Analysis of the energy and environmental breakthrough components of the global economic security of the United Euro-Atlantic countries and Ukraine

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Abstract. Despite the fact that Russia's war in Ukraine has significantly affected world economic growth (in 2023, it will be only 0.3 %), EU countries and the world are increasing financial, humanitarian and military support for Ukraine. The entire range of risks is shaping the new landscape of the new decade and changing the vector of global economic security. At the same time, it is forming a new dynamic Euro-Atlantic security system. The study confirms the hypothesis about the formation of a new effective system of global economic security with the inclusion of like-minded countries that have the potential for an "economic breakthrough" and the ability to influence global economic security against a background of the Russian war. A unique system of functional components (including 8 countries, 50 indicators for 7 security components) of an economic breakthrough in the system of global economic security of the united Euro-Atlantic countries has been formed, paying special attention to the energy and environmental components. The result of the study was the clustering of the countries with similar characteristics and indicators, the similar ability to make an "economic breakthrough" and influence the architecture of global economic security.

1 Introduction

According to the World Economic Forum's (WEF) Global Risks Report 2023 [1] at the beginning of 2023, the world faced many risks, including inflation, the cost of living crisis, trade wars, capital outflows from markets, large-scale social conflicts, geopolitical and energy cataclysms. At the same time, it is obvious that these risks are exacerbated by relatively new threats in the global dimension - challenges of Russia's war in Ukraine.

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The biggest challenges are the shocking level of debt, the low level of global investment, the extremely low rates of economic growth and de-globalization, the regression in human development, and the uncontrolled use of civilian dual-use goods. In addition to the above, there is an increase in environmental risks in the context of climate change and the loss of opportunities to ensure the window for transition to a 1.5°C world. It seems that the geopolitical and economic trends of the next decade will trigger large-scale environmental and social crises. Therefore, the cost of living crisis, ecosystem collapse, social explosions and polarization of society will also be accompanied by cybercrime and mass involuntary migration (Fig. 1).

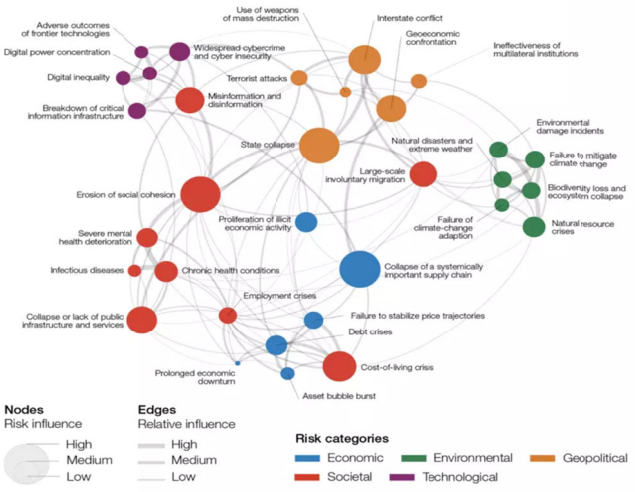

Fig. 1. Global risks landscape: an interconnections map (Global Risks Perception Survey, 2022-2023) [1].

Jenkins [2] believes that before Russia's invasion of Ukraine, world economic growth in 2022 was estimated at about 5%. An OECD report [3], published in November 2022 stated that the conflict in Ukraine caused significant and severe disruptions in energy markets. This «shock» was one of the main reasons that led to a slowdown in economic growth to only 3.1% in 2022 and its decrease to 2.2% in 2023. It is known that the war had the most profound impact on the European economy, which is expected to grow by only 0.3% in 2023. Despite this, the countries of the EU and the rest of the world continue to provide financial, humanitarian and military support to Ukraine. The largest contribution to the state budget of Ukraine was made by the USA, the EU, Germany, Canada, and Great Britain. The aid from these countries makes up a third of the expenditure of the Ukrainian consolidated budget-2022 as of the beginning of November. In total, 16 EU countries are on the list. In 2023, Poland, Estonia, Latvia, the USA, and Lithuania head the updated Forbes ranking "Friends of Ukraine". Ukraine received €84 billion worth of international aid from the start of the full-scale Russian attack until August 3. €39 billion of this amount is military aid, €32 billion is financial support, and €13 billion is humanitarian aid. Another €10 billion is spent on maintaining displaced persons. The USA provided the most substantial aid - €44.5 billion, Germany - €7.6 billion, Great Britain - €6.6 billion, Italy - €2.8 billion, Lithuania - €0.5 billion, Estonia - €0.3 billion. Poland, which provided aid to Ukraine in the amount of €5.1 billion, overtook France, Canada, Italy and Spain by this indicator. As for the amount of the country's aid as a percentage of its GDP, the most generous are Estonia - 1.13% of GDP, Latvia - 1.03% and Poland - 0.88%. Among others, one can single out Lithuania with 0.55% of its GDP, Great Britain - 0.25%, Italy - 0.15% [4].

