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GREEN INVESTMENTS AS DRIVERS OF SUSTAINABLE ECONOMIC GROWTH IN THE EU COUNTRIES: A RETROSPECTIVE ANALYSIS

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Abstract. This article addresses sustainable economic development under the green investing impact. The authors emphasize that a favorable investment climate attracts green and socially responsible investors contributing to green economic transformation. The research aimed to conduct a retrospective analysis of green transformation to determine the main driving forces and preconditions for sustainable economic growth. The relevance of the decision of the investigated scientific problem is that the green investments contribute to the harmonization of the three main pillars of sustainable development (society, economy, and environment) under the growing burden of climate change. The research object was the EU countries. The analysis covered data from 2014 to 2019 for empirical calculation and from 2000 to 2020 for bibliometric analysis. To achieve the research goal, the study involved the scope of bibliometric and econometric tools. The findings of bibliometric analysis allowed to determine the main driving forces of the economic growth and green investments considered in the literature. The obtained results empirically confirmed and theoretically proved that strengthening and developing sustainable economic performance significantly depends on the success of the green transformation under investments growth. The authors stated the necessity to further explore green investment markets on the national levels to improve the incentive mechanism for developing a green investment market.

Keywords*: Green growth, Green investments, Green investors, Economic performance, Sustainable development.*

JEL Classification: E22, O44, Q56

INTRODUCTION

The world community has become more concerned about adverse climate change. In this view, green investments have a crucial role since they allow to mitigate climate change through empowering the projects addressed the reducing CO2 emissions, air, and water pollution, accelerating the achievement of sustainable development goals, increasing green awareness, etc. It stands to note the lack of consensus on the definitions of green investments (green bonds, environmental, social and governance investing, green securitization, green mutual funds, socially responsible investing, etc.) (Inderst et al., 2012). Generally, green investments must be focused on preserving and

improving the environment while meeting the International Capital Market Association (ICMA).

Remarkably, ICMA determines the main green projects addressing renewable energy sources, energy efficiency, preventing pollution, environmentally sustainable development, clean transportation, sustainable management, mitigating and overcoming climate changes, green infrastructure, etc.). Thus, the environmental, social and governance indicators are the crucial factors for attracting investments to boost economic development. They allow estimating the potential risks and opportunities of business activity while increasing the information transparency for making investment decisions.

Figure 1 demonstrates that the size of the green bond market increases worldwide. Besides, it is worth emphasizing that Europe is a prominent leader for 2014-2020. Since 2014, the European green bonds market has remarkably increased by 8.62 times (156 bln USD). North America occupied second place (62 bln USD), while the Asia-Pacific region – the third (53 bln USD) in 2020.

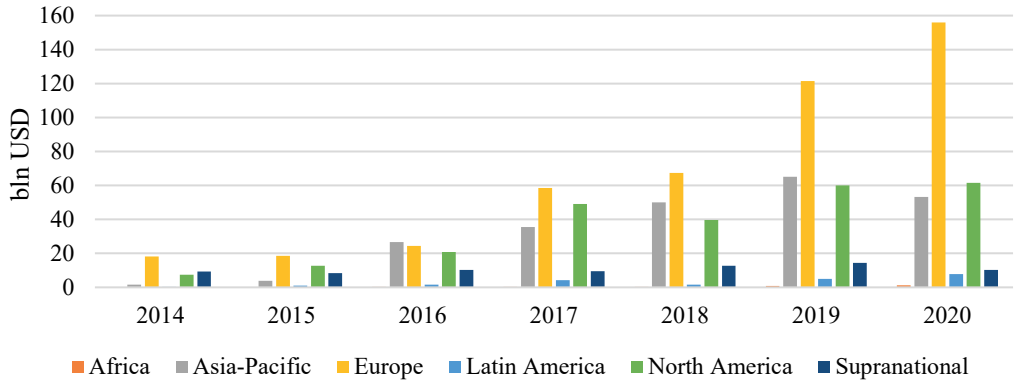

Fig. 1. The dynamic of green bonds market development by regions, 2014-2020 (Climate Bonds Initiative, 2021).

On the other hand, the EU shows good practice in reducing CO2 emissions (Figure 2).

