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WHY IS THE TRANSITION TO A GREEN ECONOMY IMPORTANT FOR ACHIEVING SUSTAINABILITY? A REVIEW OF SOME THEORETICAL APPROACHES AND EMPIRICAL RESEARCH PRESENTED IN THE LITERATURE

Lejla Terzić

University of East Sarajevo, Bosnia and Herzegovina

ORCID 0000-0002-5048-036X

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WHY IS THE TRANSITION TO A GREEN ECONOMY IMPORTANT FOR ACHIEVING SUSTAINABILITY? A REVIEW OF SOME THEORETICAL APPROACHES AND EMPIRICAL RESEARCH PRESENTED IN THE LITERATURE

Lejla Terzić

University of East Sarajevo, Bosnia and Herzegovina

ORCID 0000-0002-5048-036X

Abstract: The transition to a green economy and sustainability have recently emerged as crucial topics in modern economic theory. The green economy is a sustainable vision for prosperity and growth that can enhance quality of life and the whole economy while increasing ecological and social well-being. Promoting the creation and acceptance of sustainable technological innovation is essential to a green economy approach. The major goal of this article is to highlight the importance and factors of transitioning to a green economy for achieving sustainability by reviewing the findings of theoretical approaches (microeconomic and macroeconomic) and empirical research. This article also contributes by outlining the crucial macroeconomic challenges of a green economy transition in achieving sustainability and responding to environmental hazards. In order to clarify the numerous aspects of a green economy, this article provides a generic framework that embraces a number of thoughts, ideas, and concepts and investigates how they connect to sustainability. This paper also addresses some difficulties that decision-makers must adequately recognise to pursue sustainable and efficient transformation and recommends a few directions for future research.

Keywords: green economy; transition; theoretical approaches; empirical research; sustainability

JEL codes: A1; I31; O30; Q5.

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Introduction

A green economy, in certain perspectives, is an interconnected framework promoting progressive economic growth, welfare, and ecosystems restoration without endangering future generations or causing environmental hazards. Sustainability makes it feasible to

connect ecological sustainability with prosperity. A green economy is built on rethinking growth and development within the constraints of limited natural resources. The challenges facing a green economy would be the same as those facing the existing economy: extreme poverty, a population rate that is accelerating, lack of knowledge, sufficient power generation, building infrastructure, and maintaining overall welfare. There are many stakeholders associated with putting the ideas associated with the green economy into practice, and every one of them has a significant role to play. Increased "well-being and equitable distribution of resources, while substantially decreasing hazards to the environment and natural scarcities", corresponds to what the UNEP (2014) defines as the 'green economy'. Low-carbon, sustainable, and environmentally inclusive economies may all be summed up as green economies. The UNEP places a strong emphasis on protecting biodiversity, including ecosystems and their resources. The phrase 'green growth' is frequently used as a complement to or even a synonym for the green economy (EEA, 2017). Green growth was once exclusively used to describe the expansion of the sustainably sourced industry.

Nevertheless, the phrase now refers to the expansion of the overall economy. Green growth aims to promote growth and prosperity in the economy while preserving biodiversity as well as those ecosystem services that are essential for human wellbeing. For the economy to accomplish the above, it must stimulate investments in addition to innovation, which will support long-term growth and provide new economic opportunities (OECD, 2010). According to the World Bank (2022), green growth is a form of expansion that is effective in the utilisation of renewable resources, reduces air pollution and its detrimental effects on the environment, and is adaptable in that it considers hazards associated with nature. Each of these interpretations demonstrates that the term 'green economy' is an umbrella covering a variety of meanings related to effectiveness and the mitigation of risks while utilising environmental resources, along with prosperity and well-being. Many academics have concentrated on researching the green economy paradigm and sustainability in the past decade (Bartelmus, 2013; Borghesi et al., 2015; Costantini & Mazzanti, 2013; Heshmati, 2018; Gibbs & O'Neill, 2017; Kirby & O'Mahony, 2018). Numerous factors and parameters influencing the green economy, sustainability, and environmental performance have been identified from their conducted research. In addition to the aforementioned studies, a number of academics have identified other various aspects and factors that are linked to the transition of the green economy toward sustainability (Alam & Kabir, 2013; Bilgen, 2014; Chang & Hao, 2017; Fotis & Polemis, 2018; Ibrahim & Law, 2016; Mendonça et al., 2020; Salman et al., 2019; Saikku et al., 2015; Shahbaz et al., 2013; Song et al., 2022a; Terzić, 2022; Wang et al., 2020).

In light of the aforementioned potentially conflicting factors, clarification on the feasibility of a green economy in successfully promoting a sustainable transition is required. The efficacy and suitability of the green economy as a means for achieving

sustainability might be called into question, notwithstanding its importance throughout national and international legislative initiatives and associations (Le Blanc, 2011; Saikku et al., 2015). Providing a framework for implementation and supervision as well as the practical application of the green economy concept in order to accomplish a transition towards long-term sustainability will continue to be essential. The goal of this article is to provide an overview of the fundamental microeconomic and macroeconomic theories and empirical evidence associated with the transition to a green economy and clarify the ways in which they interact with sustainability. A pragmatic approach that might be applied when assessing existing green economy approaches is interconnected with different aspects of the transition to sustainability. Linkages between the key indices of the transition to a green economy, including the environmental performance index, green future index, global green economy index, and green growth index, have been investigated using a variety of methodological approaches and measures. A correlation analysis using Spearman's method, applied to ordinal data variables with a non-normal distribution, was carried out to assess the link between each of the chosen indices. Furthermore, the statistically significant value of Spearman's correlations was determined using the rho-p hypothesis test. The associations between key indicators of the transition to a green economy for achieving sustainability in the Group of Seven (G7) and Emerging Seven (E7) economies were explored using Spearman's rank-order correlations.

In order to seek a sustainable and effective transformation, decision-makers and specialists must understand certain challenges at all stages of society. Additionally, this article suggests several directions of inquiry for additional research. The arguments centre on a number of issues, including: focusing on microeconomic and macroeconomic issues as well as their effects; answering environmental hazards that are becoming more global; achieving transformative, not just gradual, sustainable innovation; and the role of the state in developing the most efficient green economic policy mixtures.

