite variance. The optimal lag length is chosen using the Akaike Information Criteria'. Pesaran et al. (2001) determine the cointegration relationship by using the F-test (F_A) and *t* test (t) as below.

$$H_{0A} : \beta_1 = \beta_2 = \beta_3 = 0. \tag{3}$$

$$H_{0B} : \beta_1 = 0. \tag{4}$$

Equations (3) and (4) are modified by McNown et al. (2018) to create a new F-test (F_B) that examines the null hypothesis, as is seen in Equation (5).

$$H_{0C} : \beta_2 = \beta_3 = 0. \tag{5}$$

For the cointegration relationship, Equation (4), (5), and (6) must be rejected. However, this approach gives more robust results than the standard ARDL approach. McNown et al. (2018) neglect the integration degree of the variables. However, this approach provides more robust empirical results than the standard ARDL. In addition, this method uses Fourier functions to identify structural changes. In this manner, a further structural change test is not required. The Fourier function created by Yilanci et al. (2020) considers structural changes in the model, as seen in Equation (6).

$$d(t) = \sum\nolimits_{k=1}^{n} a k \sin\left(\frac{2\pi kt}{T}\right) + \sum\nolimits_{k=1}^{n} b k \cos\left(\frac{2\pi kt}{T}\right), \tag{6}$$

where 'n' indicates the number of frequencies, $\pi = 3.14$, 'k' is the number of special frequencies selected, 't' is the trend, and 'T' is the sample size. A single frequency value suggested by Becker et al. (2006) and Ludlow and Enders (2000) is used in Equation (6).

$$d(t) = \gamma 1 sin\left(\frac{2\pi kt}{T}\right) + \gamma 2 cos\left(\frac{2\pi kt}{T}\right). \tag{7}$$

The FARDL model for this study is shown in Equation (8).

$$\begin{aligned}\Delta LCO2\mathrm{t} = {} & \beta 0 + \gamma 1 sin\left(\frac{2\pi kt}{T}\right) + \gamma 2 cos\left(\frac{2\pi kt}{T}\right) + \beta 1 LCO2\mathrm{t} - 1 + \beta 2 LFRI\mathrm{t} \\ & - 1 + \beta 3 LGDP\mathrm{t} - 1 + \beta 4 LPEC\mathrm{t} - 1 + \beta 4 LRE\mathrm{t} - 1 \\ & + \sum\nolimits_{i-1}^{\rho-1} \varphi \mathrm{i}' \Delta LCO2\mathrm{t} - \mathrm{i} + \sum\nolimits_{i-1}^{\rho-1} \delta \mathrm{i}' \Delta LFRI\mathrm{t} - \mathrm{i} \\ & + \sum\nolimits_{i-1}^{\rho-1} \emptyset \mathrm{i}' \Delta LGDP\mathrm{t} - \mathrm{i} + \sum\nolimits_{i-1}^{\rho-1} \vartheta \mathrm{i}' \Delta LPEC\mathrm{t} - \mathrm{i} \\ & + \sum\nolimits_{\mathrm{i}=1}^{\rho-1} \vartheta \mathrm{i}' \Delta LRE\mathrm{t} - \mathrm{i} + e\mathrm{t}.\end{aligned} \tag{8}$$

Yilanci et al. (2020) use the frequency value at the minimum sum of squared residuals by following the studies conducted by Christopoulos and Leon-Ledesma (2011) and Omay (2015). Using bootstrap simulation, they choose the critical values for F_A, F_B, and *t* tests.

After confirmation of the cointegration, the next step is to estimate the long-run coefficient relationship. In this sense, FMOLS and DOLS approaches developed by Pedroni (2000, 2001) are used. FMOLS and DOLS estimators were created on the occurrence of biased results after estimating the long-term relationship using the least squares method. The results are not statistically significant if the model has autocorrelation and endogeneity problems. Although the FMOLS approach corrects the autocorrelation and endogeneity problems with the nonparametric approach, the DOLS approach considers the lagged values and eliminates the autocorrelation (Figure 1).

