The Socio-Economic-Environmental Triangle: Quantitative Analysis of Interdependencies in European Union

Louisa-Maria BUCUR
Bucharest University of Economic Studies, Romania
ORCID:0009-0006-7091-1776
bucurlouisa22@stud.ase.ro

Adina-Viorica RUS
Faculty of Economics and Business Administration, Babeș-Bolyai University, Romania
ORCID:0000-0003-2295-0851
adina.rus@econ.ubbcluj.ro

Abstract
Sustainable development goals are increasingly discussed today, so this paper investigates the interdependent relationships between economic, social and environmental factors within the European Union Member States. The study explores how GDP per capita, purchasing power, official support for development, poverty and social exclusion indicators, perceived health status, educational attainment, and environmental practices such as recycling rates, circular use of materials and net greenhouse gas emissions interact with each other. The results show overall positive trends between socio-economic development and environmental performance and show how stronger economies are largely conducive to improvements in social and environmental domains. However, the study also reveals important exceptions, highlighting the crucial role of effective national policies and resource management. By identifying and discussing these complex interrelationships, the paper contributes to a deeper understanding of how economic progress can be aligned with social progress and environmental responsibility, providing valuable insights for public policymaking in the European Union.

Keywords: sustainable development; socio-economic development; environment; correlations.

JEL Classification: I15; I25; O44; Q01.

DOI: https://doi.org/10.24818/ejis.2024.04

1. Introduction

The last decade has marked an "*awakening*" towards sustainability for the global population, with a growing awareness of the need to adopt more sustainable practices. This period was marked by the adoption of the Sustainable Development Goals (SDGs) by the United Nations in 2015 (United Nations, 2024). The SDGs were designed to address a wide range of global issues, including poverty, inequality, and climate change, with the ultimate goal of ensuring a global transition to a more equitable and sustainable world by 2030.

This paper therefore explores the interdependence between economic, social, and environmental indicators, which is essential for achieving the Sustainable Development Goals. According to the literature, the success of the SDGs depends on the integration of these three dimensions of sustainable development, as each influences and is influenced by the others. Achieving the balance between economic growth, social equity and environmental protection

Received: 12 February 2024; Revised: 8 April 2024; Accepted: 31 May 2024

requires a holistic and coordinated approach, as Sachs et al. (2019) and Stiglitz (2020) point out.

The aim of this article is to specifically examine the relationship between economic, social, and environmental factors in the context of the European Union. By analysing this relationship, the paper aims to provide a deeper understanding of how the EU can shape these interactions to foster a sustainable pathway. The research question underlying this paper is:

Are there mutual influences within the European Union in the triangle of economic, social, and environmental factors?

Assuming the answer to this question is positive, then this paper could be the starting point for seeking a balance between the three elements, so that policy makers can adjust and coordinate these policies to achieve Sustainable Development Goals.

The structure of the paper will firstly consist of a prompt literature review, which will illustrate the relevance and actuality of the topic discussed. This will be followed by a description of the methodology used for data collection and analysis, describing the specific method adopted. The results and discussion section will present and interpret the research findings, exploring their implications for sustainable development in the EU. Finally, the article will end with a conclusion section summarising the most important findings and discussing the limitations encountered in the study, proposing future research directions.

2. Literature Review

Embarking on the path of sustainable development requires a profound change in the way people think and act, thus highlighting the importance of individuals becoming agents of change. This involves coordinating the actions of both people and governments across the three dimensions of economic, social and environmental change. Studies highlight the need to integrate economic, social and environmental dimensions to achieve sustainable development, this integration requires balanced investment in different forms of capital: manufactured, natural, financial, human and social (Escap & Scientific, 2015)

Over the years, several researchers have conducted studies based on only two of the three dimensions of sustainable development, analysing either the relationship between economic and social factors, the relationship between social and environmental factors, or the relationship between environmental and economic factors.

When it comes to the relationship between economic and social factors in achieving sustainable development goals, studies show that economic factors, such as GDP per capita, directly influence social factors, including health, education and poverty levels (Anzolin & Lebdioui, 2021; Bucur, 2022). Economic development can improve access to essential services, thereby increasing quality of life and reducing social inequalities (Ruggerio, 2021).

To create a more sustainable world and to engage with sustainability issues as described in the Sustainable Development Goals (SDGs), individuals need the knowledge, skills, values and attitudes that enable them to contribute to sustainable development (Nazar et. al., 2018). In this regard, education is an important factor for achieving sustainable development, both on the social and economic side. Studies show that improving people's cognitive skills could have a significant impact on a nation's economic growth, with results from standardised tests in mathematics and science strongly correlated with long-term economic growth rates (Hanushek, & Woessmann, 2021).

In addition to GDP per capita, it would also be important to look at purchasing power adjusted to GDP per capita, which could influence key dimensions of sustainable development policy, which should be consumption-oriented, firm-level sustainability and production-oriented innovation (Anzolin & Lebdioui, 2021). This policy highlights the importance of addressing the social determinants of health and the 'market determinants' that can influence health, proposing that health policies should help achieve broader EU objectives such as social progress and sustainable development (McKee & De Ruijter, 2024).

Besides the relationship between economic and social factors, some researchers have looked at the relationship between economic and environmental factors. Economic factors directly influence resource use and environmental impacts. An economy geared towards unbridled growth can lead to environmental degradation through over-exploitation of natural resources. Economic sustainability in this context requires the integration of green technologies and sustainable production practices that minimise negative environmental impacts (Mentes, 2023).

At the same time, researchers have examined the relationship between GDP, economic structure and CO2 emissions, finding that aggregate economic growth has an inverted U-shaped relationship with CO2 emissions. However, economic structure has a U-shaped effect on air pollution. The results show that industrial value added as a share of GDP is positively related to CO2 emissions per capita (Mirziyoyeva & Salahodjaev, 2023).