In fact, the support of economic growth in the conditions of rapid and shocking global challenges is practically confirmed in scientific and expert circles by the need for accelerated recovery of Ukraine and the progressive development of those countries of the world that provide Ukraine with unconditional support. On June 21-22, 2023, Great Britain, together with Ukraine, will hold the International Ukraine Recovery Conference (URC 2023) in London. It will be a continuation of the cycle of annual events, the most recent of which were held by Switzerland together with Ukraine in Lugano [5]. The URC 2023 will focus on mobilizing international support for the economic and social stabilization of Ukraine and the subsequent recovery process from the effects of the war, including through emergency assistance for immediate needs and funding for the participation of the private sector in the reconstruction process. Such a concept should be based on a long-term strategy, Euro-Atlantic experience, a developed methodology, specific guidelines, external "benchmarks" and the indicators measuring the results of an economic breakthrough.

The issues studied in the work are dynamic in scientific and analytical research, while the situation and indicators of an economic breakthrough are constantly changing. Hence, the relevance of studying the problem of global economic security is a permanent process. In this research, the authors attempted to develop the author's system of functional components (8 countries, 7 components, 50 indicators) of an economic breakthrough within the framework of an integral assessment of global economic security of the united Euro-Atlantic countries, with the focus on energy and environmental components. System, comparative and cluster analyses of the economic breakthrough indicators of 8 countries of the Euro-Atlantic zone (the USA, Great Britain, Poland, Italy, Latvia, Estonia, Lithuania, Ukraine) made it possible to hypothesize that the formation of a new effective system of global economic security started; it is based on the potential of these countries for "economic breakthrough" and their ability to influence global economic security. At the same time, the economic support and post-war reconstruction of Ukraine as a full member of the EU and NATO remains the strategic priority of an economic breakthrough.

2 Methods

The war in Ukraine, unleashed by Russia in the 21st century, breaks the entire architecture of the global security system. The topic of economic security has gained significant attention in policy discussions, particularly due to the COVID-19 pandemic and the war in Ukraine, which have both caused widespread disruptions [6,7,8]. An economic breakthrough, as a system of measures ensuring the transition of the state to an innovative path of global economic security, is able to radically change the recovery vector of the economy of Ukraine, and create conditions for the rapid development of the countries of the Euro-Atlantic zone. The goals of the economic breakthrough should be the transition from the stage of factor-resource competitiveness to the stage of breakthrough competitiveness in a historically short time and Ukraine's entry into the ranking of the thirty most competitive countries in the next 15-20 years. Such success will make Ukraine's economy similar to that of the new countries - members of the European Union and the Euro-Atlantic zone in terms of living standards, economic dynamics and structure, and the main social features.

At a time when overlapping global crises pose unprecedented challenges to advancing the 2030 Agenda for Sustainable Development, experts and scientists, representatives of governments, international organizations, civil society and academia must find solutions to accelerate progress towards SDG 16 and contribute to the leadership of like-minded countries such as the USA, Great Britain, Poland, Italy, Latvia, Estonia, Lithuania, Canada, in supporting the transition to a more sustainable and secure world on the basis of peace in Ukraine. As early as 1991, Buzan [9] discussed the changing nature of global security in the post-Cold War era.

