DOI 10.2478/sbe-2024-0003
SBE no. 19(1) 2024

ECO-INNOVATION AND HIGHER EDUCATION IN THE EUROPEAN UNION: EXPLORING THE GREEN INTERCONNECTION

Louisa-Maria BUCUR
Bucharest University of Economic Studies Bucharest, Romania

Abstract:

Currently, the emphasis is placed on sustainability, requiring economies to continuously innovate, demonstrating their competence for eco-innovation. This form of innovation is a key concept in today's world, providing innovative and sustainable solutions to environmental challenges, expecting a high level of education. Thus, this paper aims to explore the relationship between eco-innovation and higher education within the member states of the European Union, concentraiting on the quantitative analysis of the impact of higher education on eco-innovation development in these countries. Applying regression analysis, the eco-innovation index and the level of education in EU countries will be inspected to establish any significant correlation between these two variables. Following the analysis, the collected data involved in the regression method will reveal possible interrelationships and significant influences between the level of education and the degree of eco-innovation development in the member countries of the EU. Conclusively, the research proposes to highlight the influence of higher education in the development of eco-innovation within the European Union. The suggested quantitative analysis could lead to a better understanding of the association between higher education and eco-innovation, revealing the potential that the education sector has in promoting sustainability and a green future for European Union.

Key words: *eco-innovation, innovation, higher education, tertiary education, green interconnection*

1. Introduction

In recent years, the global warming has been a highly debated topic and unfortunately, the climate changes are not having a positive effect, causing disastrous effects on the population, but also on the economy, by expanding extreme weather phenomena. At the European Union level, the adverse effects of climate change may consist of the following: 22% increase in rainfall intensity in the Mediterranean region over the last 50 years; forest fires burning over 190,000 km^2 in the last 40 years; over 138,000 people killed by extreme weather events between 1980 and 2020; financial losses of over €487 billion in the EU27 from 1980 to date (Council of the European Union, 2022).

Considering all these unfavorable effects, the European Commission intended to ameliorate the situation through the Green Deal. It requires the economy to become climate

neutral by reducing carbon emissions by at least 50% by 2030 (and towards 55%) and achieving carbon neutrality by 2050 (Sikora, 2021).

Nevertheless, in order to accomplish the Green Deal targets, innovation is desired in all fields, and the transformation pertains not exclusively to innovation but specifically to eco-innovation. This variety of innovation requires a lot of study and research in the field, and this would be impossible to complete at the primary and secondary stages of education. It appears that the majority of eco-innovations are within the reach of individuals who have completed tertiary education.

As indicated by the terminology, eco-innovations are in fact those innovations that do not have negative environmental impacts. Later in this paper, the definition of eco-innovations will be further developed, but until that point a distinction must be made between eco-innovators and the eco-innovator index. This index encompasses a wide range of factors influencing eco-innovations, grouping these factors into: input, eco-innovation activities and output (see full description in the Methodology section). Thus, the input category includes human and financial resources, which undergo a transformation process and become outputs in the form of patterns and academic publications. It follows that eco-innovation relies on highly educated researchers, whose ability to implement ideas is contingent upon securing financial backing for research and development activities.

The aim of this paper is to answer the question „Are eco-innovations dependent on a high level of education?". Thus, the paper will be grounded upon the ensuing presumptions:

1. European Union Member States with a higher level of education among the population tend to show a correspondingly superior eco-innovation index.
2. Through government support of high education, EU nations attain greater levels of eco-innovation index.

If the two hypotheses prove true, then this paper could be the starting point for the transition from innovations to eco-innovations, which is only possible through higher education.

2. Literature Review

In recent years, higher education has faced multiple challenges, including profound economic changes, the need to develop a workforce adapted to new market requirements, the shift towards online activities and the emphasis on sustainability in almost every field. While some of these issues have been addressed in the past, there is now a need for action from governments and the private sector (Tierney & Lanford, 2016).