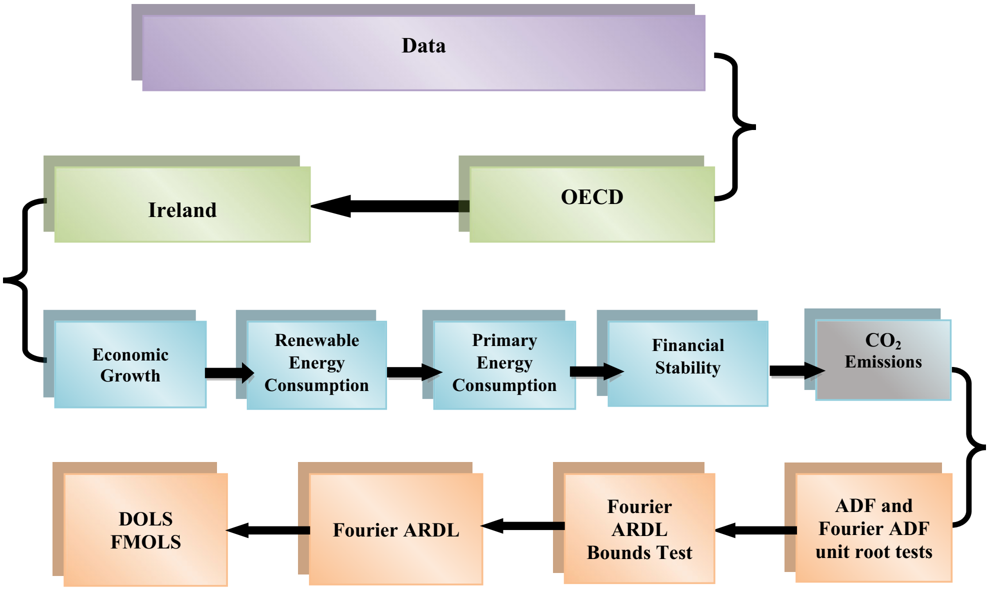

FIGURE 1 Analysis flowchart.

TABLE 1 Descriptive statistics.

Code Variable Source	LCO_2 CO_2 emissions World Bank	LFRI Financial risk index Political risk services	LGDP GDP (constant 2015 US$) World Bank	LPEC Primary energy consumption World Bank	LRE Renewable energy consumption World Bank
Mean	1.604206	3.610731	11.23847	0.559544	2.211484
Median	1.594598	3.615412	11.30094	0.374523	2.236772
Maximum	1.684419	3.753418	11.57311	1.209271	2.298847
Minimum	1.511626	3.314186	10.90416	0.166027	2.059403
SD	0.051952	0.092047	0.192319	0.350108	0.067719
Skewness	0.052332	−0.628242	−0.263446	0.463024	−0.877175
Kurtosis	1.821686	3.068864	2.111995	1.601082	2.419467
Jarque-Bera	6.996887	7.917460	5.330839	14.07268	17.07380
Probability	0.030244	0.019087	0.069570	0.000879	0.000196

Source: Author's own conception, based on Eviews-12 software.

4 | EMPIRICAL FINDINGS

As part of the proposed research, the present study contributes to the existing literature on asymmetric financial stability's impact on environmental degradation in the case of Ireland, as a major gap is missing in the literature. Based on this aim, the present study explores the effect of financial stability on environmental degradation in Ireland while controlling economic growth, primary energy consumption, and renewable energy in Ireland. Table 1 reports the descriptive statistics of the time series variables used in the present study.

As an initial step, the present study captures the integration of the order of the time series variables using the Fourier ADF and traditional unit root test. The outcomes of these unit root tests are reported in Table 2. However, the trigonometric terms (except LCO_2 and LRE) are not statistically significant according to the Fourier ADF approach. Based on this outcome, LCO_2 seems stationary at level and integration of order of the variable is zero I(0), LRE seems I(1). Therefore, we applied the traditional ADF test for the unit root test. ADF unit root test result shows that while the variables are not stationary at the level I(0), they are stationary at the first difference I(1). The results show that while the integration of the order of LCO_2 is zero, I(0), the integration of the order of LFRI, LGDP, LPEC, and LRE variables is one I(1).