Overall, Buzan's article is a valuable contribution to the ongoing debate about the future of global security in the 21st century. At the same time, Beal [10] also claims that economic security is a critically important component of national and global security. Beal emphasizes the need for renewed global efforts to address economic security problems, including inequality, climate change and technological disruptions. Ciuriak and Goff [11] also consider the concept of economic security in the context of a developing global economy. They argue that traditional approaches to economic security, focused on protecting national industries and markets in the face of globalization and technological change, are becoming increasingly obsolete. Instead, they propose a new approach based on the importance of developing resilience, adaptability and innovation in the conditions of an economic crisis.

Borrell [12], the High Representative of the European Union for Foreign Affairs and Security Policy, affirms that member states are fully aware that security is a new and multifaceted concept and has many new dimensions, one of which is the economy. Hellendoorn [13] stresses that the EU understands how economic security is related to geopolitical dynamics at a strategic level and how it resolves technical issues such as investment screening, export control, financial and economic sanctions, counter-laws and necessary assessments of risks. Finally, the scholars Chen and Ebeke [14] accept growing potential consequences of geo-economic fragmentation for multilateralism and global economic cooperation are serious. Actually, this study is designed to assess the potential economic opportunities of global economic integration, a multidimensional breakthrough of like-minded countries that have united for the sake of victory and reconstruction of Ukraine.

To assess global risks, it is essential to form an adequate system of indicators that, on the one hand, will estimate the country's existing potential for an economic breakthrough, and on the other hand, will determine the trajectory of the global economic security system. In their articles, Ilyash, et al. [15] summarized the system of indicators for assessing the impact of the components of technological growth on economic security. The sudy [16] also describes dynamic models to study the interrelationships of the elements of micro- and meso-level subsystems. The predictive model proposed by the authors proves the importance of national policies in the formation of strategic priorities for an economic breakthrough.

A system review of the literature [17] was sufficient to substantiate the need for a qualitative assessment of global economic security of the new zone of the united Euro-Atlantic countries in terms of breakthrough components, in particular energy and environmental components. In the study, the authors conducted a cluster analysis for several countries, including Ukraine, the United States, Poland, Italy, Estonia, Latvia, Lithuania and the United Kingdom, which potentially contributed the most to support Ukraine. The analysis was performed using the method of clustering seven components, namely technological and innovative, social, educational and scientific, financial, business-environment, environmental and energy. The evaluation system included 50 indicators; various indicators were used in the analysis, such as Patent applications, Life expectancy at birth, total (years), Human capital index (HCI) (scale 0-1), and others (Table 1).

The cluster analysis approach makes it possible to carry out a more in-depth study of the peculiarities of each country and determine their capacity for “economic breakthrough”. The obtained results can be applied for predictive modelling and development of possible scenarios of the economic security of the countries of the Euro-Atlantic zone. The cluster analysis is widely used in various industries and can be employed to find data structures, audience segmentation, anomaly identification, object classification, and much more.

Table 1. The system of the economic breakthrough indicators in terms of the components of global economic security of the united Euro-Atlantic countries and Ukraine