Other findings show a bidirectional relationship between GDP and CO2 emissions and a negative bidirectional relationship between CO2 emissions and renewable energy consumption (Pejović et al., 2021).

Other studies show that the lack of a statistical correlation between greenhouse gas emissions and the degree of eco-innovation in EU countries may be correlated with a lag between actual emissions and their observable effects, complicating regulatory efforts. Also, factors such as technological advances, environmental policies or financial support for official development may offset the negative impact of these emissions (Bucur, 2024).

Finally, the third relationship with a major impact on sustainable development is the relationship between environmental and social factors. The state of the environment influences public health, access to clean water, clean air and other essential resources, which has a direct impact on social well-being. Environmental degradation can exacerbate social problems such as poverty and forced migration, disproportionately affecting vulnerable communities (Ruggerio, 2021).

Some research emphasises the link between education and environmental protection, showing that risk perception and environmental knowledge significantly influence environmental concern, which in turn strongly influences behavioural intention. These constructs mediate sustainable consumption behaviour (Saari et al., 2021).

Other authors mention that as soon as man reaches his level of self-satisfaction, he no longer thinks about the needs of those around him, while becoming passive to environmental and social issues (Bodea, 2022; Bucur, 2022). Thus, from these studies, it appears that when people are in a good state, either financially or medically, they do not think about global problems.

Also, studies looking at activities such as recycling, reuse of certain materials, even renewable energy, have shown that renewable energy and reuse decrease environmental impact, recycling has no significant effect, and repair increases greenhouse gas emissions, but is the only source with a positive economic impact at the country level (Knäble et al., 2022; Huang, 2023).

Moreover, some researchers have found that there is a strong correlation between progress in socio-economic development and improvements in the Human Development Index and the

Sustainable Development Goals Index, but a negative correlation between environmental sustainability and changes in the Ecological Footprint (Hametner, 2022; Bucur, 2024).

3. Methodology

The methodology of the current research is based on a quantitative analysis of data concerning three categories of factors that may influence the sustainable development of the European Union: economic, social, and environmental. This approach enables a comprehensive view of the research topic, thereby facilitating the formulation of relevant conclusions.

In this paper, the correlations between various indicators from the economic, social, and environmental spheres from the Eurostat database were analysed using the CORREL function in Microsoft Excel. Such an analysis has also been used by Sirbu et. al (2017), in their paper "*The Role of EU Innovation Policies in the Sustainable Development of the Energy Sector*".

The CORREL function calculates the Pearson correlation coefficient, which quantifies the linear relationship between two datasets. The resulting coefficient ranges from -1 to 1, where values close to 1 indicate a strong positive linear relationship, values close to -1 indicate a strong negative linear relationship, and values around 0 indicate no linear relationship.

The quantitative analysis is carried out by assessing the value provided by Microsoft Excel for the correlations between the indicators in these three categories within the European Union over the period 2013-2022. This analysis allows for the examination of the correlations among economic, social, and environmental factors in the EU by considering three dimensions: a) the relationship between economic and social factors, b) the relationship between economic and environmental factors, and c) the relationship between social and environmental factors. The factors analysed from each category are presented in table 1. To make the correlations between the factors analysed easier to understand, each indicator has been assigned a code. Therefore, for the naming of the graphs, codes have been used instead of the full names of the indicators analysed, all to achieve a pleasant visual effect and uniform graphs.

Table 1. Economic, social and environmental factors included in the quantitative analysis and assigned codes

Category of factors	Indicator	Unit of measurement	Code
Economic	Real GDP per capita	Chain linked volumes (2010), euro per capita	Code 1
	Purchasing power adjusted GDP per capita	Percentage	Code 2
	Official development assistance as share of gross national income	Percentage of gross national income (GNI)	Code 3
Social	Persons at risk of poverty or social exclusion	Percentage	Code 4
	Share of people with good or very good perceived health	Percentage	Code 5
	Tertiary educational attainment	Percentage	Code 6
Environmental	Recycling rate of municipal waste	Percentage	Code 7
	Circular material use rate	Percentage	Code 8
	Net greenhouse gas emissions	Tonnes per capita	Code 9

Source**:** Designed by the authors. Data sources: European Commission (EUROSTAT) (2013-2022)

4. Results and discussion

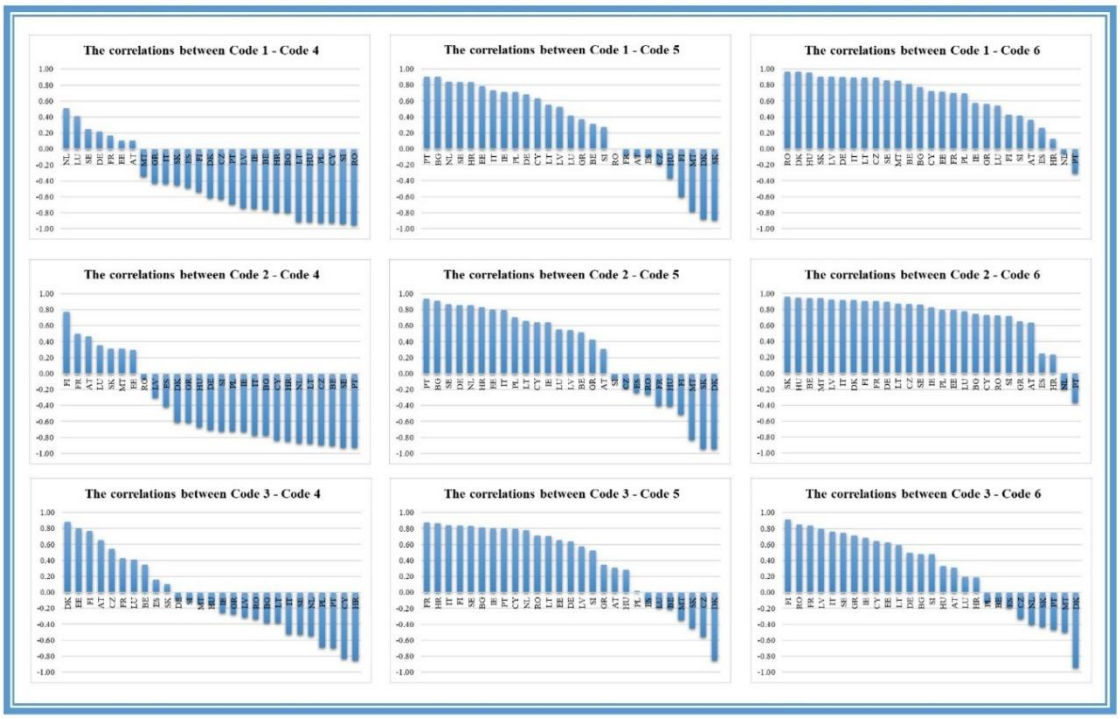
This section of the paper presents and discusses the results obtained from the analysis of the relationships between the level of socio-economic development and the achievement of key environmental protection indicators within the EU Member States. Thus, the interdependencies between real GDP per capita, purchasing power adjusted GDP per capita and official development assistance on the one hand, persons at risk of poverty or social exclusion, share of people with good or very good perceived health and tertiary educational attainment on the other hand and municipal waste recycling rates, rate of use of materials in a circular way and net greenhouse gas emissions on the other hand were investigated.