Literature review: The importance of transitioning to a green economy for achieving sustainability

Many economists in the last ten years have argued that mainstream economic models must be fundamentally changed to solve major social and economic problems such as environmental degradation, ecological imbalance, water pollution, etc. The worldwide economic downturn sparked this discussion, and the idea of a green economy was established out of these considerations (OECD, 2010; UNEP, 2014; UNFCCC, 2016; Heshmati, 2018). In 2015, nations worldwide ratified the 2030 Agenda for Sustainable Development, which includes crucial sustainable development goals. These objectives acknowledge that measures to increase economic growth must coexist with initiatives to eliminate economic inequality. However, the green economy ultimately creates an authentic connection between ecological ecosystems and the economy. Additionally,

the purposes of the green economy emphasise the necessity for an environmental transition or a significant transformation toward other, more environmentally friendly forms of consumption and production. Several surveys have concentrated on a crucial element associated with this transformation: sustainable technological progress, for example, production and consumption trends that have far fewer detrimental effects on the environment.

The article also discusses a range of significant issues that must be supported to remove obstacles to sustainable technological progress and overall sustainability. These significant issues regarding the importance of transitioning toward a sustainable green economy aim to educate governments, experts, and the broader population through the experience gained through theoretical approaches and empirical evidence. Overcoming climate change and environmental concerns involves scientific competences surrounding the different technical issues that may be employed to alleviate negative consequences as well as an understanding of the scientific method (e.g., carbon-free energy technologies). Yet promoting sustainable technological progress also presents various non-technical difficulties in the sociological, institutional, legislative, and economic spheres. In particular, the so-called transitions literature acknowledges that a variety of industries, including those that produce energy, provide water, etc., could be described as socio-economic structures or forms of technological sophistication (Gibbs & O'Neill, 2017; Kirby & O'Mahony, 2018).

The most current reviews of the green economy paradigm, covering its theoretical foundations, political setting, and growth strategies for sustainable development, are by Heshmati (2018) and Bartelmus (2013). Megwai, Njie, and Richards (2016) have given a description of several projects on greening the economy, including an emphasis on developing nations. Specifically, they have presented a critical analysis of the relationship between the green economy and environmental sustainability. The origins of the dispute between economic and ecological systems may be traced to the middle of the Industrial Age. Malthusian theory had an impact on the future development of sustainable economics. It is known that Malthus impacted Darwin, who in turn affected several economists of the 19th and 20th centuries, including Alfred Marshall and particularly evolutionary economics.

The Darwinian evolutionary paradigm, which is the foundation of current views about transitions, has been reinvigorated within studies on the economics of innovation, with a special emphasis on knowledge (Laurent & Nightingale, 2001; Mirowski & Nik-Khah, 2017). As an illustration, Georgescu-Roegen (1975) focused on physics and barely mentioned environmental economics, which has its roots in traditional neoclassical theory and the concept of externalities. Laperche, Levratto, and Uzunidis (2012) present insights according to how nineteenth-century classical economists Francois Quesnay, Karl Marx, Adam Smith, and David Ricardo approached the environmental challenge inside the evolution of (free market capitalist) economic

systems. These economists described the special significance of the natural environment. Nevertheless, ecosystems versus economic systems primarily affect modern economic thought via several pioneering works in the economics of welfare, such as Pigou's (1921) work on externalities, regulations, and additional value analyses. The economic instruments in green regulation were originally established within this microeconomic framework (Baumol & Oates, 1975). Because of the short-term focus on monetary and fiscal policy, Keynesian perceptions on the macroeconomic side were excluded from this discussion. However, some economic growth concepts ended up taking technological advancement into account, including the Solow-Swan model and the Harrod-Domar model. Keynesian macroeconomic approaches to growth, which were created in the 1950s, incorporated several seeds of the following hypothesis: the main forces behind continuous, potentially efficient, consumption throughout time that estimate a sense of cross-functionality and cross-equality without taking into account natural resource restrictions are (external) technical advancement (Keynesian roots) and Solow's breakout from the steady-state condition. The notion of environmental sustainability, which was defined by the International Commission on Environment and Development in 1987, was based on macroeconomic theory (WCED, 1987). With the development of ecological curve theory, Simon Kuznets' influence once again surfaced, connecting ecological sustainability, growth, and inequalities. Grossman and Krueger (1994) assumed and tested for an asymmetric U-shaped connection between economic development and the ecosystem, expanding Kuznets' entire theory, including environmental deterioration.

Comparable to this, Heyes (2000) demonstrates from a neo-Keynesian viewpoint that ignoring the environment while planning economic development is a strategy for significant breakdown and concludes that sustainable economic growth is required for long-term economic and social prosperity. According to this, sustainable economic growth must be accompanied by expensive but appropriate preventive actions and enhanced economic standards. Even in the 1980s, innovation played a significant role in discussions on the green economy and sustainability (Rosenberg, 1994), mainly because of a macroeconomic view on fundamental transformation and financial fluctuations. In the 1990s, it then made its way into the policy and academic spheres with a few additional microeconomic viewpoints on enterprises' behaviour. The new data has been made available through surveys like the EU Community Innovation Study. The essential conceptual approach has been the evaluation of the scientific theory that green policies may stimulate technological innovations which would otherwise be challenging for the economy to encourage (Borghesi et al., 2015; Costantini & Mazzanti, 2013), with potential effects on employment and economic effectiveness (Mazzanti & Montini, 2010). With an emphasis on the relationship between innovation and human capital, the concept of innovation has changed over the years to include eco-friendly, sustainable, economical, and disruptive innovation. Further interactions between

environmental and economic principles harmonise the innovation framework with theories of economic growth and sustainable development.

Since it is generally known that sustained economic growth requires continuous investments in both organisational and technological improvements to operate the manufacturing process with greater effectiveness, sustainability and eco-innovation (Rennings, 2000; Terzić, 2022) are crucial factors among the innovation activities of enterprises. The opportunity for sustainable innovation should be taken into account within a systemic framework. Technological solutions, and particularly environmental innovations, are insufficient to assure sustainability. The above fundamental claim – that structural reforms must accompany technological revolution – is relevant to both the firm and societal levels. Certain uniquely created solutions should accommodate the complex interrelation among numerous kinds of participants from different backgrounds, general market characteristics, and the need for new knowledge, including about institutional frameworks. In fact, the application of green technology, including zero-carbon procedures in energy-intensive sectors, may influence the necessity of institutional adjustments.