Technological and innovative	Social	Educational and scientific	Financial	Business environment	Environmental	Energy
High-technology exports (% of manufactured exports)	Unemployment, total (% of total labour force) (national estimate)	Adjusted savings: education expenditure (current US$)	GDP growth (annual %)	Foreign direct investment, net inflows (% of GDP)	Renewable energy consumption (% of total final energy consumption)	Primary energy Consumption, Million tonnes oil equivalent
Medium and high-tech exports (% manufactured exports)	Unemployment, total (% of total labour force) (modeled ILO estimate)	Current education expenditure, total (% of total expenditure in public institutions)	Market capitalization of listed domestic companies (% of GDP)	Foreign direct investment, net outflows (% of GDP)	Carbon Dioxide Emissions, Million tonnes carbon dioxide	Renewable Generation, Terawatt-hours
Research and development expenditure, (% of GDP)	Employment to population ratio, 15+, total (%) (modeled ILO estimate)	Government expenditure on education, total (% of GDP)	Primary government expenditures as a proportion of original approved budget (%)	Foreign direct investment, net inflows (BoP, current US$)	Total greenhouse gas emissions (kt of CO2 equivalent)	Renewable Consumption, Million tonnes oil equivalent
Patent applications	Social contributions (% of revenue)	Government expenditure on education, total (% of government expenditure)	Inflation, GDP deflator (annual %)	Foreign direct investment, net outflows (BoP, current US$)	Ozone Exposure(DAYLY RATE)	Electricity Generation, Terawatt-hours
Researchers in R&D (per million people)	Life expectancy at birth, total (years)	Human capital index (HCI) (scale 0-1)	Inflation, consumer prices (annual %)	Customs and other import duties (% of tax revenue)	CO2 Emissions from the Consumption of Natural Gas	Energy Intensity - Total Primary Energy Consumption per Dollar of GDP
Information and communication technologies (ICTs)	GNI per capita, PPP (current international $)	Research and development expenditure (% of GDP)	Domestic credit to private sector by banks (% of GDP)	Cost of business start-up procedures (% of GNI per capita)	CO2 Emissions from the Consumption of Petroleum	Biomass and Waste Electricity Installed Capacity, Million Kilowatts
State of cluster development, score (GII)	GNI per capita, Atlas method (current US$)	Researchers in R&D (per million people)			Coal and coke CO2 emissions, Million Metric Tonnes Carbon Dioxide	
Joint venture/strategic alliance deals PPP$ GDP, Score 100 units		Scientific and technical journal articles			Marine protected areas (% of territorial waters)	

In this study, we used hierarchical cluster analysis and non-hierarchical (flat) cluster analysis. The purpose of the cluster analysis was to create compact and homogeneous groups (clusters of the selected countries of the Euro-Atlantic zone), so that the countries within each cluster could be similar to each other and different from the countries belonging to other clusters. The Euclidean distance for our 50 indicators, as it is the most common method that specifies the geometric distance in multidimensional space and is calculated by the formula (1):

$$d(x,y) = \left[\sum_{i=1}^{N}\left(\tilde{O}_3 - \acute{O}_3\right)^2\right]^{\frac{1}{2}}, \quad (1)$$

where $d(x,y)$ – the distance between objects; $\tilde{O}_3, \acute{O}_3$ – the value of the i-th feature of objects x and y respectively; N – the number of features.

The above method of cluster analysis makes it possible to determine distances at the first stage of clustering, which leads to the formation of a separate cluster. That is, this method of calculating distances is viewed as optimal for detecting close clusters and further combining them with each other. At different levels of linkage distance, we can assign the indicators to 2 (level 20), 3 (level 15), 4 (level 12), 5 (level 9), and more clusters. In order to determine the homogeneity of the indicators and justify the necessary number of clusters, it was important to employ the method of K-means *(K-means clustering*) with an alternate analysis of graphs of mean values for each cluster, as well as Pearson Chi-square and M-L Chi-square values. In the process of conducting the cluster analysis the following steps were taken: (1) a clustering method and similarity metrics were chosen (2) the data was systematized and appropriate attributes or variables were selected; (3) the similarity matrix and distances between objects were formed; (4) the optimal clustering method was used to create clusters; (5) the results of the cluster analysis were visualised and interpreted.

The result was the clustering of the countries with similar characteristics and indicators, the potential of these countries for "economic breakthrough" and their ability to influence global economic security.

3 Results

Policies that provide an economic breakthrough are necessary to increase the competitiveness and innovative capacity of the economy, ensure the development of the welfare economy, respond to the new challenges of the COVID-19 coronavirus infection and Russia's war in Ukraine, promote comprehensive digitalization and reconstruction and improve the quality of life in Ukraine. First of all, the technological and innovative breakthroughs, the creation of appropriate conditions for breakthrough technologies, the increase in public and private sector spending on R&D, the growth of the share of innovative companies, and cluster development of the economy. Let us consider change trends in the indicators of an economic breakthrough within the functional components of global economic security.