Thus, it is imperative that academia finds innovative solutions to address these issues, with an emphasis on adjusting educational programmes with public objectives, so that higher education institutions are able to adapt quickly and effectively to changes in their operating environment.

In the literature, it has been pointed out that higher education plays a significant role in promoting sustainability. Some researchers (Freidenfelds et al., 2018) have shown that higher education institutions have the potential to educate and promote principles of

environmental understanding and stewardship, thus providing a solid foundation for increasing awareness and engagement in environmental issues.

Moreover, higher education plays a considerable position in facilitating cooperation between actors in the innovation ecosystem, thus contributing to strengthening social and economic development. Collaboration between participants in the innovation ecosystem is essential to stimulate growth. The implementation of an education plan focused on entrepreneurship and the development of creative and innovative professionals, supported by research institutions such as universities, generates opportunities for knowledge creation and economic networking. In addition, knowledge transfer between academia and industry is a leading factor in promoting innovation and economic growth, as it facilitates the integration of new scientific discoveries into business production processes (Urbano & Alvarez, 2014).

The accumulation of human and technological resources has also become the main driver of economic growth in modern societies. Higher education, through its role as a central medium for the creation, integration, dissemination and application of scientific knowledge, is one of the fundamental pillars of this accumulation (Xu et al., 2020). The development of higher education significantly influences the innovation capacity of a region, having a profound impact on the pace and pattern of regional economic development. Thus, investment in higher education not only contributes to a more skilled workforce, but also supports innovation and long-term economic growth (Xu et al., 2020).

Some studies show how a particular traditionally developed branch of industry can be developed into something innovative and at the same time sustainable (e.g. transforming traditional fisheries into an aquaponics system) (Reyes, 2018). This becomes possible only through conceptual discussions and brainstorming sessions involving people enrolled in higher education, combined with practical applications. More specifically, green intellectual capital is needed to enhance sustainability within an institution or private company. It is defined as „*the totality of knowledge that an organisation can use in the environmental management process to gain a competitive advantage*" (Yusliza et al., 2020). Therefore, the competences, skills and attitudes of employees make green interconnection possible and are not only relevant for environmental protection, but are essential elements for promoting cleaner production practices. Employees with strong skills and knowledge of green practices, acquired through academic courses, contribute to increased efficiency, including through reduced waste, costs and resource consumption. Hence, it is higher education that facilitates the interconnection between all aspects of sustainable performance, including economic, social and environmental, which is generically called the green interconnection (Yong et al., 2022).

From these conceptualizations emerges the inquiry: what correlation exists between higher education and the eco-innovation index? The answer comes precisely from the description of the composition of this indicator, which is based on 16 variables, including academic publications related to eco-innovation (Costantini et al., 2023).

Hence, a direct correlation is noticeable between institutions of higher education and the degree of eco-innovation index attained by a country. To increase this index, higher education institutions should involve in both internal and external efforts (Dlouhá et al., 2018).

Internally, these efforts include the development of institutional strategies relating to educational policy, curriculum design, teaching methods and how campuses operate. In terms of external impact, universities are actively involved in policy processes and negotiations with key stakeholders to promote sustainability. This is manifested through their participation in initiating and signing international sustainability treaties and declarations (Dlouhá et al., 2018).

Yet, it is not solely the responsibility of higher education institutions. Governments should provide financial support to aid scientific research and enhance knowledge about sustainability.Unfortunately, it is important to point out that there is significant concern about the limited commitment of government institutions to education for sustainable development. Thus, it has been found that government support and advocacy is often insufficient to successfully promote sustainable education and practice in higher education (Zorio-Grima, 2020).

2.1 Eco-innovation

2.1.1 Definition and characteristics of the concept "eco-innovation"

Over time, there have been many researchers eager to find a clear definition of the concept of "eco-innovation", with the emphasis in these definitions being placed on several elements, including: the object of innovation, market orientation, environmental aspects, the life cycle of materials used in production, the motivation for innovation, economic or environmental, and the level and status of a company (Díaz-García et al., 2015). The most commonly used definition of this concept is that offered by Kemp and Pearson: *„Eco-innovation is the production, assimilation or exploitation of a product, production process, service or management or business method that is novel to the organisation (developing or adopting it) and which results, throughout its life cycle, in a reduction of environmental risk, pollution and other negative impacts of resources use (including energy use) compared to relevant alternatives"* (Kemp & Pearson, 2007).