Factors linked to the green economic transition toward sustainability: Review of the empirical evidence

Due to developmental disparities, the green economic model being used in developed nations cannot be effectively adapted to economies with low incomes. The interconnected components of sustainable innovation – environmental issues, energy production from renewable sources, and low carbon emissions – are addressed by reorganising economic activity to create the conditions for the development of a green economy. Additionally, nations in transition have different objectives and priorities that call for modifications to the concept of the green economy as understood in developed economies. Recent empirical investigations have emphasised the factors linked to the transition of the green economy toward sustainability, as follows: economic growth and pollution control (Alam & Kabir, 2013; Chang & Hao, 2017; Rahman et al., 2020; Shahbaz et al., 2013); ecological efficiency and environmental sustainability (Ikram et al., 2020); efficient policies and green technologies (Shahbaz et al., 2013); quality of the environment (Bilgen, 2014; Fotis & Polemis, 2018); technological innovation and renewable energy sources (Mendonça et al., 2020; Wang et al., 2020); and governmental effectiveness (Ibrahim & Law, 2016; Salman et al., 2019). According to Shahbaz et al. (2013), economic expansion is the main cause of CO2 emissions. The authors propose a cut at the expense of economic expansion and funding the procurement of green technologies. Furthermore, the effects of economic expansion may vary by region. Increased economic growth, according to Alam and Kabir (2013), protects the natural environment by lowering carbon dioxide emissions. To ensure the sustainability of the environment, the authors offer policies that combine pollution control and ecological

efficiency.

Song et al. (2022a) have investigated the significance of ecological, social, and technological parameters in production improvement, using samples obtained from the Chinese A-share companies which are dependent upon natural resources from 2004 to 2018 to analyse the connection between environmental legislation, green technological accomplishments, and the overall factor of productivity. In their research, green technological advancement was chosen as a significant component of the fourth industrial revolution. From the perspective of East and South-East Asian nations, Alam and Kabir (2013) have quantitatively investigated the link between GDP growth and environmental performance. It has been discovered via the use of both theoretical and quantitative modelling that the rise in GDP per capita tends to have a favourable effect on pollution measures. Regarding the context of environmental sustainability initiatives, the scenario is still only partially accurate because three out of seven eco-efficiency indicators – including the impact of water quality on ecosystems, forestry, and agriculture – are positively impacted by rising GDP per capita. The authors also contend that in an effort to achieve ecological sustainability during the stages of economic development, governments ought to emphasise eco-efficiency initiatives in addition to pollution control activities. The qualitative findings of Wang et al. (2020) showed a favourable association between carbon dioxide emissions and economic growth, along with an increase in gross domestic product. On the contrary, the use of renewable energy and technical progress are negatively correlated with carbon dioxide emissions. The aforementioned findings have significant implications for encouraging technical advancement and the use of renewable energy sources.

The underlying effect of hazardous emissions on economic growth is estimated by Rahman et al. (2020) to be greater than one digit, showing that hazardous emissions coupled with population expansion boost economic growth. The impact is minimal nonetheless, as a result of the further slowdown in economic development brought on by trade liberalization. According to Chang and Hao (2017), both OECD and non-OECD nations' environmental sustainability and economic growth have a favourable relationship. Empirical findings provide scientific evidence that insufficient environmental quality is linked to high energy use (Bilgen, 2014; Fotis & Polemis, 2018). There is an overwhelming argument for a varied mix of fossil fuels, with renewable energy sources being viewed as the most beneficial alternatives for the reason that energy consumption is unavoidable in everyday activities. Despite the fact that many people believe in renewable energy's direct beneficial impact on sustainability, the scientific evidence around this issue is still quite contentious. The same can be said for investments in human capital (Wang et al., 2020). Similar outcomes have been confirmed in the 50 biggest economies worldwide by Mendonça et al. (2020). Population growth, renewable energy production, and economic activity (as measured by GDP) all contribute to lower CO2 emissions in advanced economies (Mendonça et al., 2020).

Saikku et al. (2015) have emphasised and evaluated the theoretical and methodological basis for implementing and tracking the various components of a green economy, the crucial elements for realising a green economy, and regulatory elements with regard to the institutional structures that could ease the transition toward a green economy.

However, Wang et al. (2020) highlight the importance of technological innovation and the utilisation of renewable energy sources in achieving environmental sustainability. Ikram et al. (2020) claim that the worldwide standard ISO 14001, which outlines the specifications for an efficient environmental oversight system, has strengthened the list of factors contributing to sustainability. The growth of green initiatives can be accelerated or slowed down depending on their governmental effectiveness, which involves the efficacy of regulations and the might of the agencies that enforce them. According to Ibrahim and Law (2016), higher institutional quality is more advantageous for enhancing sustainability via the influence of commerce than inadequate institutional quality. An institutional framework that is well-established encourages economic performance while lowering carbon emissions (Salman et al., 2019). Quality institutions also make sure that businesses follow environmental laws. A strict regulatory environment with continuously changing laws and policies will inevitably restrict the growth of enterprises, especially international commercial activity. The three primary phases for solving the sustainability challenge, according to Barbier (2011), are enhancing socioeconomic and scientific investigations of ecological shortages, evaluating the reduction of advantages, and converting results into policies. Borghesi et al. (2015) have conducted empirical research examining the impact of EU environmental policies on green innovation. In several industries, such as electricity, refineries, and the paper industry, regulations seem to play a significant role, but energy cost implications take precedence over any possible CO2-focused policy benefits. In summary, both the organisational and technological stages are important. According to Borel-Saladin and Turok (2013), the green economy possesses the capacity to bring about significant and revolutionary modifications in the direction of the pursuit of a sustainable future. Constantini and Mazzanti (2013) stress the significance of modelling macroeconomic alternatives with reference to energy challenges.

Research methodology and data

The Environmental Performance Index (EPI), created by the Yale Center for Environmental Law and Policy and the Center for International Earth Science Information Network at Columbia University, offers a data-driven assessment of global sustainability. The EPI assesses 180 nations based on their performance in addressing the effects of climate change, environmental welfare, and ecosystem integrity by utilising forty performance metrics within 11 priority areas. Such indicators offer an estimation of how close nations are to achieving set environmental policy objectives on the national level. For nations aspiring to make progress toward a more sustainable

future, the EPI constitutes a ranking system that identifies the best and worst performers in environmental performance. The EPI indices offer a tool to discover issues, create goals, monitor trends, comprehend results, and pinpoint optimal policy practices. Government representatives may further develop policies and objectives, enhance interactions with important stakeholders, and more with the use of reliable data and evidence-based research. The 76 greatest countries and regions are ranked according to their determination and achievement in constructing a future without CO2 emissions in the Green Future Index (GFI), created by the Massachusetts Institute of Technology. By investing in energy efficiency, technological advancement, and green finance, it gauges how much the economies of these nations are shifting towards sustainable energy sources, industry, agriculture, and societies.