In general, before the war, the dynamics of Ukraine's high-tech exports were positive; in particular, in 2022, the share of such products in total exports was 6.0%, which is 1.5 percentage points higher compared to the previous year. In Latvia, the share of high-tech products in the total volume of exports decreased by 3.1 percentage points over the last year, in Estonia by 1.1, in Italy by 0.9, in Lithuania by 0.5, and in Poland by 0.4. Before the war, the share of medium- and high-tech exports did not exceed 35.0%, and, therefore, the rest of the industrial products were mostly give-and-take products and semi-finished goods.

The indicator of other countries that are actively providing technical and technological support to Ukraine today is almost twice as high; for example, in the USA and Great Britain, it is more than 60.0%, and in Italy and Poland, it is 50.0%.

If before the full-scale war, the share of such expenses in the GDP of our country was 0.4%, then in the USA it was more than seven times higher (in 2022, the indicator was equal to 2.8%), in Great Britain, four times higher (1.7), in Italy, three times higher (1.4), and in Poland, three times higher (1.2). Prior to the war, more than 2,000 patent applications were registered in our country every year, and a dramatic decline began in 2020, when the figure decreased by 35.1%, or 736 applications (Fig. 2).

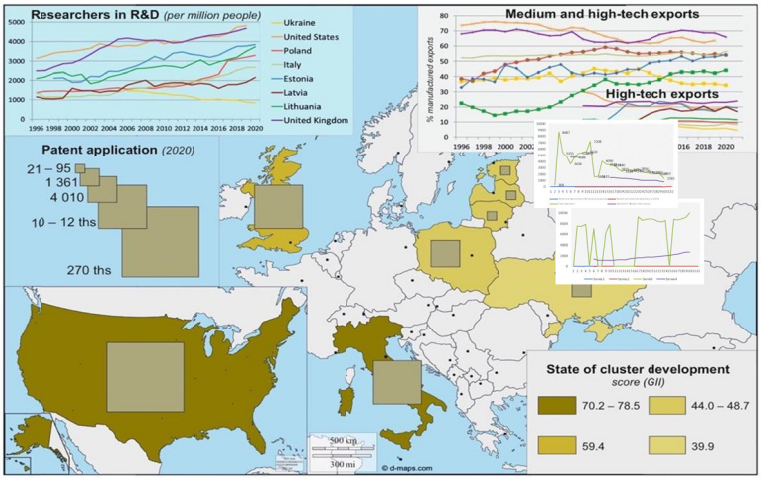

Fig. 2. Economic breakthrough indicators within the technological and innovative components of global economic security (1991-2022).

At the beginning of 2023, the state of the domestic clusters development was estimated at a score of 39.9. In general, in recent years, the indicator has ranged from a score of 31.2 (2014) to 40.9 (2020), which shows much poorer results compared to other countries. For instance, in the USA the indicator was 78.5 points, in Italy – 70.2, in Great Britain – 59.4. Because of the full-scale war, individual clusters are completely destroyed, some have lost their functionality, and others are trying to ensure at least pre-war performance results. Such circumstances require external support, especially the involvement and implementation of modern technologies and innovative developments

The basis of the post-war reconstruction of Ukraine is its competitive economy, civil society, and welfare state. In war conditions, it becomes extremely difficult to maintain social standards and solve social problems, which are also arising rapidly. In 2014, when Ukraine faced hybrid threats and risks, the unemployment rate started to rise, and at the beginning of 2022, the indicator was 9.8% (in Poland, the unemployment rate was 3.4%, in the USA, 3.7%, and in Estonia, 6.2%) (Fig. 3).

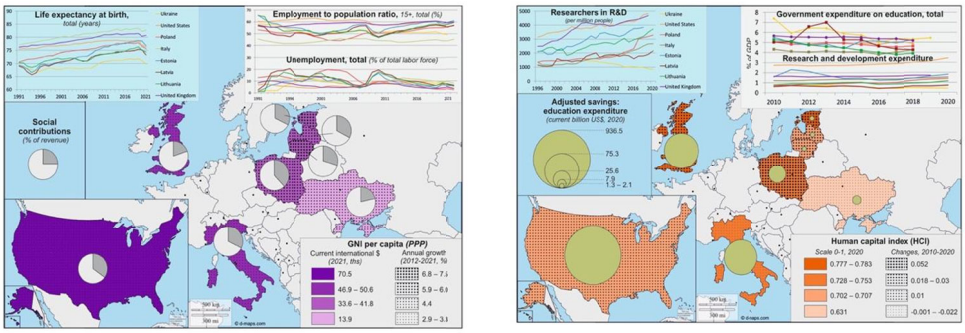

Fig. 3. Economic breakthrough indicators within the social component and the educational and scientific component of global economic security.