The results showed the expected correlations, in line with the literature, but also particular cases where the trends do not confirm. Therefore, the following discussions are dedicated to the interpretation of these results, with a focus on identifying and understanding the links between economic, social and environmental factors within the European Union.

The correlations between economic and social factors

The correlations between economic and social factors for all EU Member States can be seen in Figure 1.

Figure 1. Summary of the correlations between economic and social factors, for the period 2013-2022, in European Union member states



Source**:** Designed by the authors based on own calculations. Data sources: European Commission (EUROSTAT) (2013-2022)

The expected strong negative correlation between real GDP per capita and the percentage of people at risk of poverty or social exclusion reflects the idea that richer economies tend to offer a higher standard of living to their citizens. This suggests that as an economy grows, the resources available to improve people's well-being increase, which should lead to a fall in poverty.

However, it is observed that some EU countries show a weak positive correlation between these two indicators that can be explained by several mechanisms. The first factor is income distribution. Even if per capita GDP is high, an unequal income distribution may mean that a significant segment of the population is not benefiting from this wealth, remaining in poverty or at risk of exclusion.

Another important issue is the level of investment in social protection and access to essential services such as health and education. Thus, the research further focused on analysing the link between real GDP per capita and the percentage of people perceiving health as good or very good.

An anticipated strong positive correlation between the two indicators was expected, as wealthier economies often offer superior access to health services, opportunities for healthy living and a better overall quality of life.

However, in the case of a few EU countries where the relationship is strongly negative, this phenomenon can be explained by a few factors such as the prevalence of unhealthy lifestyles, regardless of disposable income, or the impact of the norms an individual has grown up with and the habits they have acquired (Bucur, 2022). These discrepancies highlight that GDP per capita is not the only determinant of perceptual health and that other socio-economic and environmental variables also play important roles.

The study went further and went on to analyse the relationship between real GDP per capita and tertiary completion rates. This strong positive correlation reflects the fact that richer countries tend to invest more in education and have a more skilled workforce. In most EU countries, this relationship is confirmed, indicating better access to higher education in prosperous economies.

In the specific case of Portugal, where the relationship is weakly negative, it may be influenced by the migration of educated young people to other countries with better economic opportunities. This highlights that while GDP per capita is an important economic indicator, it is not the only factor influencing the educational attainment of the population.

Analysis of the relationship between purchasing power adjusted GDP per capita and various social indicators reveals general trends as expected, but also some notable anomalies in some EU countries.

The relationship with people at risk of poverty or social exclusion is generally negative, as expected. In countries with a higher purchasing power adjusted GDP per capita, the share of people at risk of poverty or social exclusion is lower. This suggests that greater purchasing power translates into greater access to resources that can prevent poverty. However, in some countries where this relationship is reversed, factors such as increased economic inequality or poor distribution of resources, even in the context of high nominal GDP, may play an important role.

The relationship with perceived good or very good health and completion of tertiary education is generally positive. States with higher GDP per capita adjusted for purchasing power parity tend to report better perceived health status and higher tertiary education completion rates. This reflects greater investment in health and education, which improves citizens' quality of life. However, there are exceptions to this trend. These anomalies suggest that while GDP per capita adjusted for purchasing power parity is a useful indicator for comparing living standards, it is not sufficient to explain all dimensions of social well-being. Each country has a specific context that can influence these relationships, highlighting the importance of policies tailored to local needs and realities.

The relationships between Official Development Assistance (ODA) as a percentage of GNI and social indicators can be complex and vary significantly from country to country. The analysis shows that, in general, there is an expected relationship between ODA and reductions in poverty and social exclusion as well as improvements in health and education, but there are notable exceptions.