The performance of nations in the worldwide green economy is analysed using data from the Global Green Economy Index (GGEI). GGEI evaluates every country's level of advancement between 2005 and 2020 as well as its deviation from internationally agreed-upon objectives for sustainability in order to assess national sustainability achievements. The GGEI is a widely used indicator of how sustainable a nation is. It presently includes 160 countries and 18 measures assessing a country's development since 2005 according to the aforementioned metrics, as well as the proximity to every parameter within current internationally agreed-upon objectives. The Global Green Growth Institute publishes the Green Growth Index (GGI) ratings, which fluctuate between 1 and 100, with 1–20 representing extremely low, 20–40 indicating low, 40–60 signifying moderate, 60–80 representing high, and 80–100 showing extremely good green growth performance. The GGI comprises four aspects of green growth: societal inclusion, the protection of natural capital, effective and sustainable resource utilisation, and green economic possibilities. Correlation analysis using Spearman's method, which is applied to ordinal variables with a non-normal distribution, has been carried out in this study to assess the link between the chosen indicators. The statistical significance of Spearman's correlations by using the rho-p hypothesis test was also calculated. By applying Spearman's rank correlation coefficient, the relationships between the environmental performance, green future, global green economy, and green growth indices were identified. Because Spearman's correlation is a non-parametric test and some of the variables in this analysis are not normally distributed, it is a suitable estimation approach for these relationships.

Research results

The comparison of key indices of the transition to a green economy, including the environmental performance index, green future index, and global green economy index, has been carried out in 14 economies assigned to the two categories. The first group of economies is the Group of Seven (G7), consisting of the United States (USA), Japan (JPN), Germany (DE), France (FR), the United Kingdom (UK), Italy (IT), and Canada (CA). The

second group of economies is the Emerging Seven (E7), consisting of the Republic of China (ROC), India (IN), Brazil (BR), Mexico (MX), Russia (RU), Indonesia (ID), and Turkey (TR). Table 1 presents the key indicators of the transition to a green economy in achieving sustainability in the observed G7 and E7 economies.

Table 1. Scores and rankings of key indicators of the transition to a green economy in achieving sustainability in the G7 and E7 economies

Indicator	**EPI**		**GFI**		**GGEI**		**GGI**	
Economy	Score	Rank	Score	Rank	Score	Rank	Score	Rank
USA	51.1	6	5.40	7	0.567	6	61.87	7
JPN	57.2	5	5.45	6	0.547	7	65.03	5
DE	62.4	3	6.12	2	0.674	3	75.01	1
FR	62.5	2	6.12	3	0.744	1	70.93	3
UK	77.7	1	6.29	1	0.704	2	71.64	2
IT	57.7	4	5.53	5	0.669	4	70.89	4
CA	50.0	7	5.59	4	0.580	5	59.91	9
ROC	28.4	11	5.27	8	0.528	9	59.77	10
IN	18.9	14	4.73	10	0.394	13	46.38	13
BR	43.6	9	4.96	9	0.542	8	62.03	6
MX	45.5	8	4.23	11	0.500	10	61.04	8
RU	37.5	10	3.89	12	0.414	11	54.96	12
ID	28.2	12	3.68	14	0.363	14	57.36	11
TR	26.3	13	3.71	13	0.399	12	39.22	14

Source: Environmental Performance Index (2022); Green Future Index (2022); Global Green Economy Index (2022); Green Growth Index (2022). Measuring performance in achieving SDG targets; author's estimation.

On the basis of the environmental performance scores and rankings compared to other analysed economies for the studied period, the United Kingdom has achieved the best results. According to the Green Future Index, France is the best-ranked economy. Indonesia is the worst-ranked economy according to the GFI and GGEI, compared to the observed G7 and E7 economies, while India is the worst-positioned economy on the environmental performance index. Germany is the highest-ranked G7 economy according to the Green Growth Index, while the worst-positioned economy is Turkey. The correlations between the environmental performance, green future, global green economy, and green growth indices in the observed G7 and E7 economies are shown in

Table 2. The associations between the EPI, GFI, GGEI, and GGI were examined using Spearman's rank-order correlations. The secondary sources were used to compile the data. The statistical software program SPSS 25 was used to carry out the empirical investigation.

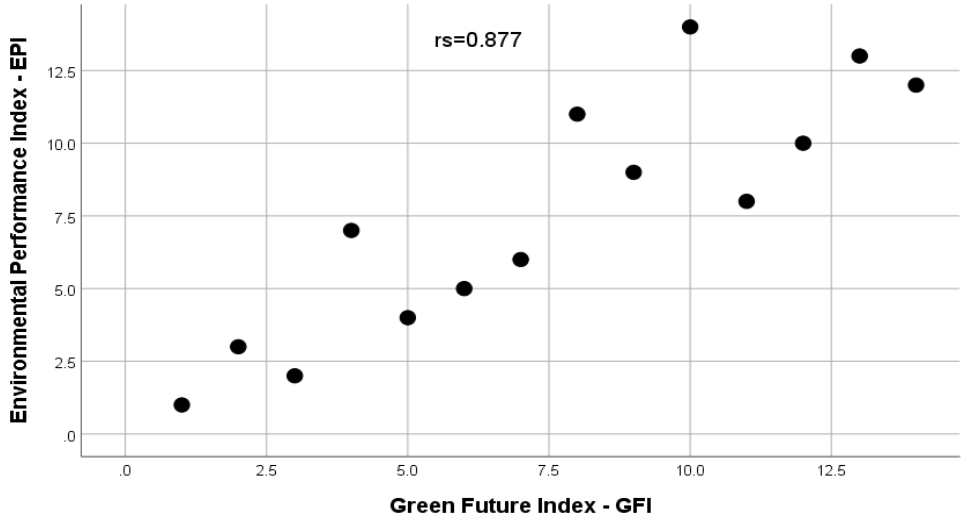
Table 2. Correlations between key indicators of the transition to a green economy for achieving sustainability in the G7 and E7 economies