The main characteristic of a competitive economy is the country's ability to form a labor force of appropriate quality and efficiency in an educational and scientific environment. Today, the possibilities of a social and scientific breakthrough can be measured by the following security indicators: (1) Before the war, the savings of the population of Ukraine for education amounted to about 7.9 billion US dollars, and compared with 2016, they increased by 83.5%; in Italy, the figure is 73.5 billion US dollars; in Poland, 25.6; (2) the share of education spending in the total expenses of state institutions constantly exceeds 90.0%, and in some years the indicator was almost 98.0%; in Great Britain, 97.0%; in Italy, 95.0%. Mechanisms for implementing grant programs, attracting international charitable aid, and creating mutual investment funds specializing in educational services are of progressive importance. (3) funding of education in Ukraine is 6.0% of GDP (before the war, it was more than 8.0% of GDP), which exceeds the value of many highly developed countries (in recent years, the share of public spending in GDP does not exceed 5% in the USA, Italy, Poland, and in Great Britain, Latvia, and Estonia, the value is 6.0%); (4) an increase in public procurement programs and budgetary funding of education on a competitive basis. Prior to the full-scale military invasion, the figure was 18.6%, and this, for example, is more than 2,0 times higher compared to that of Italy; (5) the growth of the human capital index (at the beginning of 2021, Ukraine's index was 0.63, and, for comparison, in Great Britain it was 0.79, in Estonia – 0.78, in Poland – 0.75; (6) insufficient financing of R&D (at the start of 2021, R&D expenditure in Ukraine's GDP was 0.4%, which is more than eight times lower compared to that of the USA, four times lower compared to Great Britain, Estonia, three times lower in comparison with Italy, Poland; (7) a decrease in employment in the field of R&D in Ukraine (at the beginning of 2021, there were 846 researchers per one million people, which was 4.4 times higher than in Lithuania, 3.9 times higher than in Poland, 3.2 times higher than in Italy.

In 2021, the financial component of Ukraine's economic breakthrough was characterized by an increase in foreign direct investment (net inflows) by about 13 times over a period of more than 20 years (1991-1994-2021), while in Italy this indicator was three times higher, in Poland – 10 times higher. And already in April 2023, direct foreign investment in Italy rose by 12,667 million euros.

The maximum increase was 14,203 million euros, the minimum was -10,787 million euros. Another method of integration development in the field of technology and innovation is the creation of joint ventures, but unlike in many European and other countries, it has not gained in popularity in Ukraine. At the beginning of 2023, the development of joint entrepreneurship in Ukraine was estimated at 1.8 points, and it had remained unchanged for several pre-war years.

For instance, compared with the USA, the difference in scores is big: at the start of 2023, the indicator was 75.5 points, which is 41.9 times higher than that of Ukraine; Great Britain's indicator was 31.3 times higher (56.3); Estonia's indicator was 19.3 times higher (34.8). The experience of many developed countries suggests that it is of vital importance to expand the scale of public-private partnerships in the investment and innovation spheres and involve the state in the implementation of progressive innovative and technological start-up projects (Fig. 4). Energy efficiency is critical to global economic security, the support of economic growth and sustainable development, an increase in the security of supply and acceleration of the transition to clean energy. Special attention to energy efficiency is crucial in creating a net-zero energy system by 2050. Let us consider what opportunities the selected countries have in order to make a safe economic breakthrough. Among the studied countries, the lowest level of Ozone Exposure (daily rate) is observed in the USA.

