Environmental Implications of Financial Development in CEE countries

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Abstract: The examination considers the causality between financial development and carbon dioxide (CO_2) emissions in the sample of six Central and Eastern European (CEE) countries in the period range between 2000 to 2020. Utilizing the Dumitrescu and Hurlin panel causality test, the results confirmed a one-way causality, where financial development precedes changes in CO_2 emissions. The observed one-way causality suggests that improvements or advancements in financial development might have implications for environmental sustainability. Additionally, the Westerlund error-correction–based panel cointegration tests reveal cointegration between the variables, indicating a stable equilibrium association among them in the complete sample of countries. As countries strive for economic growth and development, it becomes crucial to consider the environmental consequences and adopt measures that promote sustainable practices. Policymakers and stakeholders must proactively recognize the potentially important role of financial development in shaping environmental outcomes and identify opportunities to effectively integrate sustainable practices into financial and economic strategies.

Keywords: financial development, CO_2 emissions, CEE countries

1. Introduction

The European Union (EU) has set an ambitious goal to achieve climate neutrality by 2050. This means creating an economy where the total greenhouse gas emissions produced are balanced by the amount removed from the atmosphere, effectively resulting in zero net emissions. This commitment forms the core of the European Green Deal, which outlines the EU's comprehensive plan to address climate change and promote sustainability [1]. Achieving carbon neutrality by 2050 poses a significant and complex challenge for the Central and Eastern European (CEE) countries. Unlike their more developed counterparts in Western Europe, CEE countries cannot simply replicate the strategies employed by them. Instead, they must chart a unique path toward carbon neutrality that aligns with their specific circumstances and capabilities.

While numerous studies have shed light on the impact of economic development on carbon dioxide emissions, the relationship between financial development and emissions has been relatively understudied, leading to inconsistent findings. Interestingly, the period between 2007 and 2009 witnessed a significant reduction in global per capita CO_2 emissions [2], indicating a subtle correlation with the global

financial crisis of 2007-2008. This observation underscores the potential influence of financial factors on carbon emissions.

The prevailing mainstream viewpoint regarding the relations between financial development and CO_2 emissions can be categorized into three main perspectives. First, a majority of studies have concluded that financial development has a detrimental effect on CO_2, as demonstrated by research conducted by [3]. Second, there are some studies that have highlighted the possibility of financial development leading to an increase in CO_2, as observed in [4]. Finally, thirdly, certain studies have found no significant correlation between financial development and CO_2, suggesting a lack of substantial connection between these two factors [5].

The primary objective of the paper is to investigate the causal relationship between financial development and CO_2 emissions in the CEE countries. The study aims to delve deeply into this subject to determine whether financial development plays a causal role in influencing CO_2 emissions in these countries. The primary contribution of the research is to empirically uncover the causal connection between financial development and CO_2 emissions in selected CEE countries, complementing the existing literature with valuable insights. To achieve this research objective, the paper employs the Dumitrescu and Hurlin panel Granger causality test (DH test) [6], which is particularly suitable for examining causality when cross-sectional dependence is present.

2. Data and methodology

The analysis in the study utilizes annual data spanning the period from 2000 to 2020. The research focuses on six CEE countries, namely Bulgaria, Croatia, the Czech Republic, Hungary, Poland, and Romania, as the sample for examination.

Financial development is presented by the financial development index provided by the International Monetary Fund – variable FD. This index comprises nine individual indicators that collectively measure the depth, accessibility, and efficiency of financial institutions and financial markets. The CO_2 emissions are presented as the yearly percentage increase in total production-based carbon dioxide (CO_2) emissions, excluding emissions resulting from land-use changes – variable CO_2 emissions. Data on CO_2 emissions were taken from the Global Change Data Lab (Our World in Data).

Given the high level of interactivity and interconnectedness in the economies of the analyzed countries, the occurrence of spatial spillover consequences becomes more probable. These spillover effects can be a fundamental cause of cross-sectional dependence in the data. Two tests, the Breusch-Pagan LM test and Pesaran-scaled LM test, are used to examine cross-sectional dependence among the units in the data. The Breusch-Pagan test detects heteroskedasticity, while the Pesaran-scaled LM test specifically identifies cross-sectional correlation in panel data, indicating potential spatial spillover effects [7]. These tests ensure the reliability of the research findings on the relationship between FD and CO_2 emissions in the CEE countries. The article also utilizes the error-correction–based panel cointegration tests proposed by Westerlund [8]. Two group statistics (Gt, Ga) test whether at least one unit is cointegrated, while two panel statistics (Pt, Pa) test whether the entire panel is cointegrated. Lastly, to assess the

causality between financial development and CO_2 emissions, the study employs the DH test. This test is well-suited for yielding reliable results in both large and small heterogeneous panels, while also considering cross-sectional dependence. The DH test utilizes bootstrapping to enhance the statistical validity of the panel-causality test by reducing the impact of cross-sectional dependence [6].