Based on this definition, several characteristics of eco-innovations have been established. Thus, grounded on the nature of eco-innovations, they can be technological, organisational, social or institutional. Technological eco-innovations are either new technologies that do not have negative environmental impacts or improvements to old technologies that mitigate negative impacts. From an organisational point of view, eco-innovations should be embedded in the management of companies so that they become increasingly environmentally friendly. The social side of these innovations is concerned with consumer behaviour and closely related to this is the institutional nature, which is responsible for decision-making, scientific evaluation of eco-innovations and increasing public participation in these innovations (Rennings, 2000).

Another notable aspect of eco-innovation is its potential for interdisciplinary discourse, allowing for examination from both economic and environmental perspectives. Consequently, this feature leads to another observation: although eco-innovation generates favorable environmental externalities, it also incurs additional costs for companies considering its adoption from an economic perspective (Hojnik & Ruzzier, 2016).

2.1.2 Motivation for eco-innovation

As the definition of “eco-innovation” shows, the reasons behind the emergence of this innovation were environmental issues. However, looking at it from the point of view of a business or organisation, there are both internal and external motivations.

Regarding internal motivators, some researchers argue that many companies use eco-innovation because it is effective. This efficiency could be described as reducing costs by improving equipment and technologies used by the company or by investing in research and development (Bossle et al., 2016).

Another internal factor would be environmental capacity, with a focus on the company’s environmental strategy, on sustainability-conscious management. Finally, the quality of human resources (Bossle et al., 2016) is an important factor that could make the transition from innovation to eco-innovation. Related to this factor, the training and education in sustainability that a company’s human capital has is very important, because they influence the „absorptive capacity” of the company when it comes to recognizing the value of new external information, assimilating it and applying it. Therefore, the more educated human resources are, the more firms will be able to recognize the potential of eco-innovations, but also to develop such innovations (Díaz-García et al., 2015).

In opposition to internal factors are external factors that influence the implementation of eco-innovation. Among the most important external factors is regulation, i.e. regulatory elements that put emphasis on environmental protection by companies (Bossle et al., 2016).

In addition to regulation, companies may face a demand for eco-innovations in the market in which they operate, and this may include demands from suppliers, consumers, competitors, non-governmental organisations, research centres or funding institutions (Díaz-García et al., 2015).

As eco-innovation is quite a current issue, some companies do not know how to fulfil corporate social responsibility, so they should cooperate with other companies more advanced in this field, with various customers and suppliers, and especially with scientific research institutions and universities (Bossle et al., 2016).

2.1.3 Measuring eco-innovation in European Union

Efforts towards moving from innovation to eco-innovation, which is so desirable in view of negative climate change, had to be measured in a specific way. Thus, within the European Union, the Eco-innovation Observatory is responsible for monitoring eco-innovation in each EU Member State. For this purpose, an eco-innovation index has been created to serve as an assessment tool and to illustrate the eco-innovation performance of each EU Member State (Bahn-Walkowiak et al., 2020).

As eco-innovation involves so many complex issues, the eco-innovation index was also developed taking into account several indicators from different areas including eco-innovation inputs, eco-innovation activities, eco-innovation outputs, resource efficiency outcomes and socio-economic outcomes (Al-Ajlani et al., 2022). Thus, it might be argued that the eco-innovation index analyses both economic, environmental and social elements.