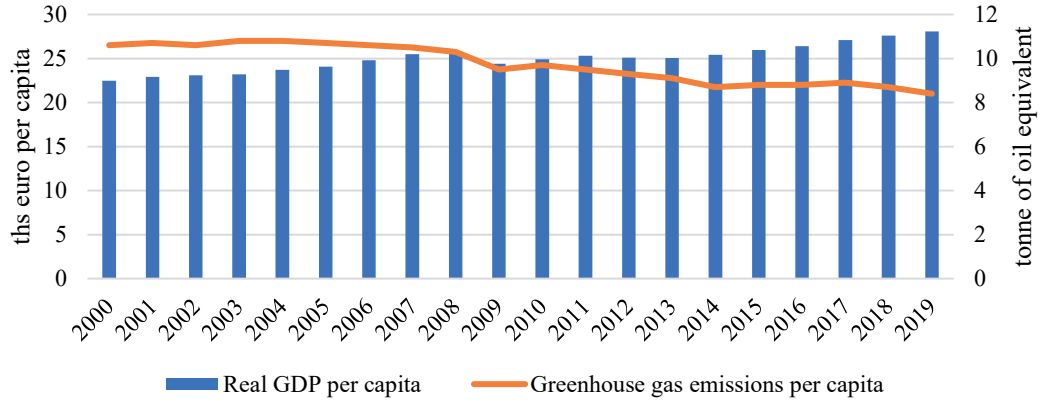

Fig. 2. The dynamic of GDP per capita and CO2 emissions in EU-27, 2000-2019 (Climate Bonds Initiative, 2021).

It stands to note that an economic slowdown caused the break-neck fall in CO2 emissions because of the global financial crisis. However, CO2 emissions remain downtrend, while the real GDP per capita has a growing tendency. In 2019, the level of

CO2 emissions per capita was less by 11.5% compared to 2009, while GDP per capita was higher by 15%.

Based on the above, it could be assumed that the EU provides an effective policy for economic development while reducing the environmental burden under the growth of the market of green investments. Indeed, that follows the principles of sustainable development. Therefore, it is appropriate to verify the impact of green investing on economic performance and the environment.

The main hypothesis of this research is as follow:

H1: Green investments accelerate sustainable economic growth while decreasing environmental pressure.

Further, in this study, Section 2 provides the literature review of the studies under research topic; Section 3 is about the methodology used in this study to verify the research hypothesis; Section 4 demonstrates the results of empirical analysis; Section 5 gives the main conclusion concerning the impact of green investments on the economic performance and environment.

1. LITERATURE REVIEW

The findings of bibliometric analysis of the literature addressing the research topic identified six main clusters concerning green transformation and sustainable development (see Fig. 3). The publications are retrieved from the Scopus database for 2000-2020.

