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VOITKO Serhii
doctor of economic sciences, professor
professor, head of the department of international economics
National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute"
ORCID: 0000-0002-2488-3210
email: s.voytko@kpi.ua

SAKALOSH Taras
candidate of economic sciences, associate professor
associate professor of the department of international economics
National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute"
ORCID: 0000-0002-3994-0847
email: sakalosh@ukr.net

MAZANKO Tetiana
PhD student
PhD student of the department of international economics
ORCID: 0000-0003-0946-2976
email: tetiana.mazanko@gmail.com

CIRCULAR ECONOMY REPRESENTED IN SELECTED GLOBAL ECONOMY INDICES

Cyclic economy or closed-loop economy compared to the linear economy is synonymous with innovations based on the use of renewable energy sources. Circular economy is aimed at changing the classic linear model of the economy in such a way as to minimize waste and emissions throughout the product's life cycle. The paper focused to the analysis of the circular economy development level and its elements, as well as analysis of the comparison of various indices characterized human wellbeing, hi-tech export for top-20 countries in the ranking and Ukraine. The method of correlation and regression analysis used in the study. The results of the study revealed a significant dependence between the High-tech export index and Environmental Performance index, Education Index and Environmental Performance index. This confirmed an assumption on the significant impact of the population erudition level to the readiness of the society for resource saving, as well as it affects the environment and energy saving innovative options implementation. Education can contribute to the rapid expansion of the circular economy concept.

Key words: Circular Economy, Environmental Performance Index, Hi-Tech Export, Education Index, Correlation.

JEL classification: F63, F64
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1. INTRODUCTION

In November 2022, Sharm El-Sheikh climate change conference was held in Egypt. The main topics were extreme weather events all over the world, as well as the food and energy crisis caused by the war in Ukraine. At the same time, the data of scientists show that the current efforts to combat carbon emissions and protect the future of our planet are not enough [1].

In 2021, COP026, held in the Scottish city of Glasgow, marked five years since the signing of the Paris Agreement (one year had to be missed due to the COVID-19 pandemic). As a result of the Conference, the Glasgow Climate Pact was signed. It confirmed the main goal: to limit global warming to 1.5 degrees Celsius.

At COP-26, the participating countries agreed to undertake stronger commitments and update national plans, setting more ambitious

goals. However, only 23 cou ntries presented their updated plans to the UN.

Many promises were made in Glasgow to achieve 'zero emissions', protect forests and finance adaptation to climate change, among many other issues.

According to the Chairman's statement, COP-27 is devoted to the transition from negotiations to "planning for the implementation" of all these numerous promises.

COP27 ended with a historic decision that failed to be reached at COP26, namely the creation and implementation of a Fund that will be allocated to poor countries to overcome the consequences of global warming. Welcoming the decision and stressing the need for the Fund, UN Secretary-General Antonio Guterres said more needs to be done now to dramatically reduce emissions: "The world still needs a giant leap in climate ambition." Egypt, the host country of the conference, called for full, timely, comprehensive, and large-scale action on the ground [2].

All these discussions will form the basis of the Global Debriefing to be held next November at COP-28. For example, it must be decided how countries should measure their emissions in practice so that everyone is on the same level.

At COP28, an assessment of the results that states will be able to achieve in the field of mitigation, adaptation and means of implementing the Paris Agreement will be carried out.

The Climate Summit in Paris took place in 2015-year end, to be more exact, contributed to further wide-scale promotion and implementation of green technologies and the latest lifesaving concepts on the Earth. The Summit resolution pushed the global mankind to review the manufacturing principles in modern global economy. As of now, vast majority of production processes worldwide actively consume fossil fuels and natural resources and this fact should serve as the trigger and change the situation almost upside down. The Summit concepts were built on the previous conferences cumulative outcomes:

- Rio de Janeiro (Brazil) – conference 'Agenda 21' (1992);
- Kyoto (Japan) – Kyoto Protocol (1997);
- Monterrey (Mexico) – Financing for Development (FfD) Conference (2002);
- Johannesburg (South Africa) – World Summit on Sustainable Development (alternate names: 'Earth Summit 2002', 'Rio + 10') (2002).

The mission of Climate Summit in Paris, according to [3] is "Goal 13: Take urgent action to combat climate change and its impacts": '... all countries agreed to work to limit global temperature rise to well below 2 degrees Celsius, and given the grave risk, to strive for 1.5 degrees Celsius'.