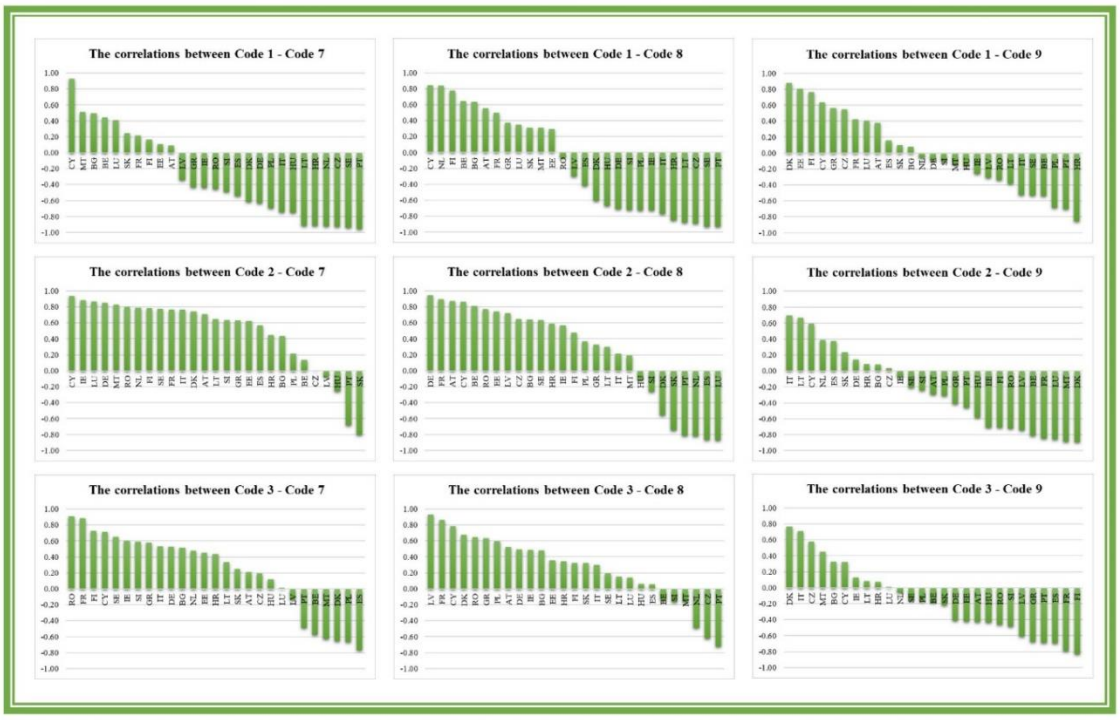
The relationship with people at risk of poverty or social exclusion is expected to be negative, implying that a higher percentage of GNI devoted to ODA could correspond to poverty reduction (Bucur, 2023). However, in some countries where this correlation is inverse, causes may include ineffective management of aid funds, focus of aid on projects that do not directly address poverty, or diversion of resources to other priorities.

In terms of the relationship with perceived health status and tertiary education completion should be positive, suggesting that greater commitment to ODA reflects an investment in human capital. However, in countries where these correlations are contrary to expectations, factors such as inefficiencies in resource management or poor prioritisation of development projects may limit the positive impact of ODA on health and education.

The correlations between economic and environmental factors

The correlations between economic and environmental factors for all EU Member States can be seen in Figure 2.

Figure 2. Summary of the correlations between economic and environmental factors, for the period 2013-2022, in European Union member states



Source**:** Designed by the authors based on own calculations. Data sources: European Commission (EUROSTAT) (2013-2022)

Analysis of the relationship between real GDP per capita and environmental indicators shows a generally negative correlation, as expected (Pejović et al., 2021). As a country's wealth increases, investments in green technologies and environmental protection measures tend to improve, reducing the rate of greenhouse gas emissions and increasing recycling rates and the use of materials in a more circular way.

Recycling rates of municipal waste and circular material use rates are expected to increase as GDP per capita increases, reflecting higher investments in recycling infrastructure and efficient production technologies. Most EU countries are following this trend. And net greenhouse gas emissions are expected to decrease as GDP per capita increases, due to better energy efficiency and the adoption of renewable energy sources.

For countries where these trends are reversed, the elements that could explain these results are Ineffective or insufficient environmental policies, Economic structure concentrated on heavy industries, variations in implementation and adaptation of green technologies (Mirziyoyeva & Salahodjaev, 2023).

These differences highlight the complexity of the interaction between economic development and environmental impact management, requiring a tailor-made approach for each country.

Analysis of the relationship between GDP adjusted for purchasing power parity per capita and environmental indicators shows that richer countries tend to invest in environmental technologies, leading to higher rates of recycling and circular use of materials, and lower greenhouse gas emissions. However, even with this correlation, it has been found that there are countries in the EU that perform contrary to expectations, which can be explained by the fact that their economies are based on polluting industries (heavy or extractive industries) or may have ineffective environmental policies.

These anomalies underline the importance of effective implementation of environmental policies and technological adaptation, which are essential to transform economic wealth into tangible environmental benefits.

Another important factor in analysing the relationship between economic and environmental factors is Official Development Assistance (ODA) as a percentage of GNI. The correlation between this and environmental factors shows mixed results in the EU.

Most EU countries show a positive relationship between ODA and municipal waste recycling rates, circular use of materials and a negative relationship between ODA and net greenhouse gas emissions suggesting that ODA investments contribute to improved environmental practices. This is based on the idea that development funds are often directed towards projects that promote sustainability and environmentally friendly technologies.