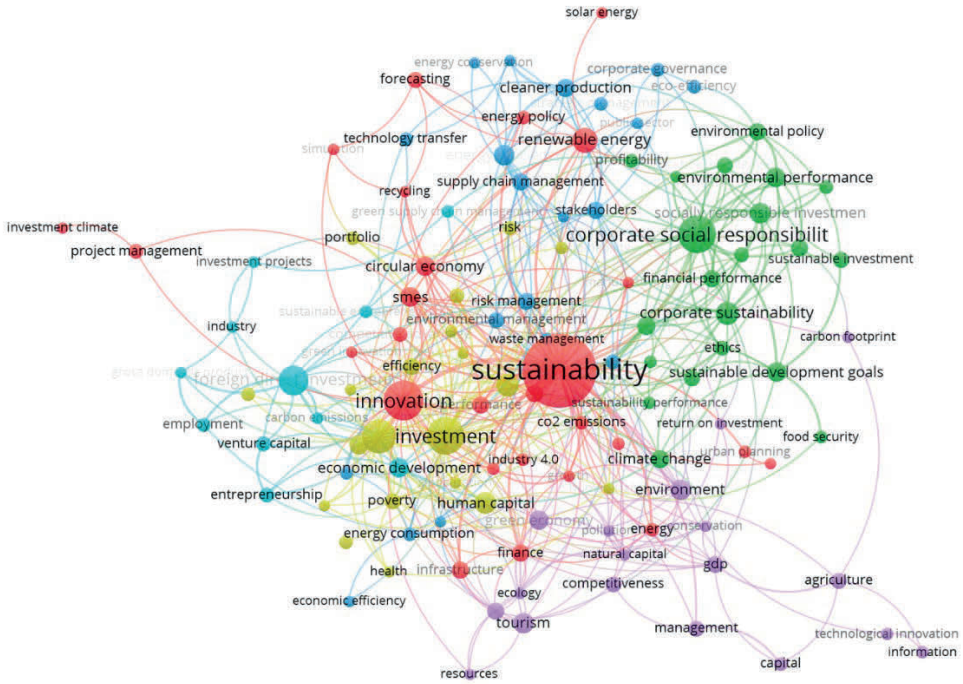

Fig. 3. The network map of keywords co-occurrences under research topic, 2000-2020 (developed by the authors based on Scopus data, 2021).

The biggest cluster (red) identified the scientific interest towards the issues of CO2 emissions, energy policy, renewable energy consumption, innovations, investment

climate, and industrial developments in the view of sustainability (Pimonenko et al., 2017; Suarez & Vargas, 2021; Bilan et al., 2020; Segers & Gaile-Sarkane, 2020).

The second cluster (green) focused on the investigations devoted to the transformations in corporate social responsibility issues under sustainable development principles (Chukwu & Kasztelnik, 2021; Kasych & Vochozka, 2017; Kyslyy et al., 2021). Several studies (Pimonenko et al., 2019a; Khadidja & Gachi, 2021; Chigrin & Pimonenko, 2014) addressed investigating the role of green investments in corporate activity. Aastvedt et al. (2021) confirmed that green investments contribute to the financial performance of US and EU companies. Therefore, green investments could be assumed to contribute to economic performance and strengthen the competitive advances at the corporate level. Remarkably, green investments don't provide the here-and-now profit for the company since they aim to gain social and environmental effects in the long term by reducing greenhouse gas emissions from economic activity. In turn, it requires modernizing the production processes, investigating new renewable sources of energy, implementing energy-efficient technologies, etc.

The third cluster (blue) combines the studies devoted to eco-efficiency. The scientists focused on the aspects of cleaner production (Pimonenko et al., 2019b), waste management (Starchenko et al., 2021), sustainable production (Vasylieva et al., 2017), etc.

The fourth (yellow) cluster covers the studies that addressed the linkages between sustainable growth and investment activity (Kwilinski et al., 2020; Dubina et al., 2020). In turn, the fifth cluster (purple) indicates the studies focused on the economic growth and its impact on the environment (carbon footprint, pollution, agriculture, recourse deployment, etc.). In this research direction, it is appropriate to indicate the works by Borychowski et al. (2020), Kolosok et al. (2020), Polcyn (2021), Pimonenko et al. (2021), etc.

The sixth cluster (cyan) is formed with studies addressing the economic development and green transformations under the contribution of foreign direct investments (Kiss, 2020; Pimonenko et al., 2018; Chygryn, 2017; Bublyk et al., 2017).

Based on the above findings, this study identified that scientists investigated sustainable economic development from different points of view while mostly concerning green investments and the growth of renewable energy consumption (Yelnikova and Barhaq, 2020; Marshall et al., 2021; Lyeonov et al., 2021, Lyulyov et al., 2021).

The scientific community considers green investments as one of the forceful approaches to overcoming climate change. Marshall et al. (2021) noted that nowadays, investors pay more attention to environmental concerns and support environmentally friendly projects. Several studies were devoted to exploring the drivers of renewable energy development (Cebula & Pimonenko, 2015; Tambovceva et al., 2020; Us et al., 2020; Ibrahiem and Hanafy, 2021; Pimonenko et al., 2020). Remarkably, Ibrahiem and Hanafy (2021) applied the Panel PMG ARDL and Granger causality methodology to confirm that foreign direct investments enhance renewable energy development in African countries.

Therefore, based on the results of bibliometric analysis and available data, it makes appropriate to check the relationship between economic development (real GDP per capita), renewable energy consumption, green investments in environmental initiatives (contribution to the international 100bn USD commitment on climate-related

expending and national expenditure on environmental protection), and environmental burden (greenhouse gas emissions per capita).