The Eco-Innovation Index serves as a tool for determining the strengths and weaknesses of European Union Member States, expounding the performance of each individual Member State compared to the EU average.The benchmark for the EU average is 100, and countries can be either below average, with values below 100, or above average, with values above 100 (Bahn-Walkowiak et al., 2020). According to the score achieved, EU Member States can be classified as follows: Eco-Innovation Leaders, if they score above 115; Average Eco-Innovation performers, if they score between 85 and 115; and Catching-up with eco-innovation, if they score below 85 (Al-Ajlani et al., 2022).

2.2 Higher education

Higher education, alternatively termed tertiary education, refers to the level of academic attainment individuals achieve upon earning an academic degree, but its most important characteristic is that *„Higher education is a rich cultural and scientific asset which enables personal development and promotes economic, technological and social change. It promotes the exchange of knowledge, research and innovation and equips students with the skills needed to meet ever changing labour markets."* (UNESCO, 2023).

Over time, the benefits of higher education to society and to individuals have been analysed, as well as how people who are highly educated behave and what kind of vision they have.

Some researchers have found that higher education is an important factor in improving quality of life. In addition to the fact that highly educated people contribute to employment and are the ones who earn higher incomes, which leads to both their personal well-being and society's wealth, it seems that high education also has an impact on psychological aspects. It has been found that highly educated people are more involved in volunteering, take an interest in political issues and exercise their right to vote, have a healthy lifestyle by smoking less, doing more sport and eating a healthier and balanced diet, which can be quantified in reduced medical costs to society (Baum et al., 2013).

Given the benefits that higher education offers, the literature has explored the ways in which higher education can contribute to the development of society, including: teaching, research and innovation, and ultimately service, the latter of which refers to the direct engagement of institutions with society at large (Oketch et al., 2014).

The paper's center of attention being eco-innovation, it proves helpful to define how the research and innovation pathway may explicate the linkage between higher education and eco-innovation.Thus, considering the efforts made by tertiary educated people in the research and innovation process could lead to the following positive outcomes (Oketch et al., 2014): production of new technologies, which could be eco-friendly and mitigate the negative effects of current technologies; products with practical and sustainable value at the same time, all leading over time to environmental conservation and lower production costs. In addition to those who have researched ways in which higher education can improve the living standards of society as a whole, there have also been researchers who have focused on the link between higher education and the community. Thus, the literature states that higher education institutions must take *„deep and moral responsibility to raise the*

awareness, knowledge, skills, and values needed to create an equitable and sustainable future" (Cortese, 2003).

How could societies fulfil this responsibility? Cortese (Cortese, 2003) also explains that at the tertiary level of education there must be a strong link between curriculum and research; understanding and reducing any negative environmental and social footprint and how to take action and work towards improving society in general. Without these links, communities could not be balanced, safe and socially, economically and environmentally sustainable.

3. Methodology

The aim of this paper is to identify the influence of high education and related issues on eco-innovation in the EU Member States. This research will be quantitative research using a cross-sectional regression with independent variables such as population with education level at least bachelor or equivalent, population with education level at least master or equivalent and population with education level at least doctorate or equivalent, and the level of government expenditure on tertiary education. The dependent variable will be the eco-innovation index.

A similar analysis has been carried out for other scientific papers, one of which, related to the green economy, is "Green Economy for Sustainable Development and Poverty Eradication" (Lukas, 2015).

In the first part of the research, the values of the independent and dependent variables were identified for the European Union Member States for the period 2013-2022. Secondary data for the dependent variable were taken from the European Commission (European Commission, 2022), while secondary data for the independent variables were taken from the World Bank (World Bank, 2023).

After data collection, the dataset was entered into the EViews statistical program, which provided the statistical results of the cross-sectional regression presented in the results and discussion section.

3.1 Dependent variable - Eco-innovation index

As previously presented in an anterior section, eco-innovation within the European Union is deliberate through the utilization of the eco-innovation index. It consists of the following elements (Al-Ajlani et al., 2022):

a) Inputs to eco-innovation: financial and human capital investments in eco-innovative activities;

b) Eco-innovation activities: the activities of enterprises in a given country in eco-innovation;

c) Eco-innovation outputs: number of patents and academic publications related to eco-innovation;

d) Resource efficiency results: a country's material productivity, water productivity and greenhouse gas emissions intensity;

e) Socio-economic outcomes: employment in environmental protection and resource management activities.