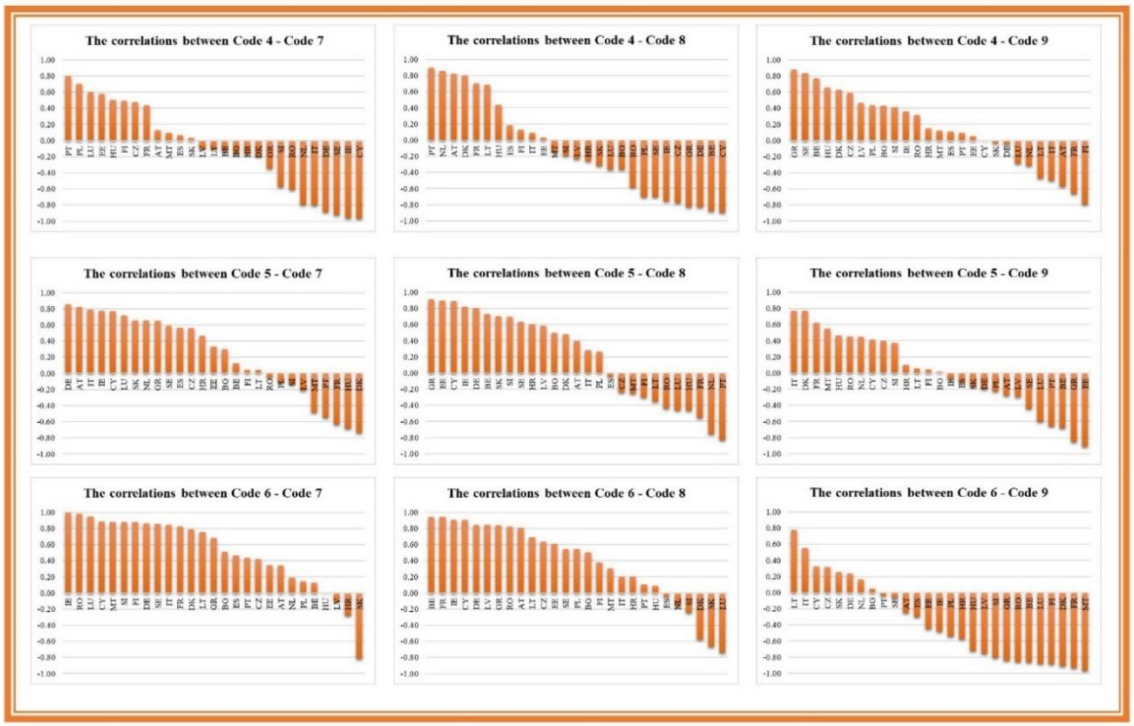
There are also a few exceptions where the relationship is contrary to expectations, which can be explained by several factors, including inefficiencies in the use of ODA funds and different priorities in development policy.

Analysis of these results highlights the complexity of the interactions between development assistance and environmental outcomes, illustrating that success depends not only on the amount allocated but also on country specificity and implementation efficiency.

The correlations between social and environmental factors

In Figure 3 are presented the correlations between social and environmental factors for EU.

Figure 3. Summary of the correlations between social and environmental factors, for the period 2013-2022, in European Union member states



Source**:** Designed by the authors based on own calculations. Data sources: European Commission (EUROSTAT) (2013-2022)

The analysis of the relationship between the percentage of people at risk of poverty or social exclusion and environmental indicators generally suggests a negative correlation. This indicates that in countries where fewer people are at risk of poverty or exclusion, recycling rates and circular use of materials are usually better and greenhouse gas emissions are lower. This may be due to better financial and social resources that allow greater investment and commitment to sustainable environmental practices.

However, even in this relationship there are exceptions. In countries where the relationship is reversed, or where there is no clear negative correlation, reasons may include limited resources to invest in environmental infrastructure or different policy priorities that may put the emphasis on immediate poverty-related needs and less on recycling.

Even though the results differ across the EU, however, they highlight the interdependence between poverty, social exclusion and environmental sustainability, illustrating the need for integrated approaches that improve both social and environmental conditions.

The environment in which an individual lives can affect his or her health, so an analysis between the percentage of the population that believes it is in good or very good health and various environmental factors is necessary to observe the relationship between social and environmental factors.

Thus, the analysis of the relationship between perceived good or very good health and environmental indicators such as municipal waste recycling rate, circular use of materials generally shows a positive correlation and the relationship between perceived good or very good health and net greenhouse gas emissions generally shows a negative correlation as expected. In countries where people perceive better health, environmental practices are usually more sustainable. This suggests that areas with effective recycling and resource management practices tend to have a cleaner environment, which can positively influence public health.

For countries where the relationship is contrary or does not follow the expected pattern, explanations may include discrepancies in data reporting. These variations show the complexity of the interaction between health and the environment, highlighting that perceived health and environmental sustainability are interlinked, but can also be influenced by other variables.

In terms of the relationship between tertiary education levels and environmental indicators, it generally shows that higher levels of education correspond to better rates of municipal waste recycling and circular use of materials, and lower greenhouse gas emissions. This suggests that higher education promotes awareness and commitment to sustainable environmental practices.

For countries where the relationship is contrary to expectations, the reasons may be that in some regions, high levels of education may be offset by polluting industrial practices or inefficient waste management. Also, higher education does not automatically guarantee efficient environmental practices, especially if state policies do not support sustainability or if there are gaps in recycling and waste management infrastructure.

The above discrepancies show that while there is an overall positive trend between tertiary education and environmental protection, its effectiveness can be influenced by structural and policy factors, highlighting the need for integrated and well-coordinated approaches.

5. Limits of the research

This paper analyses quantitatively the relationship between economic, social and environmental factors in achieving sustainable development goals. Although this type of research is based on hard data, it is essential to consider several factors that may affect the validity and generality of the results.

It is important that the data used is representative of all EU Member States and that variations in data collection methodology between countries, which may introduce errors, are considered.

The generalisation of results may also be problematic, as although the study focuses on EU countries, the results may not be applicable in other contexts with different structures. Also, the study may not include all relevant factors influencing economic, social and environmental indicators. These limitations suggest the need for cautious interpretation of the results and further research to refine the models and test the findings in different contexts and over longer periods of time.

6. Conclusions

The paper explored and analysed the interdependent relationships between economic, social and environmental factors in the Member States of the European Union, starting from the question: *Are there mutual influences within the European Union in the triangle of economic, social, and environmental factors?*. Using secondary data, the relationships between nine indicators, three in each category (economic, social and environmental), were analysed over the period 2013-2022. The results revealed a complex landscape of mutual influences and significant variations between countries.