2. METHODOLOGY

For checking the research hypothesis on the contribution of green investments to sustainable economic prosperity, this study employed the intensive form of the Cobb–Douglas function (1) based on the methodology proposed by Lyulyov et al. (2021).

$$RE = f(GDP; GI; NEEP; GHG) \quad (1)$$

where *RE* – the share of renewable energy in the final energy consumption; *GI* – contribution to the international 100bn USD commitment on climate-related expending; *NEEP* – national expenditure on environmental protection; *GHG* – greenhouse gas emissions per capita.

Table 1 demonstrates the interpretations of research variables.

Table 1. Interpretation of variables

N	Variables	Denotation	Meaning	Unit
1	Real GDP per capita	GDP	Value of the total final output of goods and services per capita within a certain time	euro per capita
2	Contribution to the international 100bn USD commitment on climate-related expending	GI	Overall spending from the annual budget (EU countries, the European Commission and the European Investment Bank) for climate finance under the United Nations Framework Convention on Climate Change	million euro
3	National expenditure on environmental protection	NEEP	Current expenditure and investments for environmental protection in a given period	Percentage of GDP
4	Share of renewable energy in gross final energy consumption	RE	Indicator of renewable energy extensity	Percentage
5	Greenhouse gas emissions per capita	GHG	All greenhouse gases without emissions and removals related to land use, land-use change and forestry, indirect CO2 emissions and international aviation	tonne of oil equivalent

This study considers the data from 27 EU countries for 2014-2019. The source of data is the Eurostat database. The empirical calculations were conducted using the EViews software tools. For testing the panel series for the stationarity, the panel unit root test was used. Then, panel time series were tested for cointegration applied the Kao Engle-Granger based tests by Johansen methodology. All variables were linearized by taking logarithms.

3. RESULTS

Table 2 demonstrates the findings of descriptive statistics for the investigated variables GDP, GI, NEEP, RE, and GHG for the whole panel of 162 observations without logarithmic transformation. The average score of the GI index for 27 EU countries is 504,58 million euro, while minimum and maximum levels of GI are 8534,08 and 0,01 million euro relatively, while the standard deviation is 1501,32. Thus, the findings on descriptive statistics indicated the significant gap in green investing between EU countries from 2014 to 2019.

Table 2. The descriptive statistic summary

	GDP	GI	NEEP	RE	GHG
Mean	26213,58	504,58	1,88	20,91	9,23
Median	20485,00	7,51	1,8	17,43	8,45
Maximum	85030	8534,08	3,3	56,39	21,6
Minimum	5470	0,01	0,6	4,46	5,00
Std. Dev.	17006,73	1501,32	0,62	11,74	3,35
Skewness	1,49	3,71	0,28	0,92	1,48
Kurtosis	5,64	16,05	2,72	3,41	5,68
Jarque-Bera	107,77	1521,09	2,73	23,78	10,04
Probability	0,00	0,00	0,25	0,00	0,00
Sum	4246600	81741,39	304,55	3387,85	1494,8
Sum Sq. Dev.	4,66E+10	3,63E+08	61,16	22203,76	1806,8
Observations	27	27	27	27	27

Source: compiled by the authors.

To test all variables on stationarity, the first stage of empirical analysis provides running the unit root test by the methods of Levin, Lin & Chu (LLC), Im, Pesaran, Shin W-Stat (IPS), ADF-Fisher Chi-square (ADF), and PP-Fisher Chi-square (PPF). Remarkably, all data are linearized by taking a logarithm. Table 3 demonstrates that all variables had unit roots in the levels. After the first-order difference, all variables for EU countries became stationary that allows avoiding the spurious regression.

Table 3. Panel unit root results for GDP, GI, NEEP, RE, GHG

Tests	Statistic Param.	Unit root in level					Unit root in 1st difference				
		Variables									
		GDP	GI	NEEP	RE	GHG	GDP	GI	NEEP	RE	GHG
LLC	Statistics	-3,46	-4,33	-12,18	0,96	-4,84	-19,85	-17,9	-24,79	-10,41	-10,01
	Probab.	0,00	0,00	0,00	0,83	0,00	0,00	0,00	0,00	0,00	0,00
IPS	Statistics	3,58	-0,14	-2,18	3,14	-0,06	-4,8	-7,5	-7,40	-3,05	-3,07
	Probab.	0,99	0,44	0,01	0,99	0,47	0,00	0,00	0,00	0,00	0,00
ADF	Statistics	30,49	58,64	72,58	29,17	64,10	88,34	126,47	107,55	78,47	77,86
	Probab.	0,99	0,25	0,00	0,99	0,16	0,00	0,00	0,00	0,01	0,02
PPS	Statistics	52,91	72,59	107,51	35,29	85,48	112,05	154,02	121,21	84,27	94,24
	Probab.	0,51	0,03	0,00	0,97	0,00	0,00	0,00	0,00	0,01	0,00