The eco-innovation index score achieved by each EU Member State from 2013 to 2022 was provided by the European Commission (European Commission, 2022).

3.2 Independent variable

3.2.1 Population with high educational attainment

3.2.1.1 Population with at least a Bachelor's educational attainment or equivalent

The population with at least a bachelor's degree or equivalent education was calculated by applying the share of the population with at least a bachelor's degree or equivalent education aged 25-64 to the total population in this age group. Data were sourced from the World Development Indicators (World Bank, 2023) for the reference period spanning 2013 to 2022.

3.2.1.2 Population with at least a Master's educational attainment or equivalent

The population with at least a master's educational attainment or equivalent has been calculated by applying the share of the population with at least a master's educational attainment aged 25-64 to the total population in this age group. Data were sourced from the World Development Indicators (World Bank, 2023) for the reference period spanning 2013 to 2022.

3.2.1.3 Population with at least a Doctoral educational attainment or equivalent

The population with at least a doctoral educational attainment or equivalent has been calculated by applying the share of the population with at least a doctoral educational attainment aged 25-64 to the total population in this age group. Data were sourced from the World Development Indicators (World Bank, 2023) for the reference period spanning 2013 to 2022.

3.2.2 Government expenditure on tertiary education

Government expenditure on tertiary education was calculated using its share in total government expenditure on education. The latter was calculated by applying their share in GDP, expressed in current values, in dollars for each EU Member State over the period 2013-2022. The necessary data were sourced from World Development Indicators (World Bank, 2023).

4. Results and Discussion

The cross-sectional regression results from EViews are as follows:

4.1 Population with high education attainment

Clearly, each level of tertiary education exercises varying intensity of influence on the eco-innovation index of EU Member States. It seems that the population with only a

bachelor's degree has a significant negative effect, while the population with a master's degree has a significant and positive effect on the level of the eco-innovation index. The population with a doctoral degree also has a positive effect. Given these results, it can be said that the first hypothesis of the paper is affirmative.

Sample: 2013 2022
Periods included: 10
Cross-sections included: 27
Total panel (balanced) observations: 270

Variable	Coefficient	Std. Error	t-Statistic	Prob.
BACHELOR	-2.20E-05	5.40E-06	-4.068679	0.0001
MASTER	1.42E-05	6.45E-06	2.199711	0.0287
DOCTORAL	0.000338	6.71E-05	5.044079	0.0000
C	105.7698	2.320575	45.57913	0.0000

R-squared	0.087702	Mean dependent var	103.0008
Adjusted R-squared	0.077413	S.D. dependent var	35.38948
S.E. of regression	33.99209	Akaike info criterion	9.904837
Sum squared resid	307353.0	Schwarz criterion	9.958147
Log likelihood	-1333.153	Hannan-Quinn criter.	9.926244
F-statistic	8.523761	Durbin-Watson stat	0.138989
Prob(F-statistic)	0.000020		

Figure 1. Statistical significance of the relationship between the eco-innovation index and high education at bachelor, master and doctoral level
Source: by the author based on the results generated by EViews

These results could be explained by the fact that the European Union adopted the Bologna Process, which divided the higher education system into three cycles: bachelor, master and doctoral studies. Thus, each stage has a specific curriculum. Undergraduate studies cover the fundamentals of a specific field. Master's level studies then complement the knowledge acquired at bachelor's level and focus more concisely on a particular field, and doctoral studies are those that comprise a period of in-depth research in a field.

Given the foregoing, it could be argued that the undergraduate population exerts negligible influence on a country's eco-innovation index, as the basic knowledge provided at this level does not satisfy the engagement in discussion regarding eco-innovations. It is necessary to go through the next stages of the education system, which is also observed in the results obtained.