	EPI	**GFI**	**GGEI**	**GGI**
EPI	1.000	.877**	.943**	.938**
GFI	.877**	1.000	.947**	.846**
GGEI	.943**	.947**	1.000	.886**
GGI	.938**	.846**	.886**	1.000

**. p<0.001.

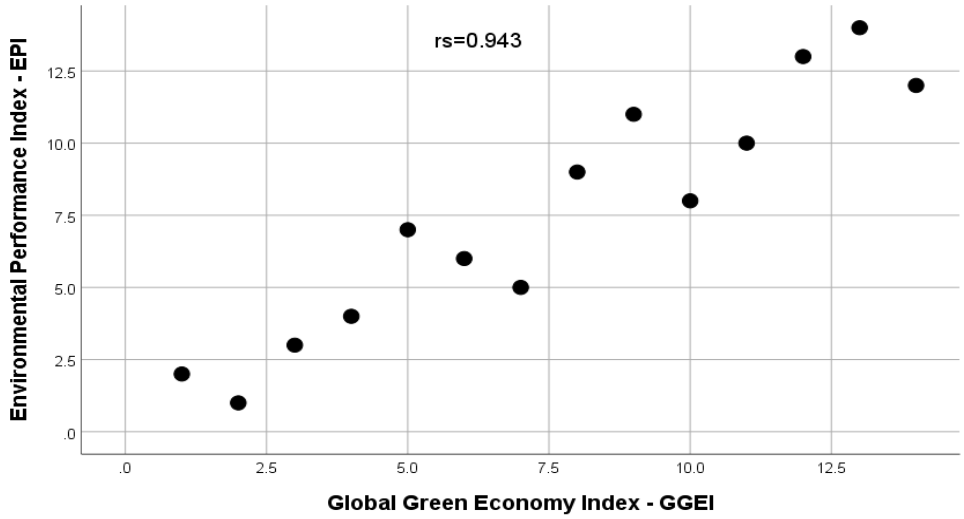
Source: Author's own estimation.

The following scatter plots show results of Spearman's correlation coefficient in the observed G7 and E7 economies. The scatter plot in Figure 1 shows a very strong positive and significant relationship between the Green Future Index (GFI) and the Economic Performance Index (EPI), as confirmed by Spearman's rank-order correlation coefficient rs = 0.877, p<0.001.



Source: The author, employing SPSS.

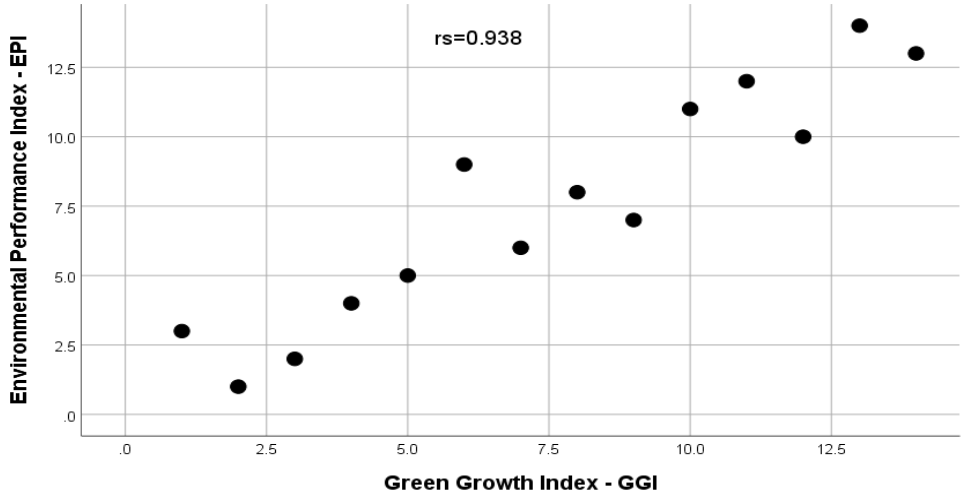
Figure 1. A scatter plot displaying the correlation between the GFI and EPI



Source: The author, employing SPSS.

Figure 2. A scatter plot displaying the correlation between the GGEI and EPI

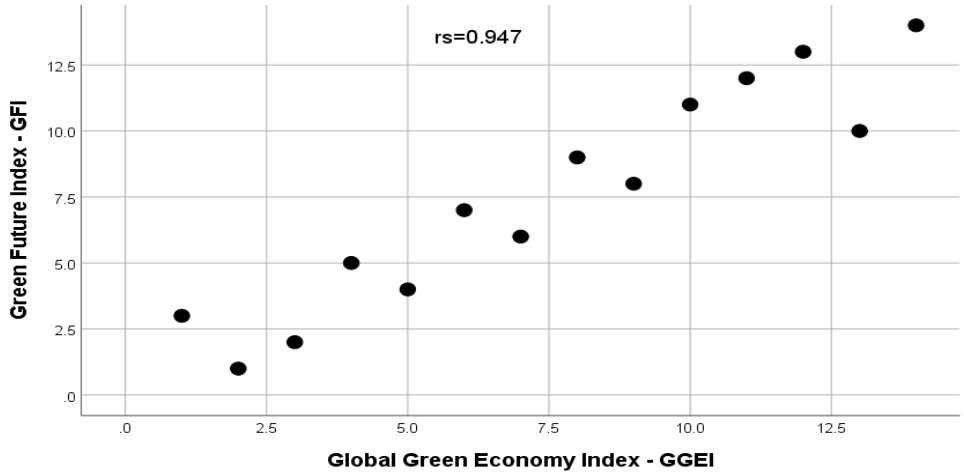
A very strong positive and significant association was determined between the Global Green Economy Index and the Environmental Performance Index, confirmed by the correlation coefficient rs = 0.943, p<0.001, as presented in Figure 2.



Source: The author, employing SPSS.