The Climate Action Summit took place in September 23rd, 2019 in New York City, USA. The Summit built on the outcomes of the Global Climate Action Summit (GCAS), the 73rd session of the UN General Assembly (UNGA 73) and the 24th session of the Conference of the Parties (COP 24) to the UNFCCC, among others, and sought to challenge states, regions, cities, companies, investors and citizens to step up action in six areas: energy transition, climate finance and carbon pricing, industry transition, nature-based solutions, cities and local action, and resilience [4].

On November 13th, the Glasgow Conference of the Parties to the United Nations Framework Convention on Climate Change (COP26) was ended, in which almost 200 states took part. It was agreed the final document - the Glasgow Climate Pact [5]. The main conclusions are recognizing the emergency, accelerating action, moving away from fossil fuels, delivering on climate finance, completing the Paris rulebook, focusing on loss and damage.

2. ANALYSIS OF RECENT RESEARCH AND PUBLICATIONS

Researching the concept of circular economy is an extremely popular topic for both foreign and domestic scientists. Among the foreign scientists who considered the main principles of implementing the circular economy model, we can highlight the following: american economist K. Boulding [6], groups of scientists W.Stahel, G. RedayMulvey [7], M. Braungart, W. McDonough [8], D. Pearce [9], P. Lacy, J. Long, W. Spindler [10]. To date, such Ukrainian and foreign researchers as: O. Sysoev [11], I. Zvarych [12], V. Gurochkina, M. Budzynska, M. Varfolomeev, and O. Churikanova [13].

3. SELECTION OF PREVIOUSLY UNSOLVED PARTS OF THE GENERAL PROBLEM TO WHICH THIS ARTICLE IS DEDICATED

The implementation of the circular economy depends on many factors, as well as directly on the main economic indicators such as: High-tech export index and Environmental Performance index, Education Index and Environmental Performance index. The analysis of previous studies and publications shows that the study of the dependence of these indicators on each other and their direct influence on the speed of implementation of the circular economy concept is an insufficiently covered problem.

4. FORMULATION OF THE OBJECTIVES OF THE ARTICLE

High-tech and knowledge-intensive productions consider the principles of the circular economy at the design stage, these technologies are directly related to the export of high technologies. Export of high technologies is one of the indicators that a country is ready to accelerate the implementation of circular economy principles. With the comparison of various indices, the article proves that only well-developed countries can really implement the concept of circular economy.

5. PRESENTATION OF THE MAIN MATERIAL OF THE RESEARCH WITH FULL JUSTIFICATION OF THE OBTAINED SCIENTIFIC RESULTS

Challenges of the transition towards circular economy. The majority of the challenges discussed within the above-mentioned global summits are going to be resolved through the global transition to the model of the circular economy.

Circular economy (Cyclic economy or closed-loop economy) vs linear economy is an innovative economy paradigm underpinned by utilizing renewables.

The linear “take, make and dispose” extractive industrial model has been exhausting the fossil fuels and contaminating the Earth’s noosphere for the whole century. To counterbalance, the circular economy is focused on changing the classical linear production model and this change might happen if the core attention is targeted on development, production and using services and goods that minimize waste, emissions and discharges throughout the full product life cycle. The circular economy seeks to rebuild capital, whether this is financial, manufactured, human, social or natural. This ensures enhanced flows of goods and services. The system diagram illustrates the continuous flow of technical and biological materials through the ‘value circle’ [14].

The circular economy principles are: 1) Preserve and enhance natural capital by controlling finite stocks and balancing renewable resource flows; 2) Optimize resource yields by circulating products, components and materials in use at the highest utility at all times in both technical and biological cycles; 3) Foster system effectiveness by revealing and designing out negative externalities [15]. In general, the circular economy model is pushing global society towards the Fourth Industrial Revolution as it aims at maximizing the use of resources by maintaining the value of products, materials and resources in the economy for as long as possible, as well as to minimize the generation of waste and emissions and thus the need for disposal according to the Waste minimization hierarchy [16]. Moving towards a more circular economy could deliver benefits, including reduced pressure on the environment; enhanced raw materials supply security; and increase competitiveness, innovation, growth and jobs. However, there are also challenges, such as finance, key economic enablers, skills, consumer behavior, business models and multi-level governance [17].

