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Published online: 20 Jan 2022.

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Green finance and sustainable development in Europe

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ABSTRACT

This study provides a comprehensive analysis of whether financial development impacts environmental degradation, over time. It highlights how financial development, institutional frameworks, and foreign investment dictate the extent of green development. The sample includes 40 countries in Europe and data is collected on a large set of variables, for the years from 1990 to 2019. Financial development is measured through domestic credit to the private sector, bank credit to the private sector and foreign direct investment (FDI). Environmental degradation is measured through energy use, CO_2 emissions, greenhouse emissions and natural resource depletion. The model controls for income levels, institutional quality, technology, education, population, and urbanization. Regression analysis is conducted to analyze the data. The results suggest that financial development has a negative relationship with four different measures of environmental degradation, while FDI and institutional quality appear to worsen the environmental measures. Recommendations for policy makers include development of green finance policies and strong institutions, to lower environmental degradation in the long run.

1. Introduction

Sustainable economic development has been at the forefront of much debate in recent years. Along with myriad other factors, environmental pollution is of importance for economic growth and well-being of the population at large. The effect of pollution is not only harmful for human health but also worsens the depletion of resources and increases the occurrence of natural disasters, caused by rapid climate change. Environmental pollution includes deterioration of land, soil, water, and the atmosphere. The primary sources of environmental degradation include an over-reliance on fossil fuel combustion for energy, for domestic as well as commercial purposes. The toxic emissions from automobiles and the waste produced at industrial sites are also major contributors. In addition, deforestation, degradation of soil, and loss of natural

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resources are relevant issues for policy makers. Essentially, the root cause of environmental degradation can be traced to the aftermath of human activities like agriculture, transport, manufacturing, and energy production. Energy consumption and the emission of greenhouse gases have increased considerably over the last two decades, and present a very real global challenge. As one of the primary inputs for industries and households alike, energy can be considered a prerequisite for economic activity. As globalization increases, higher levels of energy will inevitably be consumed and this will result in increased carbon emissions (Shahbaz et al., 2018).

One of the driving forces for economic development is the financial sector. With a strong management system, even countries with limited financial resources are able to employ them productively. The efficient use of financial resources leads to innovation in the finance sector, stimulating economic growth in turn (Furuoka, 2015). There are strong correlations between financial and economic development (Sadorsky, 2011). Well-managed financial sectors are more attractive for investors, provide a boost for the stock market and stimulate economic activity. By stimulating economic growth, the financial sector encourages inflows of FDI, which further boosts economic growth, completing a cycle of development (Azam, 2016). Progress of the finance sector also encourages deepening of the financing network, which lowers financial costs. This encourages industries to borrow for increasing production. This leads to an increase in energy consumption and, therefore, carbon emissions. Thus, it can be argued that financial development has a significant effect on environmental degradation (Haseeb et al., 2018). This relationship between financial development and environmental quality can most succinctly be summed up by the Environmental Kuznets Curve (EKC). The financial crisis of 2008-9 proved that shocks to the financial system are felt across the entire economy. It is safe to say that the financial sector has an important role to play in the overall health of an economy. This generates the question: does financial development impact environmental degradation over time?

In recent years, existing literature suggests that financial development is a driving force for economic growth (Borio, 2011; Nasir et al., 2014; Rajan & Zingales, 2003; Shahbaz et al., 2018) and to speak of financial stability is to speak of economic stability (Shahbaz et al., 2018). With the emphasis on Sustainable Development Goals (SDGs) in recent years, the associations between green economics and finance are of increasing interest across the globe. The basic idea is that countries can achieve financial and economic growth, while also preventing environmental degradation.

Importantly, Tamazian and Rao (2010) suggested that institutional quality and financial development together determine environmental degradation. So for this research, we also investigate how well governance dictates the extent of green development countries are able to achieve. This has previously been analyzed by Ntow-Gyamfi et al. (2020) for African countries, Azam (2016) and Nasir et al. (2019) for the ASEAN region, Gorus and Aslan (2019) in MENA countries, Haseeb et al. (2018) for BRICS countries and Park et al. (2018) for European Union (EU) countries.