Figure 3. A scatter plot displaying the correlation between the GGI and EPI

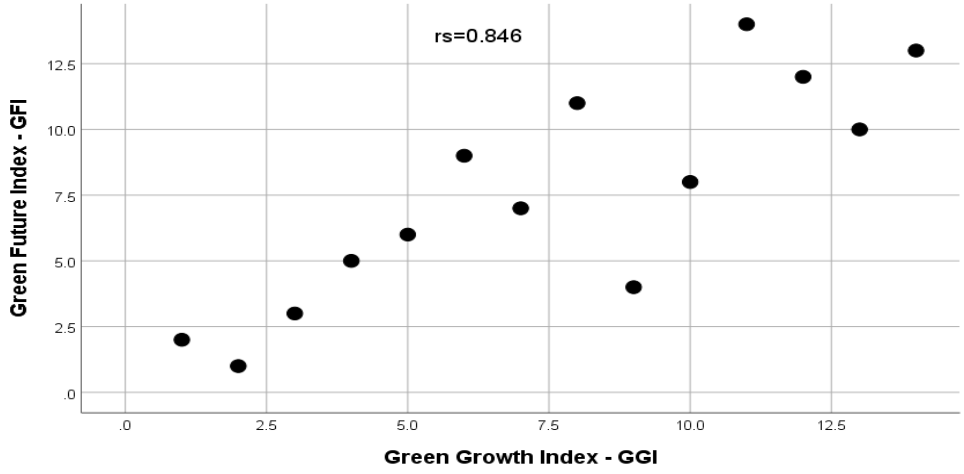
The scatter plot in Figure 3 presents a very strong positive and significant association that was identified between the Green Growth Index and the Environmental Performance Index, as confirmed by the correlation coefficient rs = 0.938, p<0.001.



Source: The author, employing SPSS.

Figure 4. A scatter plot displaying the correlation between the GGEI and GFI

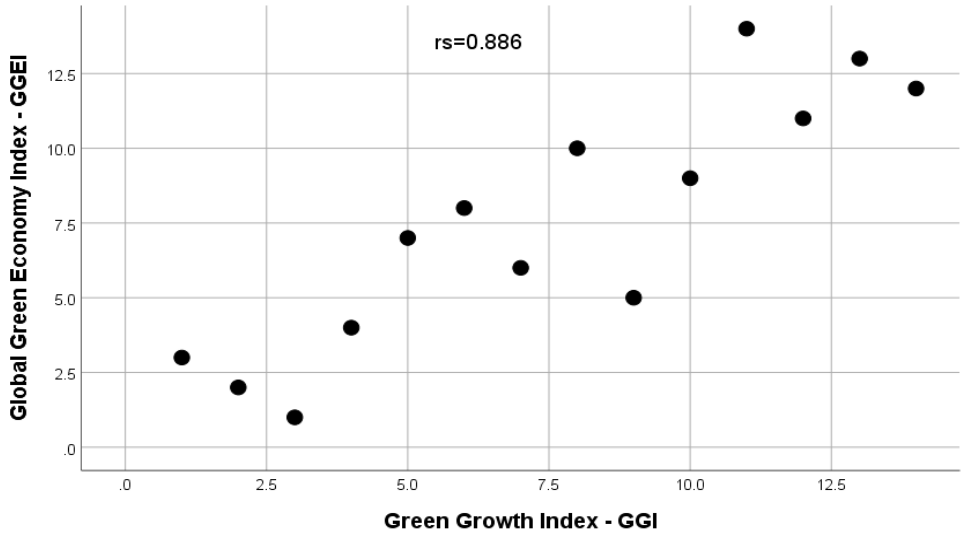
The scatter plot in Figure 4 displays a very strong positive and significant relationship between the Global Green Economy Index and Green Future Index, confirmed by the correlation coefficient rs = 0.947, p<0.001.



Source: The author employing SPSS.

Figure 5. A scatter plot displaying the correlation between the GGI and GFI

The scatter plot in Figure 5 shows a very strong positive and significant association between the Green Growth Index and Green Future Index, as shown by the correlation coefficient rs = 0.846, p<0.001.



Source: The author, employing SPSS.

Figure 6. A scatter plot displaying the correlation between the GGI and GGEI

The scatter plot in Figure 6 displays a very strong positive and significant relationship between the Green Growth Index and the Global Green Economy Index, as determined by the correlation coefficient rs = 0.886, p<0.001.

The Green Future Index tracks how much each nation is doing to decrease its emissions of carbon dioxide, create clean energy, and innovate in green industries. The GFI additionally highlights the importance of governmental policies on climate change and protection of the environment. The rankings of the world's green economies, green futures, environmental performance, and green growth provided by suitable measures could become crucial in comparing achievements between nations and provide helpful suggestions for governments in the implementation of economic policies for achieving long-term sustainability. The EPI, GFI, GGEI, and GGI can be used by the G7 and E7 countries to track the sustainable well-being of the entire population. The observed economies are in a good position to create the necessary sustainable solutions which will support growth. According to the research, attention should be directed toward adopting green policies that might boost future green prosperity in order to build economies that are greener and more resilient, competitive, innovative, and sustainable.

Responding to environmental hazards

The environmental policies developed over the last fifty years have resulted in the implementation of strict regulations on the release of pollutants into the atmosphere and waterways. Although perennial main polluters, such as industrial facilities, have always been very simple to track and supervise, including via greenhouse emissions guidelines, they were mostly ignored in this early phase. Globalization and the increasing importance of worldwide ecological issues like climate change have simultaneously made the situation more complex. Dealing with ecological problems frequently calls for international discussions about responsibility, which have proven to be difficult (Ciscar et al., 2013).

The challenges of coming to a strong and adequate worldwide agreement on climate change serve to illustrate this issue. It can be hard to restrict diffuse emissions since they are not easy to identify. Furthermore, a lot of attention was dedicated to specific environmental consequences throughout this early phase, such as emissions into surrounding waterways having a detrimental influence on other enterprises and/or residents within the same region. Consumer goods that are frequently manufactured include a number of hazardous materials, especially toxins. It is still hard to track the possible exposure of people and ecosystems to these compounds.

Technology advancement that eventually improves material identification and surveillance ought to become a main agenda item. The community needs to come up with alternate, even more 'ad hoc', methods of ecological surveillance and regulation in order to effectively handle these widespread environmental problems. Supporting innovative products that take modifiability and renewability into consideration is an essential strategy for promoting product recycling. A component-based software framework can, however, benefit from recycling and reuse (EEA, 2018). Yet there really are difficulties associated with this. There might not be any regulatory methods through which material recovery facilities can offer a producer any incentives to improve product development which frequently results in higher recycling expenditures for subsequent processes (Calcott & Walls, 2005; Heshmati, 2018).