One case (spot case) of circular economy within the planet scale will neither influence the global economy development nor push it forward substantially and thus, the actual results of the circular economy can be produced only its fundamental principles are used widely on global economy level. High-technology export [18] in this situation can serve as one of the indices to demonstrate either country is ready to accelerate implementing the circular economy fundamentals. First of all, only well-developed countries can really implement circular economy concept. The second argument – high-tech and science-intensive productions might have taken into account the circular economy principles at a design stage. Thirdly, the global economic model demonstrates the growth of specialization and cooperation, primarily in high-tech area. The fourth argument – circular economy is closely associated with high-technology export; these two cannot be splitted.

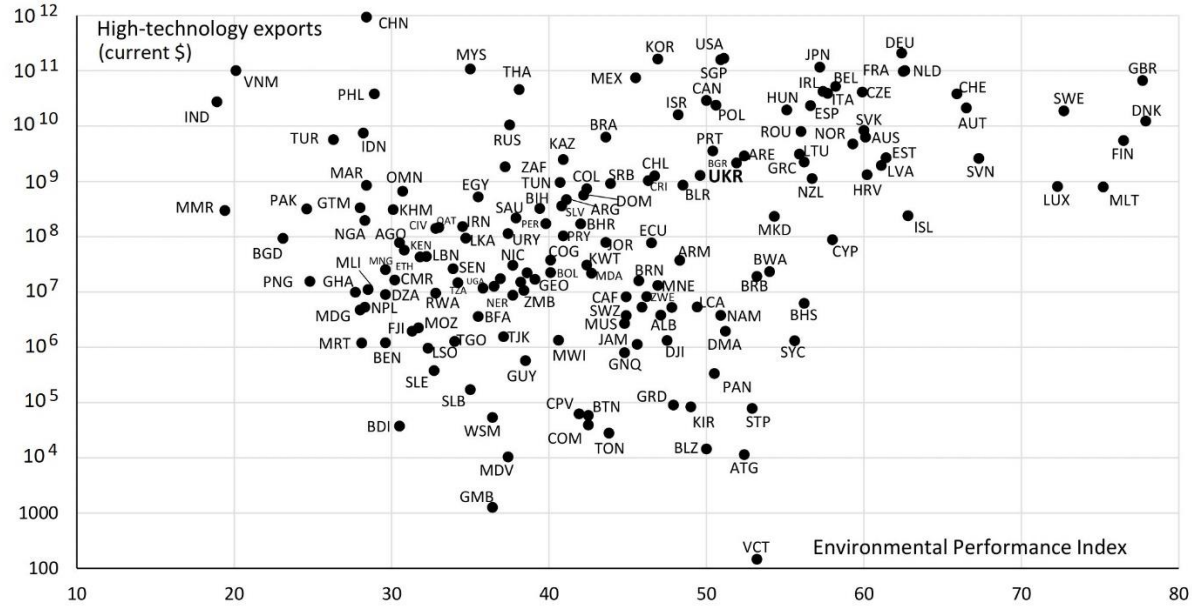

Figure 1. Environmental Performance Index (2022) to High-technology Export (2022) ratio for 160 countries

The regression equation (Figure 1):

$$y = 1000000 + e^{0,105x}$$
$$R^2 = 0,0872$$

Figure 1 shows the ratio of Environmental Performance Index to High-technology exports for 160 countries with high-technology export.

During analyzing of the ratio, we can see that Denmark, United Kingdom, Finland, Malta, Sweden, Luxembourg, Slovenia, Austria, Switzerland and Iceland create a TOP-10 in the Environmental Performance Index 2022. As for High-technology Export TOP-10 2022, China, Hong Kong, Germany, USA, Japan, Malaysia, Netherlands, France, Mexico and United Kingdom.

There is a key point to be paid attention on – only United Kingdom is the member of both indices groups simultaneously. Thus, the conclusion is obvious – the leaders have no real balanced approach to be guided with.

Table 1 presents TOP-10 ratings for Environmental Performance Index [18] and High-technology exports [19] as well as the Ukraine's position in this rating.

For the first twenty countries the situation is a bit different, countries like United Kingdom and Switzerland are in both TOP-20. Moreover, United Kingdom is "G7" country and has been already oriented towards resource saving and waste minimization industries development.

Correlation of the education and environmental performance. Like other objects, specific indicators that are actually the input data with numerical value characterize circular economy. These data differ by the nature of origin, meanings and dimensions. The experts might easily recognize them, while the public may misunderstand this diversity as it creates difficulties to get an idea about the processes taking place in a particular area. While considering the circular economy in the light of global economy, the attention should be paid to certain indices specific for an identified area of activity. Public may misunderstand primary data characterizing either professional field in numbers. Therefore, researchers elaborate and then give publicity to the indices, which names are quite understandable for people; their content totally depicts the target scope. Having got such indices, which, besides understandable content, have a dimensionless normalized value; one can correlate various indices in terms of content and then find certain correlation patterns.