The relationship between economic and social factors was highlighted through the correlation between GDP per capita, GDP-adjusted purchasing power, official development assistance and social indicators such as poverty, social exclusion, perceived health and tertiary educational attainment. In general, stronger economies have been associated with reductions in poverty and social exclusion rates as well as improvements in health and education. However, this relationship has sometimes been contradicted by regional disparities and inefficient resource management, suggesting that economic progress does not automatically translate into social benefits, particularly in the absence of effective redistributive policies and investment in human capital.

The relationship between economic and environmental factors was analysed by examining the link between GDP per capita, GDP-adjusted purchasing power, official development assistance and indicators such as recycling rates, circular use of materials and net greenhouse gas emissions. The results showed that countries with more developed economies tend to exhibit more sustainable environmental practices, highlighting the role of economic investment in green technologies and green infrastructure. However, exceptions highlighted that factors such as dominant industrial structure and political priorities can negatively influence these trends, even in the context of high GDP.

The relationship between social and environmental factors was illustrated by correlations between perceived health, education and environmental indicators. Better perceived health and higher levels of education were associated with higher recycling rates and reduced greenhouse gas emissions, suggesting that awareness and access to information can improve environmental behaviours. However, these positive correlations are not universal and are often modulated by the quality and effectiveness of local environmental policy implementation.

In conclusion, the results underline the importance of a holistic and integrated approach in formulating economic and social development policies that include sustainability considerations. This requires not only investment in education and health, but also careful planning of environmental policy to ensure that economic progress is not achieved at the expense of the environment. The results suggest that a better understanding of the interactions between different indicators can facilitate the creation of more effective strategies to combat poverty and promote a healthy and sustainable environment.

References

Anzolin, G., & Lebdioui, A. (2021). Three dimensions of green industrial policy in the context of climate change and sustainable development. *The European Journal of Development Research*, *33*(2), 371-405.

Bucur, L. M. (2022). The Social Nature of the Green Economy. *Emerging Markets Economics and Business. Contributions of Young Researchers*, 58

Bucur, L. M. (2023). Sustainable Development: A Viable Solution To Reduce Poverty. *Management of Sustainable Development, 15*(2).

Bucur, L. M. (2024). Nexus between ECO-Innovation, Human Development and CO2 Emissions. *Romanian Economic Journal*, *27*(87), 2-10.

Escap, U. N., & Scientific, C. (2015). Integrating the three dimensions of sustainable development: A framework and tools.

European Commission. (2024). *Database—Eurostat*. https://ec.europa.eu/eurostat/data/database.

Hametner, M. (2022). Economics without ecology: How the SDGs fail to align socioeconomic development with environmental sustainability. *Ecological Economics*, *199*, 107490.

Hanushek, E. A., & Woessmann, L. (2021). Education and economic growth. In *Oxford Research Encyclopedia of Economics and Finance*.

Huang, R. (2023). SDG-oriented sustainability assessment for Central and Eastern European countries. *Environmental and Sustainability Indicators*, *19*, 100268.

Knäble, D., de Quevedo Puente, E., Pérez-Cornejo, C., & Baumgärtler, T. (2022). The impact of the circular economy on sustainable development: A European panel data approach. *Sustainable Production and Consumption*, *34*, 233-243.

McKee, M., & De Ruijter, A. (2024). The path to a European Health Union. *The Lancet Regional Health - Europe, 36*, 100794. https://doi.org/10.1016/j.lanepe.2023.100794

Mentes, M. (2023). Sustainable development economy and the development of green economy in the European Union. *Energy, Sustainability and Society*, *13*(1), 32.

Mirziyoyeva, Z., & Salahodjaev, R. (2023). Renewable energy, GDP and CO2 emissions in high-globalized countries. *Frontiers in Energy Research*, *11*, 1123269.

Nazar, R., Chaudhry, I. S., Ali, S., & Faheem, M. (2018). Role of quality education for sustainable development goals (SDGS). *International Journal of Social Sciences*, *4*(2), 486-501.

Pejović, B., Karadžić, V., Dragašević, Z., & Backović, T. (2021). Economic growth, energy consumption and CO2 emissions in the countries of the European Union and the Western Balkans. *Energy Reports*, *7*, 2775-2783.

Ruggerio, C. A. (2021). Sustainability and sustainable development: A review of principles and definitions. *Science of the Total Environment*, *786*, 147481.

Saari, U. A., Damberg, S., Frömbling, L., & Ringle, C. M. (2021). Sustainable consumption behavior of Europeans: The influence of environmental knowledge and risk perception on environmental concern and behavioral intention. *Ecological Economics*, *189*, 107155.

Sachs, J. D., Schmidt-Traub, G., Mazzucato, M., Messner, D., Nakicenovic, N., & Rockström, J. (2019). Six Transformations to achieve the Sustainable Development Goals. *Nature Sustainability*, 2(9), 805–814. https://doi.org/10.1038/s41893-019-0352-9

Sirbu, O., Crudu, R., & Ignatov, A. (2017). The Role of EU Innovation Policies in the Sustainable Development of the Energy Sector. *Studia Universitatis Babes-Bolyai Oeconomica*, *62*(2), 3-19

Stiglitz, J. E. (2020). *Rewriting the rules of the European Economy: An agenda for growth and shared prosperity*. WW Norton & Company.