These findings allow seeking the existence of a long-term relationship between the variables. For the cointegration test, we use the FARDL bounds test. The FARDL approach gives robust results in small samples. Another advantage is that the FARDL approach considers the structural breaks; therefore, we do not need to apply additional structural break tests. Table 3 indicates that the variables have a long-term cointegration relationship according to the FARDL test results. To this extent, Table 4 shows the long-term coefficients based on the FARDL model.

Table 4 shows the FARDL long-run form. First, it is seen that all variables except for GDP are statistically significant. According to the findings, while LFRI and LRE decrease LCO_2, LPEC affects LCO_2 positively. The result of the Breusch-Godfrey Serial Correlation LM Test of Q-statistics is illustrated in Table 5. The outcome indicates no problem in the estimated model. As reported in Figures 2 and 3, CUSUMSQ and CUSUM reveal that the estimated model is stable and reliable.

Table 6 shows the FMOLS and DOLS findings. First, FMOLS and DOLS test results are similar to the FARDL long-term coefficient model. Therefore, it can be concluded that empirical findings are robust and consistent. FMOLS and DOLS test results depict that while LFRI and LRE decrease LCO_2, LPEC positively impacts it. In addition, LGDP is statistically significant according to the

TABLE 2 Fourier ADF and ADF unit root tests.

Variable	F-STAT	FADF	ADF
LCO_2	7.560912***	−3.909825**	
LFRI	4.814277		−1.5626
LGDP	4.586987		−1.0893
LPEC	4.358797		−2.4101
LRE	7.370032***	−2.289707	
$DLCO_2$			
DLFRI			−8.6916***
DLGDP			−3.3240**
DLPEC			−3.8469***
DLRE		−3.804761**	

Note: *, **, and *** denote statistically significant at the 10%, 5%, and 1% levels, respectively. The table reports the tests statistics.
Source: Author's own conception, based on Eviews-12 software.

TABLE 3 Fourier ARDL bounds test.

F-bounds test	Value	Significance	I(0)	I(1)
F-statistic	3.8987**	10%	2.2	3.09
k	4	5%	2.56	3.49
		2.5%	2.88	3.87
		1%	3.29	4.37

Note: *, **, and *** denote statistically significant at the 10%, 5%, and 1% levels, respectively. The decisions are based on Banerjee et al.'s critical values (2017).
Source: Author's own conception, based on Eviews-12 software.

TABLE 5 Heteroskedasticity test: Breusch-Pagan-Godfrey.

Null hypothesis: Homoskedasticity			
F-statistic	1.392333	Prob. F(22, 92)	0.1395

Source: Author's own conception, based on Eviews-12 software.

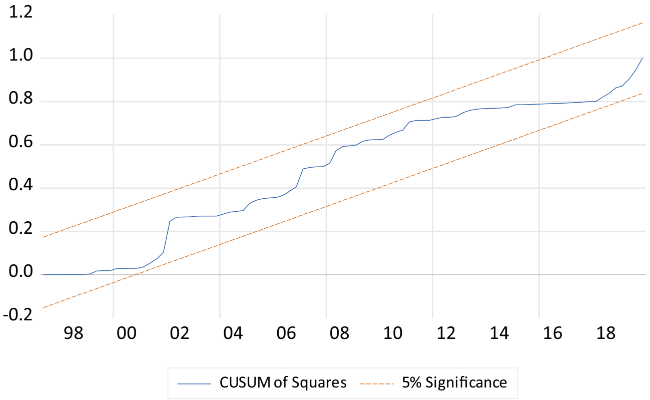

FIGURE 2 CUSUM of squares. *Source*: Author's own conception, based on Eviews-12 software.