Despite the fact that promoting energy efficiency could be utilised to deal with the problem of multiple environmental effects, it might not always be a beneficial move. Such approaches indicate that perhaps the economy can create the same quantity of products and services with a smaller amount of resources, for example energy and material ones, yet they additionally have the unintended consequence of creating a phenomenon known as the rebound effect (Greening, Greene & Difiglio, 2000).

Resources are unleashed and may be utilised to enhance the manufacturing and consumption of many other items, in addition to efficiency improvements. Increased

spending throughout the economy could at least partially compensate for this. The attention being paid to dispersing emissions into the environment suggests that implicit pollution prevention measures must be a foundational part of environmental control.

However, implementing each of these approaches (such as encouraging recycling and material efficiency) entails difficulties; they might encounter significant obstacles (such as those associated with item design and product utilisation) and may have unfavourable negative consequences (e.g., rebound effects). Furthermore, an emphasis on recycling and process improvement must not overshadow the requirement to strengthen product design benefits and strengthen the identification and surveillance of hazardous components and pollutants. Innovations in both business and technology are also required. Ultimately, a greater emphasis on circular economy alternatives will suggest that the various economic sectors must cooperate extensively. In fact, it is because of this interdependence that the desired efficiency increases are even achievable. This will necessitate novel ways for businesses to collaborate, especially in their approaches to economic activities.

Crucial macroeconomic challenges to the green economic transition in achieving sustainability

The transition to a green economy depends on gradual improvements, including improved resource and energy efficiency in current production systems. Extremely significant, perhaps even radical, technical innovation is still required. For example, substituting fossil fuels in the transportation industry and in the manufacturing of iron and steel involves major technological transformations rather than merely small increases in efficiency (Anser et al., 2020).

There are a few aspects that might make enabling transformational change intrinsically challenging. One barrier has been the risk that businesses investing in technical advancement (such as fundamental R&D and experimental tests) and the general financial market will have reduced capacity to tackle the problem of long-term vulnerability. Because of the absence of historical information to evaluate risks, such marketplaces might not be able to offer tools for managing risks with developing technologies. Concerns have also been raised about the liberalization of global capital markets, suggesting that individual financial speculators now have a shorter time horizon (Newell, 2012; OECD, 2010).

For example, studies indicate that even in the presence of fully functioning capital markets, focused conduct may occur because of agency issues inside private enterprises' decision-making processes. The transfer to green sectors of the economy also necessitates negotiating future trade according to various objectives and the preferences of different decision-makers (Pitkänen et al., 2016).

The end of the 1990s resulted in greater awareness about the shortcomings of the microeconomic viewpoint as a theoretical basis for comprehending sustainability issues and formulating policy recommendations. These shortcomings indicated the transition to an updated framework, with resulting novel studies on the green economic transition and sustainable innovation emphasising a shift beyond the microeconomic dimension of particular companies and their customers to the meso-economic dimension of entire industries and structures which are associated with production and consumption. The fundamental tenet of the transitions viewpoint is the recognition that the major economic and environmental problems that society is currently confronting, such as inequalities, decreased biodiversity, and environmental degradation, are especially difficult to address because they are "systemic" (EEA, 2017).

The difficulties that governments encounter when attempting to employ different policy measures or adequate market prices to achieve sustainability objectives could be conceptualised by adopting a systemic viewpoint. This would provide insight into the process of systemic change and its implications for policymaking. The green transitions argues that structural reform strongly depends on the growth and diffusion of various types of innovation encouraging effective solutions in thought and conduct – new institutional practices, technological advances, economic models, new structures, etc. This argument draws on neo-Schumpeterian and evolutionary economics.

Okampo (2005) identifies four macroeconomic issues that should be analysed in the green economy. The first of these deals with issues of intertemporal wellbeing. Intertemporal wellbeing is the way the welfare of upcoming generations has been considered throughout prevailing economic decisions. This is a topic that affects decision-making when it comes to saving and investing nowadays, but it also has significant ramifications because the socioeconomic discount rate selected is necessary in cost-benefit analyses at the microeconomic level. The second is concerned with biodegradation and its effects on overall supply, along with the way environmental expenditures and control measures affect overall demand and supply.

The transition to a green economy must involve major modifications to the processes of production and consumption. This highlight of the third point relies on the fact that economic growth continues to be a process of radical transformation. The last macroeconomic issue concerns how worldwide efforts in this field will be sponsored. The main finding of the initial macroeconomic paradigm is that intergenerational fairness and ethical discussions cannot be separated from analyses of intertemporal prosperity. According to past research on overall demand and supply, green finance has had an additional beneficial effect on the economy's supply and demand.

Based on Zhang et al. (2022), three of the main focuses of current green economy efforts are as follows: encouragement of a macroeconomic approach to long-term

economic prosperity at the regional and national levels; encouragement of further development of the green economy, notably in the fields of investment, new technology, and green financing; and assistance to various countries in integrating manufacturing and economic expansion to make the transition to renewable energy sources possible in the future.

Policy recommendations and the role of the state

Both governments (at the macroeconomic level) and companies (at the microeconomic level) perceive the idea of a green economy to be particularly appealing since it promises to address unemployment and sustainability issues at the same time by developing innovative green sectors and measures for reducing harmful effects on the environment (Barbier, E., 2011; Borghesi et al., 2015; Borel-Saladin & Turok, 2013).

According to the UNEP Green Economy synopsis for decision-makers, "the designated 'trade-off' among economic growth and the protection of the environment is a delusion" from a long-term perspective (UNEP, 2010). Due to the presumption that there may be positive outcomes that benefit the economy and the natural world, this subject warrants further investigation (Constantini & Mazzanti, 2012; Porter & Van der Linde, 1995).

This controversial "Porter hypothesis" lies at the centre of how we conceptualise the relationship between several theoretical presumptions about substitutability on a practical level. Given these factors, the majority of the green economy argument focuses on the scope of adjustments and methods for implementing them. In general, promoting green technological advancement – not to mention transformative innovation – must rely on a combination of measures. Three main groups of tools have been presented in the academic literature as the basis for an innovative policy mix (Kivimaa & Kern, 2016; Rogge & Reichardt, 2016; UNEP, 2014): technology-push tools that assist in the delivery of fundamental and applied technological inputs, including funding for R&D, patent safety, tax advantages, etc.; demand-motivated tools, including deployment policies like government tendering, feed-in quotas, taxes, etc., which promote the emergence of new marketplaces; the concept of systemic tools encouraging different activities to take place at each stage of the innovation framework, such as offering infrastructures that allow stakeholder coordination and encouraging the advancement of objectives and alternative institutional approaches.