Within the EU, around 8% of all greenhouse gas emissions are caused by the consumption of energy (Shahbaz et al., 2018). Recently, in response to the United States

withdrawal from the Paris Agreement in 2017, EU has doubled down to curb climate change and tackle environmental challenges (Shahbaz et al., 2018). In addition, the Lima Call for Climate Action has mandated EU members' reduction of domestic emission of greenhouse gases by 40% by 2030.

A pandemic is an unpleasant natural experiment which offers a rare opportunity to assess the financial sector (Mirza, Hasnaoui et al., 2020; Mirza, Naqvi et al., 2020; Mirza et al., 2022; Umar, Su, Rizvi, & Lobonț, 2021; Umar, Su, Rizvi & Shao, 2021; Yarovaya, Mirza, Rizvi, Saba & Naqvi, 2020; Yarovaya et al., 2021). In the context of Europe, there was exponential growth in COVID-19 cases and the pandemic epicenter moved from China to Europe (Mirza, Naqvi et al., 2020). The large-scale spread of this disease disrupted many businesses across the EU, as lockdowns were strictly imposed for weeks (Mirza, Rahat et al., 2020). These businesses are trying to combat the challenges, including financial ones. These factors make the EU an appropriate setting for the current study.

The current study has collected data of 40 European countries, for the $1990 - 2019$ period. This covers different measures of financial development and environmental degradation. The impact of institutional quality is also assessed. Regression analysis is applied to analyze the data. Results suggest that financial development has an inverse relationship with environmental degradation, while FDI is positively associated. Quality of instituions helps curb environmental degradation. However, strong institutions have to be combined with green finance policies to help lower environemntal damage. Importantly, education has a significant negative relationship with environmental degradation.

This study has provided multiple practical implications. It can be used to guide the development of policies, in the finance sector. It has highlighted the different types of environmental degradation. This information can be used by authorities to implement the required changes (for example, a tax on carbon emission). The research has shown the importance of institutions in limiting environmental damage. So it presents the rationale for setting up strong institutions. This article has also underlined the importance of education, for tackling environmental deterioration. So it should be used by authorities, in the education sector, to design appropriate policies.

Moreover, this paper presents the important role institutional quality and education play in regards to sustainable financial development by highlighting the need for institutional reforsms in countries with high carbon emissions, GHG emissions, high rates of natural resource depletion and high concentration of energy usage. It indicates implications for financial institutions in vetting the borrowing businesses for a greener economy.

In this paper, Section 2 provides an overview of existing literature on the topic. Next, Section 3 presents the methodology. Section 4 highlights and discusses the findings. This paper ends with a conclusion, in Section 5.

2. Theoretical background and literature review

The finance sector plays an important role in helping businesses acquire the financial resources they need (Ji et al., 2021). It also provides earning oportunities for

investors. In this sector, it is necessary to increase green financing because traditional financing options are likely to affect the environment negatively (Kim et al., 2020). Further, investors are becoming more aware of the value of green energy for environmental welfare and this has led to an upswing in green finance (Gagnon et al., 2020; Miralles-Quirós & Miralles-Quirós, 2019). Green financing lowers credit risk because sustainable business models have less volatility in earnings (Umar, Ji, Mirza, & Naqvi, 2021). Borrowers with less credit risk means lenders can benefit from lower loan loss provisions and capital requirements. This helps achieve environmental goals. Research has found that green financial assets outperform assets that are not environment-friendly (Ji et al., 2021). However, caution is recommended because research has also found that there are disincentives for investors who would like to avail green options (Naqvi et al., 2021).