The difference between the coefficients attained for the independent variable population with at least a master's degree or equivalent and the population with at least a doctoral or equivalent can be explained by the fact that most students stop studying after the master's level.

The relevance and effects of these cross-sectional regression results could be explained by highlighting differences in the specialisation of knowledge and skills acquired at bachelor, master and doctoral level.

Studies at undergraduate level, while they may provide a solid grounding in the field, often focus on more general and theoretical aspects of the subject, providing a general understanding of concepts and practices. In contrast, masters and doctoral programmes typically involve advanced research and specialisation, allowing students to deepen their knowledge in their field of interest and develop advanced skills in solving specific problems (Tierney & Lanford, 2016).

Therefore, the result shows that, as far as eco-innovations are concerned, undergraduate studies may not provide sufficient specialisation and practical experience to positively influence the eco-innovation process. On the other hand, masters and doctoral programmes, which often involve applied research and practice in the field, provide students with the skills and knowledge to contribute to the development and implementation of eco-innovations (Urbano & Alvarez, 2014).

In terms of the greater influence of master's level studies compared to doctoral studies, this can be attributed to the duration and accessibility of the two programmes. Master's studies are typically shorter in duration and more accessible than doctoral studies, which may attract a larger number of students and provide broader opportunities for eco-innovation training.

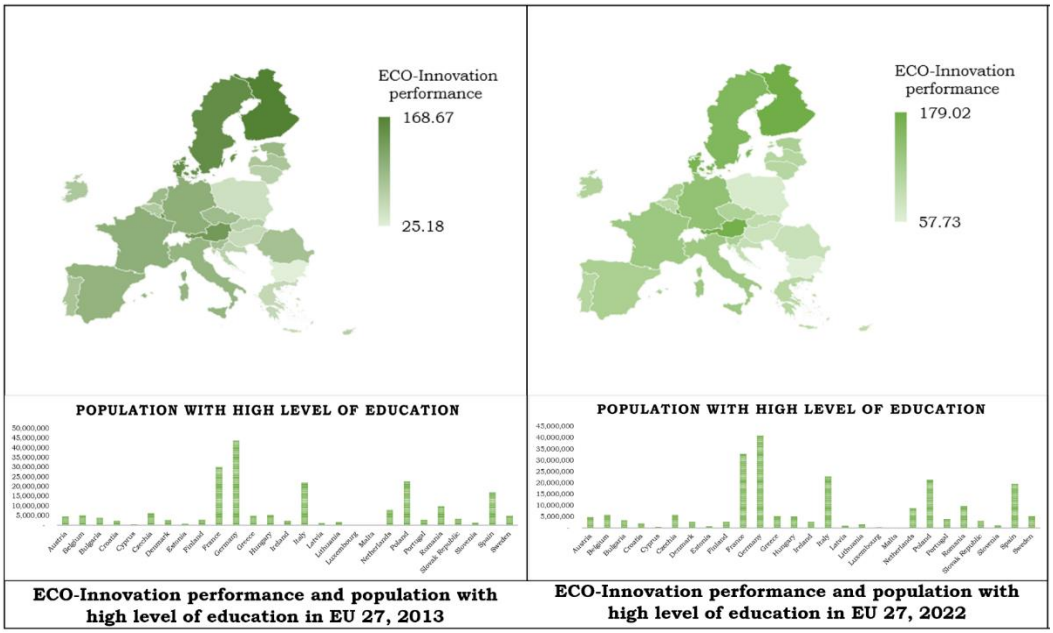

Figure 2. Comparison of the influence of the high educated population on the eco-innovation index in 2013 and 2022

Source: by the author based on World Bank data

From Figure 2 it can be seen that a higher number of highly educated people in each EU country does not necessarily mean a higher eco-innovation index. In 2013, the country with the highest eco-innovation index (168.67) was Finland, but this was not the country with the highest number of tertiary educated people. This can be explained by the fact that the Finnish education system is different from other systems and is well known as

a model to follow, as it seems to have the highest efficiency. In 2022, Luxembourg topped the ranking with the highest eco-innovation index score (179.02), but Finland ranked just behind with a score only 1 point lower.