United Nations. (2024). *THE 17 GOALS | Sustainable Development*. https://sdgs.un.org/goals

Appendices

Appendix 1. The correlations between economic and social factors, for the period 2013-2022, in European Union member states

Country	Code 1 - Code 4	Code 1 - Code 5	Code 1 - Code 6	Code 2 - Code 4	Code 2 - Code 5	Code 2 - Code 6	Code 3 - Code 4	Code 3 - Code 5	Code 3 - Code 6
Austria	0.10372	-0.09719	0.36590	0.46689	0.30709	0.63533	0.65504	0.31047	0.30853
Belgium	-0.76188	0.31510	0.81202	-0.90509	0.51560	0.93906	0.34609	-0.21164	-0.14200
Bulgaria	-0.80048	0.90345	0.77294	-0.77328	0.90594	0.74200	-0.37780	0.81561	0.47792
Croatia	-0.79593	0.63291	0.72013	-0.83472	0.64154	0.72713	-0.82759	0.79736	0.64124
Cyprus	-0.92424	-0.19727	0.89423	-0.89072	-0.18354	0.86635	0.54680	-0.55519	-0.33044
Czechia	-0.62837	0.68401	0.89811	-0.70545	0.85935	0.89482	-0.09352	0.63710	0.49670
Denmark	-0.61479	-0.88156	0.96455	-0.60645	-0.94549	0.91625	0.87861	-0.84946	-0.94053
Estonia	0.10579	0.78685	0.71376	0.29300	0.80123	0.79180	0.80232	0.65469	0.62835
Finland	-0.53799	-0.10457	0.26175	-0.41667	-0.23897	0.24384	0.15738	-0.13189	-0.19231
France	0.16692	-0.60001	0.42383	0.77367	-0.51327	0.90846	0.76706	0.83506	0.90860
Germany	0.21721	-0.07830	0.70118	0.49908	-0.40287	0.90414	0.42486	0.87590	0.83763
Greece	-0.43090	0.37194	0.56440	-0.61337	0.42316	0.64835	-0.26996	0.34769	0.71288
Hungary	-0.91596	0.83440	0.12519	-0.84847	0.83110	0.23590	-0.85249	0.86706	0.19147
Ireland	-0.75024	-0.36874	0.95251	-0.67008	-0.41124	0.94461	-0.16161	0.28411	0.33015
Italy	-0.43836	0.71216	0.57140	-0.72758	0.64109	0.82629	-0.25807	0.80391	0.68275
Latvia	-0.74473	0.73519	0.89503	-0.77118	0.79562	0.91917	-0.52488	0.84242	0.76217
Lithuania	-0.91315	0.55137	0.89467	-0.87865	0.65665	0.87282	-0.38119	0.70443	0.59327
Luxembourg	0.41009	0.41277	0.53992	0.35139	0.55317	0.77421	0.40862	-0.19466	0.19536
Malta	-0.34260	0.52408	0.90123	-0.30114	0.54339	0.92047	-0.31089	0.57297	0.79760
Netherlands	0.50950	-0.78420	0.85342	0.30992	-0.83339	0.93807	-0.14570	-0.34811	-0.49687
Poland	-0.92297	0.83977	-0.06022	-0.86853	0.85789	-0.19612	-0.54297	0.77888	-0.40205
Portugal	-0.69395	0.71176	0.69174	-0.72307	0.70203	0.79398	-0.68656	0.01994	-0.13058
Romania	-0.95244	0.90510	-0.30594	-0.92922	0.93529	-0.36693	-0.70130	0.80289	-0.46454
Slovakia	-0.45439	-0.00442	0.96555	-0.06381	-0.26205	0.72660	-0.33786	0.71069	0.84713
Slovenia	-0.93615	0.83800	0.86046	-0.92810	0.86739	0.86210	-0.52972	0.82867	0.74698
Spain	-0.48836	0.27309	0.41417	-0.72169	-0.06141	0.71990	-0.10574	0.52370	0.47763
Sweden	0.24439	-0.89326	0.90305	0.31090	-0.94260	0.95551	0.10248	-0.45074	-0.43271

Source**:** Designed by the authors based on own calculations. Data sources: European Commission (EUROSTAT) (2013-2022)

Appendix 2. The correlations between economic and environmental factors, for the period 2013-2022, in European Union member states

Country	Code 1 - Code 7	Code 1 - Code 8	Code 1 - Code 9	Code 2 - Code 7	Code 2 - Code 8	Code 2 - Code 9	Code 3 - Code 7	Code 3 - Code 8	Code 3 - Code 9
Austria	0.088672	0.551715	0.380109	0.710518	0.877143	-0.295924	0.207324	0.522819	-0.425678
Belgium	0.443355	0.645555	-0.535910	0.134441	0.811167	-0.808552	-0.576912	-0.145122	-0.184734
Bulgaria	0.494456	0.632706	0.079197	0.437234	0.641966	0.083699	0.515854	0.481907	0.328370
Croatia	0.924397	0.843639	0.631696	0.934804	0.862878	0.591546	0.714520	0.784414	0.324343
Cyprus	-0.924238	-0.890717	0.546796	0.000093	0.648206	0.033555	0.192534	-0.621118	0.576986
Czechia	-0.628368	-0.705447	-0.093524	0.854049	0.948915	0.144446	0.529531	0.492651	-0.411917
Denmark	-0.614794	-0.606453	0.878614	0.743180	-0.559604	-0.889424	-0.653896	0.672843	0.766589
Estonia	0.105788	0.292996	0.802321	0.626563	0.741712	-0.709847	0.452430	0.359466	-0.420668
Finland	-0.537988	-0.416666	0.157379	0.569101	-0.866721	0.378306	-0.765624	0.055573	-0.691487
France	0.166924	0.773673	0.767058	0.780831	0.477467	-0.710391	0.726157	0.324921	-0.831569
Germany	0.217214	0.499077	0.424858	0.765922	0.898788	-0.847379	0.885047	0.864385	-0.793567
Greece	-0.430904	0.371939	0.564398	0.627516	0.328784	-0.413269	0.577238	0.637121	-0.679502
Hungary	-0.915955	-0.848473	-0.852488	0.448015	0.591554	0.084978	0.439385	0.345039	0.072599
Ireland	-0.750241	-0.670081	-0.161611	-0.255150	-0.116011	-0.581245	0.119815	0.064161	-0.430882
Italy	-0.438365	-0.727583	-0.258072	0.884551	0.569048	-0.070038	0.601478	0.485716	0.131060
Latvia	-0.744725	-0.771178	-0.524879	0.765691	0.216023	0.696453	0.533362	0.302563	0.710631
Lithuania	-0.913152	-0.878646	-0.381192	0.649301	0.303021	0.667735	0.335829	0.154816	0.085974
Luxembou	0.410093	0.351389	0.408623	0.870512	-0.868101	-0.853984	0.011346	0.140692	0.011553
Malta	-0.342596	-0.301135	-0.310894	-0.072304	0.718950	-0.741496	-0.138522	0.928721	-0.610076
Netherlanc	0.509502	0.309920	-0.145696	0.830018	0.193795	-0.884071	-0.628013	-0.167019	0.451244
Poland	-0.922973	0.839765	-0.060223	0.789289	-0.821949	0.389256	0.475067	-0.486753	-0.058062
Portugal	-0.693946	-0.723072	-0.686555	0.215855	0.367192	-0.310662	-0.665818	0.594588	-0.168929
Romania	-0.952437	-0.929223	-0.701305	-0.681760	-0.815402	-0.459153	-0.488194	-0.724288	-0.687388
Slovakia	-0.454391	-0.063806	-0.337860	0.802385	0.769907	-0.718567	0.911137	0.648582	-0.459225
Slovenia	-0.936150	-0.928098	-0.529719	0.780268	0.636471	-0.206131	0.655271	0.194355	-0.162240
Spain	-0.488355	-0.721693	-0.105741	0.633754	-0.260754	-0.240631	0.591358	-0.164489	-0.481894
Sweden	0.244387	0.310895	0.102477	-0.803199	-0.747032	0.233599	0.252633	0.324637	-0.215839