This relationship between finance and the environment is dynamic and evolves over time (Torras & Boyce, 1998). Existing literature suggests that there is a U-shaped curve, the EKC, that explains the relationship between development and environmental welfare. In the initial stages, countries are too poor to focus on environmental conservation so they just follow policies that are needed to attain development. Once they reach some semblance of stability, attention starts shifting to the conservation of natural resources and sustainable development. As countries adopt policies that reflect these changes, the result is a U-shaped curve explaining the relationship between income and the environment (Galeotti et al., 2006). It is safe to assume that in the initial stages, environmental degradation may be rapid because the adoption of green policies may be too costly for young nations to justify. As concerns begin to rise about the quality of air and water, economies start looking for environment-friendly solutions (Dinda, 2004). Pao and Tsai (2011) have found that economic and financial development initially contribute to degradation of the environment (carbon emissions) but over time, this deterioration slows down and even improves in some cases. Similarly Shahbaz have found that that there exists a non-linear relationship between financial deepening and environmental degradation (energy consumption and carbon dioxide emissions), across countries ranging from low-income to high-income. They have also discovered that FDI led to an increase in environmental degradation. This phenomenon has been described by some researchers as Pollution Haven Hypothesis. The financial and economic development lead to higher emissions of greenhouse gases but after a certain level, carbon emissions are controlled.

Relevant research has highlighted three possible channels between financial development and environmental degradation. First, financial development can impact environmental degradation through economic growth. Financial development attracts FDI, which encourages economic growth. Economic growth leads to higher energy consumption, which results in degradation of the environment (Shahbaz et al., 2018). Second, when financial markets flourish there is more credit available for consumers. This increases purchasing power and demand for energy-intensive products. When such products are purchased and consumed in greater quantities, pollution increases (Agbloyor et al., 2016). Third, financial development increases investment which leads to higher power consumption and power production is a main contributor to

environmental deterioration (Marrasso et al., 2019). In this context, economic growth generates growth in demand and consumption of energy (Taghizadeh-Hesary et al., 2021). Research has found that countries that rely too much on non-renewable resources face lower financial development (Umar, Ji, Mirza, & Rahat, 2021).

Based on these findings, the following relationship is hypothesized.

H_1: There is a curvilinear relationship between financial development and environmental welfare

In this research, we also investigate how countries' institutional frameworks affect these financial development-environmental sustainability relationships. The rationale behind this is that institutional quality and strength of regulatory frameworks are important in this context. Specifically, quality institutions are more likely to promote the interests of society by demanding laws and regulations that lead to greener development. This is why Azhgaliyeva and Liddle (2020) promoted fiscal policies to support climate-friendly investment options. Research has found that regulators have a strong influence on green investing policies (Chen & Feng, 2019). Supporting this, Ntow-Gyamfi et al. (2020) highlighted the pivotal role of institutional quality in preventing environmental deterioration in the long run. Abid (2017) even stated that the association between economic and carbon performance must be routed through development of institutions, such as financial intermediaries.

Based on the evidence highlighted, the following relationship is hypothesized.

H_2: There is a negative relationship between institutional quality and environmental degradation

In this context, the Paris climate conference is an important milestone to support environmental welfare across the world (Ji et al., 2021). An valuable outcome is the promotion of investment that supports sustainable business models. This investment is pivotal in achieving goals of the conference (Ji et al., 2021). Thomä et al. (2021) have suggested including climate risks in portfolio management to help reach the goals of the Paris climate agreement. Another relevant topic is the SDGs which are 17 objectives set by the United Nations (UN) in 2015, with an end date of 2030 (Fenner & Cernev, 2021). They cover areas like environmental protection and poverty reduction. So UN's agenda has highlighted the importance of green energy development and pollution reduction (Taghizadeh-Hesary & Yoshino, 2020). However, the COVID-19 pandemic has moved attention away from these goals. A novel coronavirus struck China, at the end of 2019, and spread across the world (Zhou et al., 2020). As the world tries to cover the costs generated by this disaster, pressure will build up to lower environmental standards and make economic growth a priority. In this situation, environmental degradation warrants government action, guided by SDGs and the Paris climate agreement (Yoshino et al., 2021).

The ongoing COVID-19 crisis has adversely impacted major economies and many financial markets (Rizvi, Mirza et al., 2020; Yarovaya, Mirza, Rizvi & Naqvi, 2020; Yarovaya, Mirza, Rizvi, Saba & Naqvi, 2020). It was also found that performance of renewable funds deteriorated during this pandemic (Naqvi et al., 2021). However, this crisis has generated some positive effects also. In the environmental welfare area, carbon emissions were contained during the first half of 2020 as lockdowns were

Table 1. Description of variables.