At the next stage, the panel cointegration test was performed to test the existence of the long-run relationship between variables. The Kao Residual Cointegration test findings under Dickey-Fuller (DF) tests rejected the null hypothesis (non-cointegration among investigated variables). Therefore, the alternative hypothesis (cointegration among variables) was accepted (Table 4).

Table 4. Kao Panel cointegration test results

	rho	Prob.	t-Statistic	Prob.
DF	-3,25	0,00	-5,09	0,00
DF*	-1,86	0,03	-4,42	0,00

Following the above, the FMOLS and DOLS methodologies were used to estimate the long-term relationship among these variables. In this context, the impact of GI, NEEP, RE, and GHG on GDP, while DP, GI, NEEP, GHG on RE were analyzed.

Table 5 presents the obtained results on checking the above assumption by FMOLS and DOLS panel cointegration techniques.

Table 5. The findings of long-term relationship among GI, GDP, RE, NEEP and GHG by FMOLS and DOLS panel cointegration techniques

Variables	Statistic Parameters	FMLOS		DOLS	
		Dependent			
		GDP	RE	GDP	RE
GDP	Coefficient		0,49		0,58
	Prob.		0,00		0,00
GI	Coefficient	0,01	0,02	0,05	0,15
	Prob.	0,04	0,05	0,02	0,00
NEEP	Coefficient	0,27	0,02	0,35	0,07
	Prob.	0,89	0,98	0,00	0,03
RE	Coefficient	1,65		1,58	
	Prob.	0,00		0,00	
GHG	Coefficient	2,37	-1,01	2,33	-1,11
	Prob.	0,00	0,00	0,00	0,00

The obtained result from DOLS panel cointegration techniques showed that all variables are statistically significant. In contrast, the findings by FMOLS panel cointegration techniques showed that NEEP is a statistically insignificant variable. Herewith DOLS results confirmed that green investments contribute to sustainable economic development. Thus, the 1% growth of GI increases GDP by 0,05%, RE – by 0,15%. At the same time, increasing the NEEP by 1% leads to 0,35% growth of GDP and 0,07% of RE. Given FMOLS results, the impact of NEEP on GDP and RE is statically insignificant.

On the other hand, GI growth by 1% results in 0,01% growth of GDP and 0,02% of RE (FMOLS). Besides, the findings showed the relationship between economic development and GHG growth. The growth of GHG by 1% increases GDP by 2,37% (FMOLS) and 2,33% (DOLS). Remarkably, that increasing the share of renewable energy in gross final energy consumption (RE) by 1% leads to a 1,65% growth of GDP (FMOLS) and 1,58% (DOLS).

CONCLUSION

The obtained results supported the research hypothesis that green investments contribute sustainable economic development. Thus, the findings of FMOLS techniques showed that green investment growth by 1% results in 0,01% growth of GDP and 0,02% of renewable energy (FMOLS). Remarkably, FMOLS results indicated no statistically significant impact of national expenditures on environmental protection on GDP and the share of renewable energy in gross final energy consumption.

On the other hand, DOLS results showed that the 1% growth of green investment increases the GDP by 0,05% and the share of renewable energy in gross final energy consumption by 0,15% while increasing the national expenditures on environmental protection by 1% leads to 0,35% growth of GDP, and 0,07% growth of the share of renewable energy in gross final energy consumption.

The obtained results confirmed the research hypothesis that green investments accelerate sustainable economic growth under renewable energy development.

Therefore, investing in environmentally friendly initiatives is crucial to boosting economic growth without additional environmental pressure. Moreover, it contributes to mitigating and overcoming the negative climate changes.

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