Supporting the creation of generic technology that can be further developed by small businesses remains a crucial function of a new green innovation policy. In order to encourage variation and enable the verification, optimization, and upscaling of innovative technologies, government investment in research and development and funding from others for experimental and demonstration facilities are used. Since

inadequate investment owing to knowledge spill-overs may be especially significant for these kinds of innovations, as was already said, there is substantial scientific evidence for governmental R&D funding of sustainable technology advancement. Implementing each of the aforementioned policy combinations will be fraught with difficulties, including securing approval from legislators, specifying precise concepts for policy tools, and figuring out the best way to measure them.

Future studies should pay close attention to each of these difficulties. However, the necessity for innovation-specific policies could be specifically underlined here. According to the aforementioned discussions, there are two reasons to rely upon innovation-specific tools to encourage long-term advancements in technology: the desire to encourage more radical sustainability advances and the fact that diffuse emissions are frequently difficult to regulate, preferably without additionally spending prohibitively large monitoring expenses.

Technology-specific innovation structures typically accompany renewable energy technologies. In the context of obstacles, processes for learning, and changes in the structure of capital-intensive goods sectors, for example, various innovations are exposed to distinctive and multifunctional growth operations.

Innovative green technologies are less likely to experience technological limitations than established advances in technology, and the form of knowledge transmission and future dangers will be different as well. The implementation of innovation-specific policies as supplements to conventional environmental policies ought to serve as the foundation for encouraging sustainable innovation. That represents a barrier to policymakers as a matter of themselves and necessitates a comprehensive understanding of the interactions between different policies and tools, along with a greater understanding of the governing structures where these tools are applied.

Conclusion

This paper aimed to highlight the importance and factors of transitioning to a green economy for achieving sustainability by reviewing the findings of theoretical approaches (microeconomic and macroeconomic) and empirical research. The green economy has become a crucial policy paradigm for both advanced and emerging economies' prosperity and growth. The research results showed extremely significant positive relationships between the Environmental Performance Index, Green Future Index, Global Green Economy Index, and Green Growth Index. An economy that can be considered environmentally sustainable is known as a "green economy". It is predicated on the notion that environmental protection and green growth are compatible goals. In addition to lowering CO2 emissions, preserving natural resources, and encouraging energy from renewable sources, the green economy makes numerous other contributions towards

sustainability. Nevertheless, the green economy is not without its challenges and shortcomings. The high cost of integrating green innovation and procedures is one of the key challenges.

The absence of political determination to put sustainability-promoting policies into action is an additional obstacle. The inability to minimise the release of carbon dioxide emissions to rates that are acceptable for both the environment and people, as well as the failure to effectively manage natural resources, are among the other shortcomings. Various aspects of a green economy's transition to sustainability are associated with a pragmatic approach that may be used while evaluating existing green economy ideas. Decision-makers and experts must comprehend specific difficulties at all stages of society in order to pursue sustainable and effective reform.

The paper's arguments concentrate on a variety of concerns: microeconomic and macroeconomic issues as well as their effects; responding to environmental hazards that are evolving into global ones; reaching transformative, not only gradual, sustainable innovation; and the role of state authorities in creating the most effective policy combinations for the green economy. The idea of a green economy has become widely recognised in politics and is frequently included in the priorities of worldwide organisations.

This paper has offered a general framework encompassing several thoughts, ideas, and concepts and has examined how these relate to sustainability in order to make clear the various aspects of a green economy. The changes needed could be either substantial or gradual, depending on the selected approach. Some approaches, such as environmentally friendly manufacturing, which can be described as being adjusted for effectively sustainable production, tend to be more in accordance with general economics and only require minor modifications, while alternative ones, such as ecological sustainability in industry or solutions rooted in nature, rely on major modifications to our routines for manufacturing and consumption that will necessitate significant investments in environmentally friendly infrastructure.

It can be concluded that if the mutually beneficial idea of human well-being throughout the global framework is to become a reality, green economy legislators may be inclined to take an increased environmentally conscious or proactive sustainability viewpoint. There are already substantial gaps in knowledge regarding how this transformation will be put into practice. Additionally, distinct interventions may be needed for various economic sectors. In the event that this is expressly included in future research on the sustainability of the economy, an appropriate legislative framework should be created.

The complexity of the relationships between various types of stakeholders from various backgrounds, general market characteristics, and the necessity for new

knowledge involving institutional frameworks should all be taken into account while developing new approaches to the green economy. In reality, the use of green technology, such as carbon-free processes, in energy-intensive industries may affect the need for institutional changes. Recent empirical studies have focused on the following factors that are linked to the transition of the green economy toward sustainability: economic growth and pollution control, ecological efficiency and environmental sustainability, efficient policies and green technologies, quality of the environment, technological innovation and renewable energy sources, and governmental effectiveness.

Comparative analyses of national achievements based on global green economy rankings, as well as their green futures, environmental performance, and green growth derived from appropriate metrics, could be essential. The rankings of observed economies may also offer useful recommendations for governments already implementing green policies to achieve sustainability. The G7 and E7 economies are able to assess the well-being of the entire population using the EPI, GFI, GGEI, and GGI. The observed countries are well-positioned to develop the essential long-term adjustments which are beneficial to accelerating growth. In accordance with the research, focus should be placed on implementing green policies that could increase future green growth and national prosperity.

Appropriate green policies should be created and implemented to provide environmental benefits that are anticipated to boost the well-being and overall prosperity of each economy. The economic advantages of a transition to a green economy in achieving sustainability and the utilisation of natural capital as an element of production consequently represent an initial type of benefit from green initiatives and policies. The majority of these initiatives are also probably expected to have temporary financial impacts, such as greater investment or operating expenditures. As a result of the aforementioned expenditures, compromises could be made between the growth of the economy and environmental conservation. However, by addressing current inefficiencies and failures, environmental measures may generate economic benefits and support growth.

Conflict of interests

The author declare no conflict of interests.

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Lejla Terzić is Associate Professor, Faculty of Economics in Brčko at the University of East Sarajevo, Bosnia and Herzegovina. ORCID 0000-0002-5048-036X, lejla.terzic.efb@gmail.com

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