	Variable	Measure
Environmental degradation	Energy Use	Energy use per capita (kg of oil per capita)
	CO_2 Emissions	Carbon dioxide emissions per capita
	Greenhouse Emissions	Greenhouse emissions per capita
	Natural Resource Depletion	Natural Resource Depletion (% of GNI)
Financial development	Financial Development$_1$	Domestic credit to the private sector, percent of GDP
	Financial Development$_2$	Bank credit to the private sector, percent of GDP
	Investment Inflows	Foreign Direct Investment (% of GDP)
Controls	Income Level	GDP per capita, current U.S. dollars
	Institutional Quality	Government effectiveness index (-2.5 weak; 2.5 strong)
	Technology	Mobile phone subscribers, per 100 people
	Population	Population size, in millions
	Urbanization	Urban population (% of total population)
	Education	Secondary school enrollment, percent of all eligible children

Source: World Development Indicators.

imposed across the globe to control the spread of this disease (Tollefson, 2021). These lockdowns led to suspension of transportation and industrial operations, which are the main sources of air pollution (Nundy et al., 2021). As controls were relaxed in the second half, emissions started increasing again. So even in the post-pandemic world, carbon emissions will remain a relevant issue. Further, in developed economies financial investments can play a pivotal role in scaling up green projects (Schumacher et al., 2020). In the EU, going green improves financial flexibility and access to credit markets (Fernandez-Cuesta et al., 2019). These factors justify conducting research in the context of EU countries.

3. Research methodology

Our data was collected from 40 (out of 48) European countries, with the variables covering the years from 1990 to 2019. 8 countries were removed from our sample due to lack of data availability. The data inlcudes multiple measures of environmental degradation and financial development, as well as a comprehensive list of control variables to take confounding factors into account. Environmental degradation is estimated using four proxies: energy use, CO_2 emissions, greenhouse emissions, and natural resource depletion. Financial development is measured using domestic credit to the private sector, bank credit to the private sector, and FDI. The model controls for income, institutional quality, technology, education, population, and urbanization. The complete list of variables is presented in Table 1.

Before the methodology and analysis, summary statistics are presented in Table 2.

The summary statistics show that the average European country uses 3455 kg of fuel, emits 7.4 kilotons of CO_2 and releases 2.38 kilotons of other greenhouse gases per capita. The average European country depletes its natural resources at a rate of 0.7% per annum. However the standard deviation, particularly for natural resource depletion, is large. A regression analysis will allow for a more robust assessment of environmental degradation across Europe, with a focus on the role of financial development and institutional quality (Chang, 2015; Sadorsky, 2011). The regression results account for time- and country-fixed effects as well as random effects.

Table 2. Summary statistics.

Variable	Observations	Mean	Standard deviation
Energy Use (kg per capita)	1,025	3455.53	2191.03
CO_2 Emissions (kt. per capita)	1,035	7.40	3.69
Greenhouse Emissions	884	2.38	4.88
Natural Resource Depletion (% of GNI)	959	0.70	1.63
FD_1 (% of GDP)	1,053	70.95	46.78
FD_2 (% of GDP)	897	72.24	48.42
FDI (% of GDP)	1,119	7.47	27.48
Income ($ per capita)	1,167	22730.43	21501.64
Governance (-2.5 to 2.5)	840	0.84	0.88
Technology (Mobile Subscriptions per 100)	1,129	74.21	51.69
Population (millions)	1,200	19.96	29.67
Urbanization (% of total population)	1,200	69.34	13.51
Education (% of children in secondary school)	1,067	101.35	16.38

Source: Author's own calculations.

4. Results and discussion

The results from the regression analysis are presented in Table 3.

The regression results are presented below for each measure of environmental degradation.