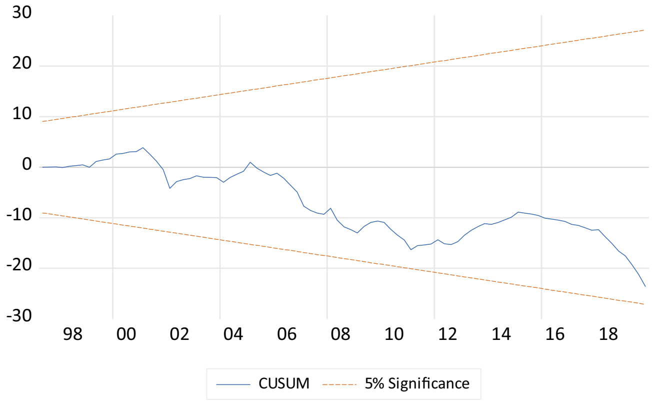

FIGURE 3 CUSUM. *Source*: Author's own conception, based on Eviews-12 software.

TABLE 4 Fourier ARDL long run form.

Variable	Coefficient	SE	t-statistic	Prob.
LFRI	−0.280700**	0.135068	−2.078215	.0405
LGDP	0.035718	0.102624	0.348046	.7286
LPEC	1.047349***	0.160493	6.525817	.0000
LRE	−0.198851***	0.070086	−2.837241	.0056
C	0.002557	0.628191	0.004070	0.9968
CointEq (−1)*	−0.063001***	0.012686	−4.966260	0.0000

Note: *, **, and *** denote statistically significant at the 10%, 5%, and 1% levels, respectively.
Source: Author's own conception, based on Eviews-12 software.

DOLS approach and negatively impacts LCO_2 in Ireland over the period 199Q1–2019Q4.

Overall results show that financial stability improves environmental quality in Ireland. Countries with efficient financial markets may have a cleaner environment (Dasgupta et al., 2001) because the advanced financial sector encourages companies to adopt low-carbon modern technologies in the energy sector (Kumbaroğlu et al., 2008) and provide financial funds for environmentally friendly investments (Omri et al., 2015). Therefore, having a robust financial market (Lane & Moloney, 2018), financial stability contributes to environmental quality in Ireland. Empirical findings are supported by some studies that found a linear relationship between financial stability and environmental quality or financial instability and environmental pollution (Abbasi & Riaz, 2016; Jalil & Feridun, 2011; Nasreen et al., 2017; Richard, 2010; Shahbaz, 2013; Tamazian et al., 2009; Zaidi et al., 2019). However, some studies found a negative relationship between financial stability and environmental quality (Farhani & Ozturk, 2015; Shahbaz et al., 2016; Yang et al., 2020; Zhang, 2011; Zhang & Chiu, 2020) or could not find a significant relationship (Ozturk & Acaravci, 2013; Salahuddin et al., 2018).

TABLE 6 Robust test.

FMOLS				
Variable	**Coefficient**	**SE**	**t-statistic**	**Prob.**
LFRI	−0.175071***	0.042735	−4.096660	.0001
LGDP	0.007366	0.058355	0.126231	.8998
LPEC	1.010212***	0.104551	9.662391	.0000
LRE	−0.138665***	0.023008	−6.026811	.0000
C	−0.002422	0.429658	−0.005638	.9955
DOLS				
Variable	**Coefficient**	**SE**	**t-statistic**	**Prob.**
LFRI	−0.081632***	0.023582	−3.461618	.0008
LGDP	−0.067052*	0.035327	−1.898060	.0603
LPEC	1.055345***	0.061378	17.19411	.0000
LRE	−0.093900***	0.014140	−6.640613	.0000
C	0.371228	0.249192	1.489725	.1392

Note: *, **, and *** denote statistically significant at the 10%, 5%, and 1% levels, respectively.
Source: Author's own conception, based on Eviews-12 software.