Figure 2 presents Education Index [20] to Environmental Performance Index correlation for 76 countries. The correlations focused on revealing the impact patterns of education system over the Environmental Performance. After all, the population erudition level should influence the readiness of people to start resource saving, it has to raise the environmental awareness within society. All the above should be brought together and gradually solve the circular economy issues for a country.

Table 1. TOP-10 Environmental Performance Index (2022) and High-technology exports rating (2022), Ukraine's position [18, 19]

Country	Rating 2022	
	High-technology exports	Environmental Performance Index
Denmark	24	1
United Kingdom	10	2
Finland	32	3
Sweden	22	4
Luxembourg	48	5
Slovenia	38	6
Austria	20	7
Switzerland	15	8
Iceland	59	9
Netherlands	7	10
Ukraine	42	52

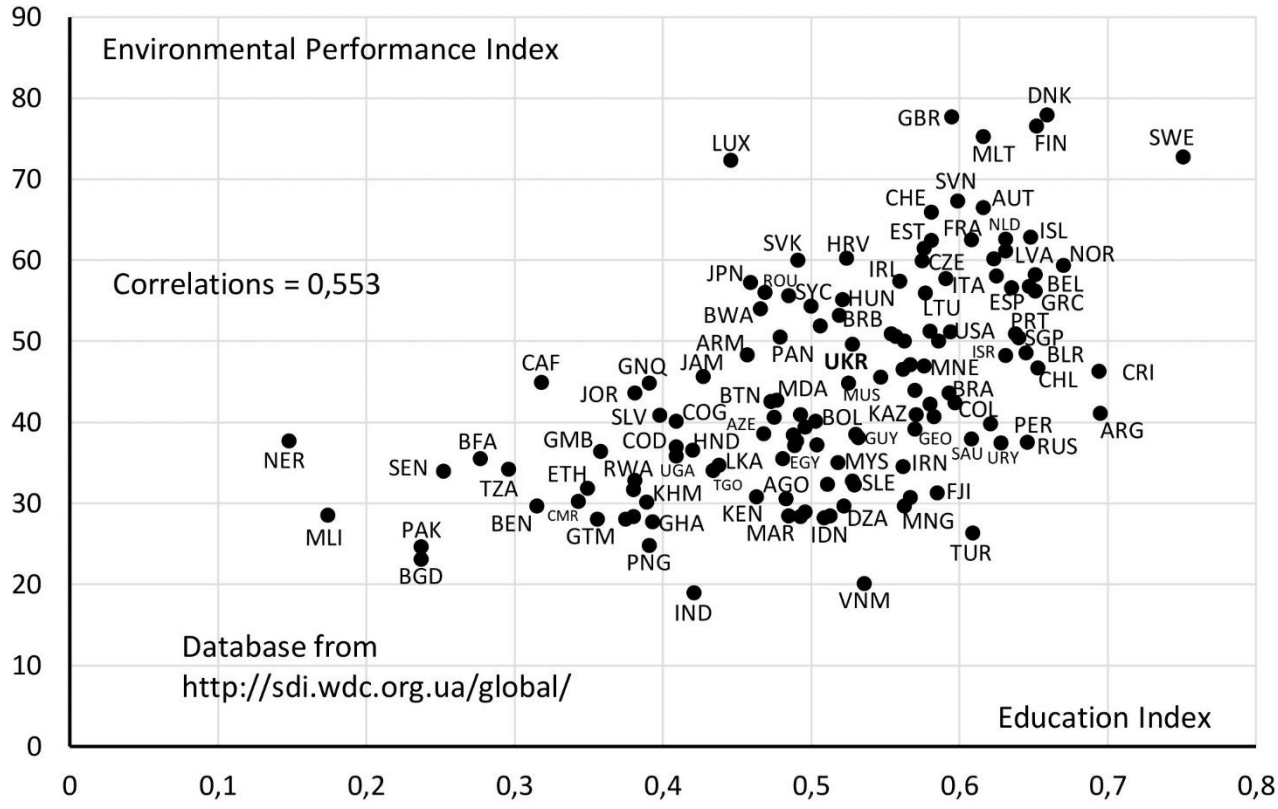

Figure 2. Education Index correlation (2022) to Environmental Performance Index (2022)

The regression equation (Figure 2):

$$y = 118{,}63x^2 - 46{,}056x + 35{,}273$$

$$R^2 = 0{,}3302$$

The correlation dependence as well as statistical correlation between two variables has shown that correlations are equal to 0.553 and it means that there is a moderate correlation between these variables. We acknowledge that Education Index really affects the Environmental Performance Index as the indices have shown certain interconnection. This means that countries with very good education tend to be more concerned and taking care over the environment.