1. CO_2 Emissions
   Carbon emissions have a significant inverse relationship with financial development, measured by FD1 and FD2. However, we have found a significant positive relationship between carbon emissions and FDI. This suggests that as foreign investment increases, countries tend to move towards higher levels of carbon waste. The relationship between carbon emissions and institutional quality is also significant at the 95% level, indicating that the enforcement of strong frameworks helps countries in the implementation of green initiatives. The results also suggest that countries with higher education levels have lower levels of carbon emissions, while countries with bigger populations and higher rates of urbanization face an increase in carbon emissions.

2. Natural Resource Depletion
   NRD follows a pattern similar to that of carbon emissions. It has a significant inverted relationship with FD1 and FD2, and a significant positive relationship with FDI, suggesting that foreign inflows of investment increase environmental degradation in the host country. Institutional quality appears to play an important role in reducing the depletion of resources, with a significant relationship at the 95% level. NRD does not appear to have a relationship with the technology, education, and urbanization rates of countries but does increase as population increases.

3. Greenhouse Emissions
   The results indicate that greenhouse emissions decrease as financial development increases, measured by FD1 and FD2. However, these emissions do not have a significant relationship with FDI. It has also been observed that the greater a country's population is, the higher its greenhouse gas emissions are. Countries with higher education levels have lower levels of these gases.

Table 3. Regression results.

Variables	(1) CO$_2$ emissions	(2) Natural resource depletion	(3) Greenhouse emissions	(4) Energy use
FD1	−0.107***	−0.197***	−0.6477*	−0.3809
	(0.0396)	(0.0203)	(0.3449)	(0.2871)
FD2	−0.0785**	−0.204***	−0.6081*	−0.3260
	(0.0397)	(0.0202)	(0.3446)	(0.2873)
FDI	0.00610*	0.00578*	0.0299	0.9752***
	(0.00330)	(0.00298)	(0.0256)	(0.2307)
Income	0.6615***	0.3365***	1.046	0.0295***
	(0.842)	(0.592)	(0.713)	(0.00607)
Governance	−0.908***	−0.503***	−0.2227	0.2578
	(0.249)	(0.143)	(0.1935)	(0.1772)
Technology	0.0126***	−0.000223	0.0038	−0.2340
	(0.00346)	(0.00185)	(0.0027)	(0.2472)
Population	0.0139***	0.0184***	0.0137***	0.1235***
	(0.00418)	(0.00231)	(0.0344)	(3.030)
Urbanization	0.0781***	0.00966	0.0726	0.1120***
	(0.0131)	(0.00833)	(0.0112)	(0.9600)
Education	−0.0313***	−0.00922	−0.02626*	−0.2397***
	(0.0101)	(0.00590)	(0.0851)	(0.7292)
Constant	3.045***	0.565	1.468*	−0.1991***
	(0.923)	(0.495)	(0.7590)	(0.6662)
Observations	574	554	414	529
R-squared	0.416	0.382	0.832	0.480

Standard errors in parentheses.
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.
Source: Author's own calculations.

4. Energy Use
   Consumption of energy does not have a significant relationship with FD1 or FD2 but it is positively related to FDI. One possible explanation is that as foreign investment increases, industries flourish and consumption of fossil fuels (for energy) increases. Institutional quality has little to no role in mitigating this, while education levels appear to have an inverse relationship with energy use. Consumption of fossil fuels is further increased by growth of populations and more urbanization.

These results are aligned with the work of Ntow-Gyamfi et al. (2020). Results indicate that environmental degradation and institutional quality have an ambiguous relationship – while institutional quality is helpful in reducing the depletion of natural resources and carbon emissions, it does not appear to affect greenhouse emissions and energy use. These findings also suggest that setting up strong institutions can enable countries to pursue greener policies. The presence of strong environmental protection institutions helps in ensuring that economic agents are kept in control and new policies are not harmful for the environment.

The evidence for the relationship between financial development and environmental degradation is also a mixed bag, as FD1 and FD2 have a negative relationship with environmental degradation but increases in FDI also lead to greater harmful effects on the environment. This provides a unique challenge for policy makers, because they need to develop policies that encourage financial deepening but also

Table 4. DH Granger non-causality test.