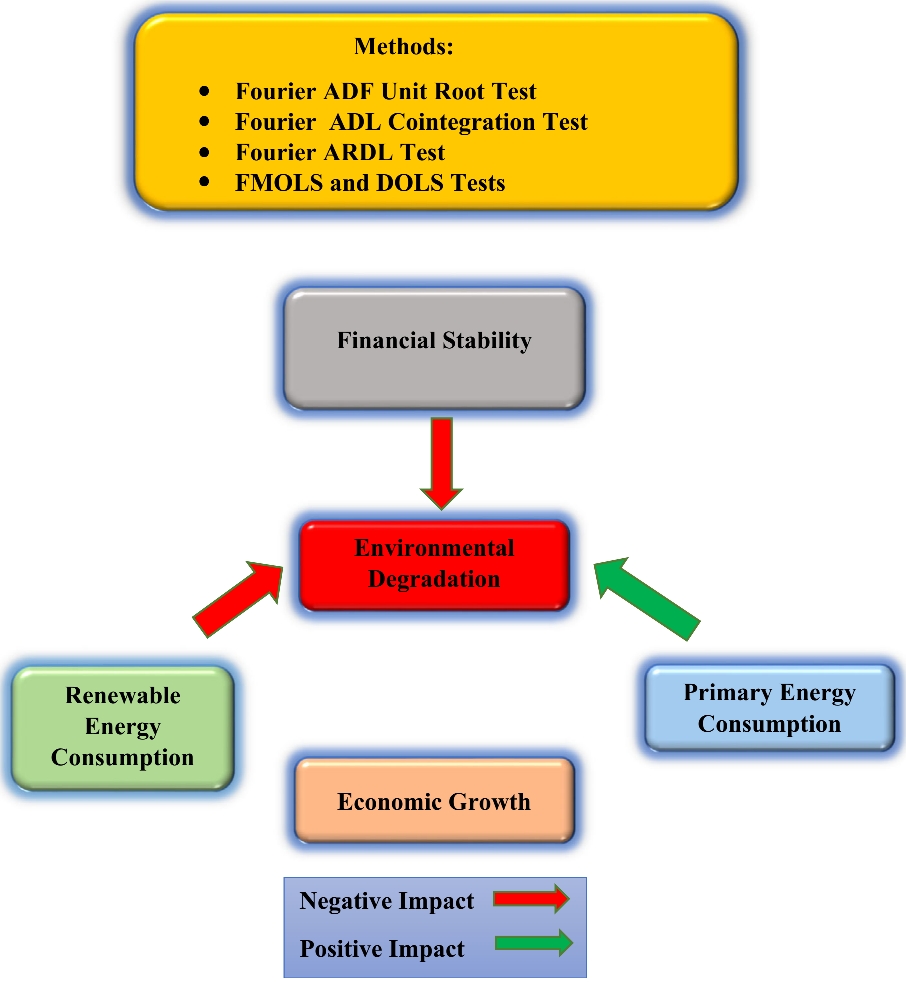

FIGURE 4 Empirical outcomes.

Primary energy consumption increases environmental degradation since fossil fuel consumption is still high in Ireland. According to Central Statistics Office (2020), in 2019, 87% of the total primary energy supply came from fossil fuels in Ireland. Besides, many studies claim that energy consumption and economic growth are essential determinants of environmental degradation (Dogan et al., 2020; Esso & Keho, 2016; Fan et al., 2017; Odhiambo, 2012). Therefore, the coefficient of primary energy consumption is consistent with the expectations. Furthermore, renewable energy consumption also improves environmental quality since it emits zero emissions into the atmosphere. By confirming our findings, Safi et al. (2021) determine that financial stability and renewable energy consumption decrease CO_2 emissions. Finally, the negative impact of economic growth on CO_2 emissions might be attributed to decoupling. Wang et al. (2013) found that developed countries might decouple CO_2 emissions and economic growth thanks to technological advancement and energy efficiency. Figure 4 reports the summary of the empirical outcomes of the present study.

5 | CONCLUSIONS

Although there is a body of evidence that financial development contributes to the quality of the environment, either positively or negatively, the effect of financial stability or financial risk on environmental degradation has not been explored comprehensively. To close the gap in the environmental tale economics literature, the present study investigates the asymmetric financial stability's impact on environmental degradation in the case of Ireland while controlling some important factors, such as economic growth, renewable energy consumption, and primary energy consumption. Based on this aim, the present study uses novel economic approaches: Fourier ADF unit root, FARDL bounds, and FARDL tests.