Therefore, even if some countries have a high eco-innovation index, they adopt an education system that focuses on the quality of education and specialisation in areas relevant to innovation and sustainable development. In such countries, the emphasis in education is on encouraging creativity, critical thinking and practical skills at the expense of obtaining university degrees.

Some countries could also promote technical and vocational education to respond to labour market demands and support key sectors of their economy (Reyes, 2018). Thus, even if the number of university graduates is lower, these countries can have a more specialised and skilled workforce in areas relevant to eco-innovation.

4.2 Government expenditure on tertiary education

Analyzing the impact of government expenditure in the tertiary education sector, it was discovered to have a considerable positive influence, thereby affirming the second hypothesis of the paper.

Complementing this result is the finding of other researchers, who explain the increase in eco-innovation score based on higher incomes in different countries. More government spending is needed in the tertiary education sector because research is expensive and requires investment in various studies (Oketch et al., 2014).

Sample: 2013 2022
Periods included: 10
Cross-sections included: 27
Total panel (balanced) observations: 270

Variable	Coefficient	Std. Error	t-Statistic	Prob.
EXPENDITURE_ON_TERTIARY_	5.58E-09	3.07E-09	1.819961	0.0699
C	101.7844	2.246266	45.31273	0.0000

R-squared	0.012208	Mean dependent var	103.0008
Adjusted R-squared	0.008522	S.D. dependent var	35.38948
S.E. of regression	35.23835	Akaike info criterion	9.969527
Sum squared resid	332786.7	Schwarz criterion	9.996182
Log likelihood	-1343.886	Hannan-Quinn criter.	9.980230
F-statistic	3.312256	Durbin-Watson stat	0.029860
Prob(F-statistic)	0.069880		

Figure 3. Statistical significance of the relationship between the eco-innovation index and the government expenditure on tertiary education
Source: by the author based on the results generated by EViews

The cross-sectional regression results can also be explained by the fact that government spending on tertiary education includes funding for research projects and educational programmes focused on eco-innovation, thus governments can stimulate growth and

development of innovative solutions to environmental problems. Another element included in government spending on tertiary education is the provision of scholarships, grants and other forms of financial support, through which the interest and involvement of young researchers in eco-innovation activities can be stimulated (Yusliza et al., 2020)

Moreover, through financial support from governments, educational infrastructure, laboratories and other facilities needed for eco-innovation research and development can be built and upgraded.

It would be expected that the countries where governments spend the most money on tertiary education would also have the highest eco-innovation index. Figure 4 shows that this is not the case, and that countries such as Germany and France, which have the highest government spending compared to other EU countries, are not even among the top performers when it comes to eco-innovation. However, these countries are among the leaders in eco-innovation.

A good explanation for this result would be that government spending on higher education is sometimes directed to other aspects than eco-innovation research and development. In some cases, investments are made in improving access to education or upgrading educational infrastructure at the expense of funding eco-research and innovation.