Variables	CO$_2$ emissions	Natural resource depletion	Greenhouse emissions	Energy use
FD1	26.29***	2.98***	1.53	2.295
FD2	7.466***	2.34*	2.12*	2.52**
FDI	2.13	0.208	−7.635	2.17**
Secondary School Enrollment	3.18*	4.98*	6.18	3.36*
GDP Per capita	4.836***	2.10**	−0.202	0.389
Governance	3.08*	−0.95	−0.93	−1.376
Technology: Mobile Subscriptions per 100	3.72**	2.66**	2.08*	2.93**
Population	12.6***	2.79**	9.94***	16.9***
Urbanization	12.18***	0.69	10.93***	17.26***

Standard errors in parentheses.
***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.
Source: Authors' own calculations.

avoid damage to the environment. This is important because institutional quality alone cannot handle all sources of environmental degradation.

The next step in our analysis is to test the direction of the relationship between the variables of interest. We employ the Granger causality test to check if financial deepening and the control variables Granger cause changes in environment. Due to the data being a panel dataset spanning multiple countries and years, we employ the Dumitrescu and Hurlin non-causality Granger test (the DH test). The optimal lag length is selected using the Akaike information criteria (AIC), Bayesian information criteria (BIC, and Hannan–Quinn information criteria (HQIC). The results are presented in Table 4:

Table 4 shows that Fd1, FD2, education, national income, institutional quality, population and urbanization all Granger cause increases in CO2 emissions, while FDI does not Granger cause changes in CO2. For resource depletion, FD1, FD2, education, income level, technology and population Granger cause changes in natural resource depletion rates, whereas FDI, governance and urbanization have no significant relationship. For total greenhouse gas emissions, only FD2, technology, population and urbanization have a significant Granger causality, while FD2, FDI, education, technology, population and urbanization all have a Granger effect on total energy usage. These results make sense in line with our earlier regression analysis, especially the importance of institutional quality in curbing environmental degradation, as well as the role of secondary education at reigning in harmful effects of financial deepening.

5. Conclusion

This paper investigates the relationship between financial deepening and environmental degradation, taking into account the role of institutions in avoiding environmental degradation. Results suggest that FD1 and FD2 have an inverse relationship with different measures of environmental degradation, while FDI appears to worsen certain environmental measures. We also find that the quality of instituions has a significant role in curbing environmental degradation. However, strong institutions must be combined with green finance policies to help lower, if not eliminate, long run effects

on the environment. One consistent finding has been that education, measured by secondary enrollment, has a significant relationship with environmental degradation. Specifically, countries will benefit from focusing on post-primary education for a more sustainable environment in the long run.

This study has provided multiple practical implications. It can be used to guide the development of financial policies. It has highlighted different forms of environmental degradation. This information can be used by authorities to implement required changes (for example, a tax on carbon emission). This research has uncovered the role of institutions in controlling environmental damage so it presents the rationale for setting up strong institutions. It has also underlined the importance of education for environmental welfare. So it should be used by authorities to design appropriate education programs.

Although this research has generated useful results, it has certain limitations. These should be viewed as opportunities for future research on this topic. The model can be expanded to include more variables. For example, more types of financial development or environmental degradation. Future studies can select a different sample, for example, it would be interesting to find out whether these findings hold in developing countries. This study has relied on secondary data only so future researchers should design a different methodology.

Conflicts of interest

There are no competing interests, financial or non-financial.

Data statement

Data will be made available on request.

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Appendix: Sample countries

1. Denmark
2. Finland
3. Cyprus
4. Iceland
5. Switzerland
6. Sweden
7. Malta
8. Netherlands
9. Norway
10. Luxembourg
11. Belgium
12. Austria
13. Turkey
14. United Kingdom
15. Germany
16. France
17. Spain
18. Ireland
19. Portugal
20. Greece
21. Lithuania
22. Hungary
23. Italy
24. Poland
25. Russia
26. Estonia
27. Albania
28. Slovenia
29. Czechia
30. Ukraine
31. Moldova
32. Slovakia
33. Belarus
34. Latvia
35. Croatia
36. Bosnia and Herzegovina
37. Serbia
38. Bulgaria
39. Romania
40. North Macedonia