Ukraine has ranked 40th position in this indices ratio range. The top 20 countries by Education Index are: United States, United Kingdom, Germany, Canada, France, Switzerland, Japan, Australia, Sweden, Netherlands, New Zealand, Denmark, Norway,

Italy, Finland, Austria, Spain, Belgium, South Korea and Ireland.

However, such countries as United States, United Kingdom, Germany, Canada, France, Switzerland, Japan, Australia, Sweden, Netherlands, Denmark, Norway, Finland and Austria, have joined the TOP-20 within 2 indices.

6. CONCLUSIONS FROM THIS STUDY AND PROSPECTS FOR FURTHER INVESTIGATION IN THIS DIRECTION

The circular economy today is an innovative economy paradigm providing a unique opportunity to save resources and reduce the Earth's noosphere pollution. Within the help of high technology and circular economy concepts realization, it becomes possible to cope with environmental stress. It has been studied that developed countries within saving potential can easily do that. Moreover, normally high technology can quickly adapt to production conditions and consumer needs. Having analysed the countries by high technology development level, we have come to the conclusion that no particular country-leader exists today, and this means the global economy doesn't fully utilize the circular economy to further develop production processes.

The educational system regular influence over Environmental Performance indicates that the population erudition level significantly impacts the readiness of the society to save resources, and hence it impacts the environment and energy saving know-hows implementation. This fact proves the education can contribute to the rapid expansion of the circular economy concept and it can be evidenced by the knowledge economy concept provisions as well as other related concepts. It should be noted that Ukraine occupies an appropriate position in this ratio of indicators and occupies a fairly high position according to the relevant indicators. Using hydro, solar, wind, wave, combustible renewable energy and waste energy seems the most essential in this context as this is the core of the circular economy paradigm - the refusal to use non-renewable resources, i.e. fossil fuels. At time being about one-fifth of the countries deal with this issue and that is far not enough concept comprehensive development. However, it is worth mentioning that the TOP-10 list includes such industrialized countries as China, Hong Kong, Germany, USA, Japan, Malaysia, Netherlands, France, Mexico and UK, with significant population density.

The further study required for the correlation of the unaccounted factors and other approaches such as Multi-regional Environmentally Extended Supply and Use/Input-Output Tables, co-efficient approach, and analysis of the domestic material extraction (DME), domestic material consumption (DMC), material footprint (MF), GDP and its combinations per capita.

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Анотація

ВОЙТКО Сергій Васильович, САКАЛОШ Тарас Васильович,
МАЗАНКО Тетяна Олександрівна

Циркулярна економіка у вибраних індексах глобальної економіки

Циркулярна економіка або економіка замкнутого циклу порівняно з лінійною економікою є синонімом інновацій, заснованих на використанні відновлюваних джерел енергії. Циклічна економіка спрямована на зміну класичної лінійної моделі економіки таким чином, щоб мінімізувати відходи та викиди протягом життєвого циклу продукту. Завдяки цьому відновлюється фінансовий, виробничий, соціальний і природний капітал. Серед переваг переходу на нову модель відзначимо зменшення впливу на навколишнє середовище, підвищення конкурентоспроможності, інноваційні зміни на підприємствах і, як наслідок, збільшення робочих місць. Стаття присвячена аналізу рівня розвитку циркулярної економіки та її елементів, а також аналізу порівняння різних індексів, що характеризують добробут людини, експорт високих технологій для 20-топ країн рейтингу та України. Порівнюючи різні показники, стаття доводить, що найпродуктивніше реалізувати концепцію циркулярної економіки можуть лише добре розвинені країни. У дослідженні використано метод кореляційно-регресійного аналізу. Результати дослідження виявили значну залежність між індексом експорту високих технологій та індексом екологічної ефективності, індексом освіти та індексом екологічної ефективності.

Ключові слова: *циркулярна економіка, індекс екологічної ефективності, експорт високих технологій, індекс освіти, кореляція*

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