3. Results and Discussion

Table 1 displays the results of the cross-sectional dependence tests, indicating that there is indeed cross-sectional dependence among the examined countries. The presence of cross-sectional dependence supports the appropriateness of using the DH test to examine the causality between financial development and CO_2 emissions.

Table 1. Cross-sectional dependence tests results

Variable	FD	CO_2 emissions
Breusch–Pagan LM	145.3339	92.65646
	(0.0000)	(0.0000)
Pesaran-scaled LM	23.79561	14.17806
	(0.0000)	(0.0000)

Source: Authors' calculations

Table 2 presents the results of the robust Westerlund error-correction–based panel cointegration tests. The robust p-values for Gt, Ga, Pt, and Pa statistics lead to the rejection of the null hypothesis of no cointegration at a 1% significance level, indicating the presence of a cointegration relationship between financial development and CO_2 emissions in the complete sample of countries.

Table 2. The Westerlund cointegration test results

Westerlund's Test	Value	Z-value	P-value	Robust P-value
Gt	-3.405	-5.719	0.0000	0.0000
Ga	-13.185	-5.053	0.0000	0.0000
Pt	-9.658	-7.203	0.0000	0.0000
Pa	-14.785	-11.640	0.0000	0.0000

Source: Authors' calculations

The results of the short-run dynamic bidimensional causality between the variables presented in Table 3. reveal a one-way causality, where financial development influences CO2 emissions. This finding indicates that changes in financial development precede changes in air pollution, implying that improvements or alterations in financial development may have an impact on CO_2 emissions in CEE countries.

Table 3. The Dumitrescu-Hurlin panel causality test results

Variable	FD	CO_2 emissions
FD	-	-1.1256
CO_2 emissions	5.4701**	-

Notes: *The values are the Z-bar statistics. ** Indicate significance at 5% P-values are computed using bootstrap replication*

Source: Authors' calculations

4. Conclusions

The analysis demonstrates a one-way causality from financial development to CO_2 emissions, indicating that changes in financial development precede changes in air pollution levels in CEE countries. The finding emphasizes the potential role of financial development as a driver of environmental outcomes, underscoring the need for integrating sustainability considerations into economic and financial strategies.

One possible limitation of the examination is that while the DH test showed causality between FD and CO_2 emissions, it did not provide insights into the specific positive or negative impacts of this relationship. To address this limitation, future research can use appropriate panel models to better understand the magnitude and direction of the effects between FD and CO_2 emissions, thus improving the examination's comprehensiveness.

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References

[1] European Commission. (n.d.). 2050 long-term strategy. Retrieved from https://climate.ec.europa.eu/eu-action/climate-strategies-targets/2050-long-term-strategy_en

[2] Sadorsky, P. (2020). Energy Related CO2 Emissions before and after the Financial Crisis. *Sustainability, 12*(9), 3867. doi:10.3390/su12093867

[3] Al-mulali, U., Tang, C. F., & Ozturk, I. (2015). Does financial development reduce environmental degradation? Evidence from a panel study of 129 countries. *Environmental Science and Pollution Research, 22*(19), 14891–14900. doi:10.1007/s11356-015-4726-x

[4] Sehrawat, M., Giri, A. K., & Mohapatra, G. (2015). The impact of financial development, economic growth and energy consumption on environmental degradation. *Management of Environmental Quality: An International Journal, 26*(5), 666–682. doi:10.1108/meq-05-2014-0063

[5] Maji, I. K., Habibullah, M. S., & Saari, M. Y. (2017). Financial development and sectoral CO2 emissions in Malaysia. *Environmental Science and Pollution Research, 24*(8), 7160–7176. doi:10.1007/s11356-016-8326-1

[6] Dumitrescu, E.-I., & Hurlin, C. (2012). Testing for Granger non-causality in heterogeneous panels. *Economic Modelling, 29*(4), 1450–1460. doi:10.1016/j.econmod.2012.02.014

[7] Baltagi, B. H., Feng, Q., & Kao, C. (2012). A Lagrange Multiplier test for cross-sectional dependence in a fixed effects panel data model. *Journal of Econometrics, 170*(1), 164–177. doi:10.1016/j.jeconom.2012.04.004

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