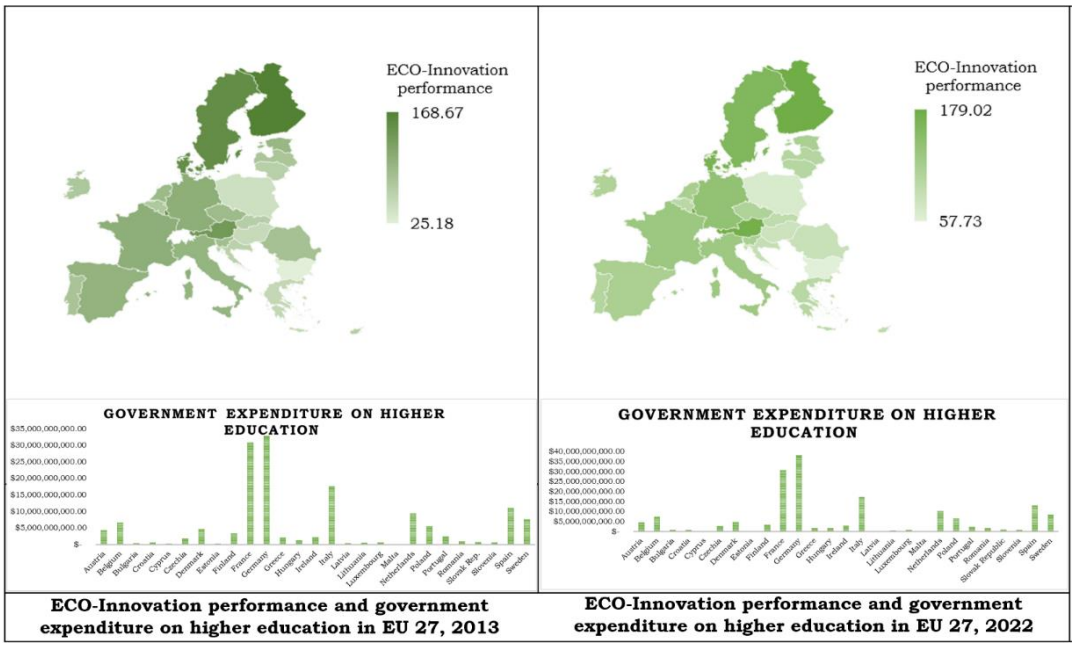

Figure 4. Comparison of the influence of government expenditure on higher education on the eco-innovation index in 2013 and 2022

Source: by the author based on World Bank data

5. The limits of research and future research directions

One of the biggest limitations of the paper was that the database on the highly educated population only included people in the 25-64 age category. Thus, it can be understood why higher education at bachelor level does not have a positive effect on the

eco-innovation index. This age category is more relevant for studying the effects of master and doctoral studies on eco-innovation, as people in this age group have managed to complete bachelor and maybe even master level studies.

The World Bank only made available information on the educational attainment of populations within EU countries for the 18-24 or 25-64 age groups. Thus, it could be considered that the first category would not be relevant for the present case study, as most of the young people in that age group are either at the beginning of bachelor or master studies. Therefore, the results obtained would not have been relevant if 18-24 age category would have been included.

However, for future research it would be interesting to replicate this study, but this time to include the 18-24 age category. Perhaps the results on the effects of Bachelor's level higher education on eco-innovation would be positive.

6. Conclusions

Considering the results of the quantitative analysis, this research has confirmed and highlighted the existence of a positive and significant relationship between higher education attainment, in particularly master's and doctoral level, and government expenditures in the higher education sector, and eco-innovation development in the European Union Member States. These findings bring light to the key role that higher education can play in promoting eco-innovation and sustainability today.

However, the results of the regression analysis showed that a larger population of individuals educated at tertiary level, especially at master and doctoral level, is associated with a substantial increase in eco-innovation in EU countries. Higher education provides the knowledge and skills needed to deal with challenging environmental issues and to create innovative and sustainable solutions.

Furthermore, the analysis showed that government expenditure in the higher education sector has a positive influence on eco-innovation. Sustained investment in higher education increases access to knowledge and research, which can lead to the development of a favorable framework for eco-innovation and a qualified workforce. In this way, governments can play a key role in promoting eco-innovation by allocating sufficient resources for the development and improvement of the education system.

The results of this research could provide valuable input for the promotion of higher education programmes focused on eco-innovation and sustainability, which contribute to the development of a workforce capable of responding to the challenges and opportunities of eco-innovation. Governments should therefore continue to allocate adequate resources for the development and improvement of the higher education system, particularly in areas related to the environment and sustainability, and also develop strategies and policies that encourage collaboration between universities, industry and the public sector to stimulate eco-innovation.

To conclude, this research provides a clear insight into the essential connection between higher education, government expenditure and eco-innovation in EU countries. In a changing world, where environmental concerns are growing, the development and support of innovative and sustainable solutions are becoming more important than ever.

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