Source**:** Designed by the authors based on own calculations. Data sources: European Commission (EUROSTAT) (2013-2022)

Appendix 3. The correlations between social and environmental factors, for the period 2013-2022, in European Union member states

Country	Code 4 - Code 7	Code 5 - Code 8	Code 6 - Code 9	Code 4 - Code 7	Code 5 - Code 8	Code 6 - Code 9	Code 4 - Code 7	Code 5 - Code 8	Code 6 - Code 9
Austria	0.13068	0.82273	-0.56910	0.82337	0.39705	-0.28091	0.34048	0.80497	-0.24943
Belgium	-0.13080	-0.87937	0.76834	0.12113	0.73058	-0.68360	0.12663	0.94374	-0.86661
Bulgaria	-0.16817	-0.36529	0.42696	0.29995	0.49806	0.01377	0.50666	0.50322	0.05018
Croatia	-0.96629	-0.89766	-0.00703	0.76796	0.89424	0.41391	0.88496	0.90690	0.32440
Cyprus	0.47239	-0.77946	0.58695	0.55957	-0.23663	0.39878	0.41552	0.63129	0.31667
Czechia	-0.89164	-0.83183	-0.04962	0.85728	0.80505	-0.19864	0.86191	0.84567	0.23698
Denmark	-0.19292	0.80215	0.63069	-0.73405	0.48225	0.77064	0.78805	-0.57593	-0.91201
Estonia	0.57591	0.03228	0.05455	0.33420	0.89580	-0.91263	0.34294	0.60896	-0.45074
Finland	0.06805	0.18747	0.11221	0.56779	-0.04704	-0.12619	0.46089	-0.04916	-0.30386
France	0.49304	0.12839	-0.79082	0.04071	-0.30180	0.04277	0.87786	0.37636	-0.88893
Germany	0.43466	0.70661	-0.66431	-0.63615	-0.55962	0.62363	0.82211	0.93935	-0.93326
Greece	-0.34962	-0.82961	0.88030	0.65305	0.91714	-0.85573	0.68146	0.83746	-0.84456
Hungary	-0.17150	-0.26501	0.15099	0.46290	0.60528	0.10171	-0.27865	0.20426	-0.57211
Ireland	0.50128	0.43458	0.65803	-0.68297	-0.46786	0.46268	-0.00673	0.08663	-0.72153
Italy	-0.96109	-0.75425	0.36314	0.77818	0.82555	-0.06808	0.99129	0.90959	-0.48643
Latvia	-0.80523	0.09148	-0.49867	0.78596	0.28236	0.77494	0.84197	0.20438	0.54897
Lithuania	-0.11308	0.68589	-0.46878	0.04012	-0.35422	0.05813	0.75174	0.69034	0.78047
Luxembou	0.59770	-0.36307	-0.28497	0.71984	-0.45847	-0.60156	0.94638	-0.74073	-0.88186
Malta	-0.10340	-0.23214	0.46478	-0.21524	0.58556	-0.29737	-0.10826	0.84191	-0.75607
Netherlanc	0.09389	-0.15366	0.12465	-0.48381	-0.25668	0.54934	0.88042	0.30342	-0.96455
Poland	-0.79567	0.85616	-0.31579	0.65416	-0.75688	0.44703	0.18989	-0.16937	0.16245
Portugal	0.70466	-0.70334	0.43355	-0.11580	0.26923	-0.22838	0.14618	0.54357	-0.54317
Romania	0.79962	0.89951	0.09437	-0.54915	-0.83015	-0.65915	0.43622	0.10415	-0.04184
Slovakia	-0.60820	-0.58639	0.31351	-0.05309	-0.43703	0.45180	0.98124	0.82138	-0.85939
Slovenia	-0.92348	-0.70649	0.83059	0.58653	0.63832	-0.44613	0.85583	0.54548	-0.05938
Spain	-0.57491	-0.19116	0.41357	-0.14213	0.69693	0.37599	0.87801	-0.24748	-0.80947
Sweden	0.03319	-0.31668	-0.03530	0.65835	0.70613	-0.16976	-0.81490	-0.67024	0.25245

Source: Designed by the authors based on own calculations. Data sources: European Commission (EUROSTAT) (2013-2022)