The FARDL bounds test outcomes reveal a long-run cointegration equation between environmental degradation and financial stability, economic growth, renewable energy consumption, and primary energy consumption in Ireland. After capturing the long-run linkage, the FARDL approach was performed to identify the sign and significance of the financial stability, economic growth, renewable energy consumption, and primary energy consumption on environmental degradation in Ireland. The outcomes from FARDL approach reveal that (i) financial stability leads to a decrease in environmental degradation in Ireland; (ii) renewable energy consumption grows environmental sustainability; (iii) primary energy consumption has a negative effect on Ireland's environmental quality. As a robust test, FMOLS and DOLS' outcomes proved the strength of the outcomes of the FARDL test. These findings are consistent with the empirical results determined by (Abbasi & Riaz, 2016; Jalil & Feridun, 2011; Khan et al., 2019; Nasreen et al., 2017; Richard, 2010; Safi et al., 2021; Shahbaz, 2013; Tamazian et al., 2009; Zaidi et al., 2019). Our findings show that increasing financial stability could be a policy tool to lower CO_2 emissions and reach net zero targets. These findings could be applied widely in other regions, since financial stability could promote technological developments, green investments, and energy efficiency. However, there is an important limitation in the applicability of these policies. A strong financial infrastructure is required for financial stability to reduce CO_2 emissions. Otherwise, countries may increase CO_2 emissions while trying to increase financial stability (Shahbaz et al., 2016; Zhang & Chiu, 2020).

To tackle climate change, the European Union has set ambitious goals for reducing greenhouse gas emissions. These objectives call for net emissions to reach zero by 2050 and a reduction of 45% from 2020 levels by 2040 (Environmental Protection Agency, 2022). Yet, net zero targets are far from the reduction in emissions necessary to maintain the Earth's temperature at or below the Paris Agreement's goal of 1.5°C (Hans et al., 2022). In this context, it is necessary for Ireland to implement green policies towards union goals. However, emission reduction has a financial burden (Clarke et al., 2014) and the budget and cost required to reach net zero targets may be higher than anticipated (Tol, 2021). At this point, increasing financial stability, Ireland could catalyse its emission reduction to achieve a net zero emissions target by 2050. The other advantage is that Ireland could promote decarbonization by stimulating economic growth (Glynn et al., 2019). In this way, the Irish government could implement decoupling policies regarding economic growth and the environment meaning that Ireland could decrease CO_2 emissions while promoting economic growth.

There is a need to increase financial reforms to establish a positive relationship between financial stability and environmental sustainability. This way, private sector loans could be provided for low-carbon and climate-resilient investments. Restrictive regulations should be introduced for energy-intensive sectors that cause environmental pollution. However, the green transition of these sectors should be promoted at the same time. In this way, the green transition could be achieved without market failures. Firms should be provided cheaper credits to adapt to low-carbon and eco-friendly technologies, which increase environmental sustainability (Safi et al., 2021).

As a policy suggestion, this study encourages the Irish government to increase the level of financial stability to reduce CO_2 emissions, which will help him meet its long-term targets under the Paris Agreement. Moreover, the Irish government needs to ensure the transition to new and high-energy efficiency technologies from outdated ones. Policy encouraging rapid investment in the development of renewable energy should be enacted. Renewable energy incentives could decrease the ecological footprint, increase environmental sustainability, and ease achieving net zero targets.

The limitation of this study is that it does not consider the dimension of cultural characteristics and domestic financial dynamics. In this context, we have a recommendation for future studies. Comparative results obtained from a panel data analysis will be examined in separate models, considering the financial infrastructures and financial stability of developed, developing, and underdeveloped countries, which will contribute to the literature.

AUTHOR CONTRIBUTIONS

Dervis Kirikkaleli: review and editing; Software; Investigation; Conceptualization; Supervision. **Emrah Sofuoğlu:** writing – original draft; Visualization; Methodology; formal analysis.

ACKNOWLEDGEMENTS

We also confirmed that this research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors. Besides, we have no conflicts of interest to disclose.

PEER REVIEW

The peer review history for this article is available at https://publons.com/publon/10.1002/gj.4707.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

ORCID

Dervis Kirikkaleli https://orcid.org/0000-0001-5733-5045

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How to cite this article: Kirikkaleli, D., & Sofuoğlu, E. (2023). Does financial stability matter for environmental degradation? *Geological Journal*, *58*(9), 3268–3277. https://doi.org/10.1002/gj.4707