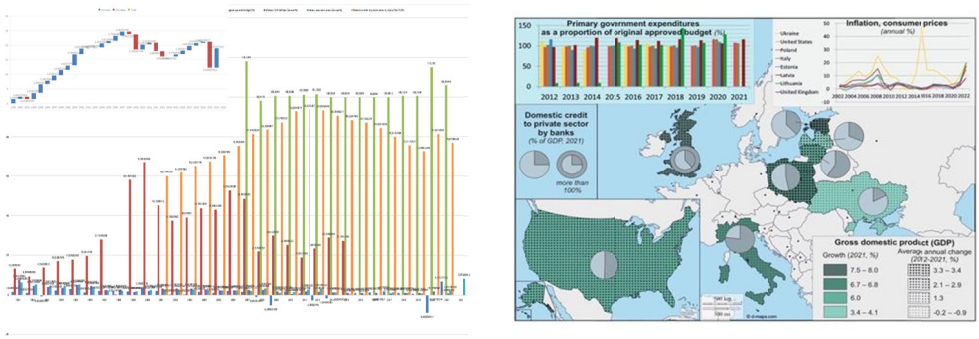

Fig. 4. Economic breakthrough indicators within the financial component and the "business environment" component of global economic security (1991-2022).

The EU Ambient Air Quality Directive aims to protect vegetation from ozone and sets two standards: a target value and a long-term goal. In 2020, a historic low of 5.5% of Europe's agricultural land was exposed to ozone above the threshold value. In 2020, the critical level was not exceeded, in particular, in such countries as Estonia, Finland, Iceland and Latvia, which are members of the European Environment Agency, and it was exceeded only in less than 1% of Lithuania. In addition, we observe the following trends in the change of the energy component: in 2022, the United Kingdom took 2nd place among 180 countries with an indicator of 77.7 and demonstrated strong growth of this indicator by 23 points in 10 years. In the UK, the government has supported work towards the circular economy transition, and private sector initiatives have reduced waste and increased circularity in key sectors, including the food and textile industries.

The United States ranked 43rd with a score of 51.10 and showed a 3.3-point rise over the past 10 years. Estonia, Latvia, Italy, Lithuania, and Poland took 14th, 15th, 23rd, 31st, and 46th places, respectively. However, Ukraine's indicator was the worst among the studied countries - 52nd place with a score of 49.6 and the growth by 6.2 points over 10 years. Given the military actions in the territory of Ukraine, the situation will worsen, especially taking into account Russia's detonation of the Kakhovka HPP, which will lead to an ecological disaster.

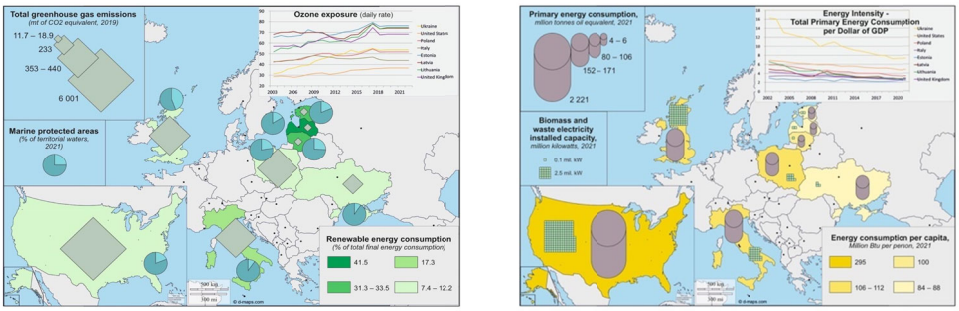

Fig. 5. Economic breakthrough indicators within the environmental and energy component of global economic security (1991-2021).

According to the analysis of the indicators of Carbon Dioxide Emissions and Total greenhouse gas emissions, the lowest values are in Latvia, Estonia and Lithuania. Estonia demonstrates a decrease in Total greenhouse gas emissions (excl. removals by ecosystem) per capita, CO2 equivalent tons from 15.20 in 2018 to 9.5 in 2021. By 2050, Estonia aims to reduce greenhouse gas emissions by almost 80% compared to 1990 (Fig. 6).

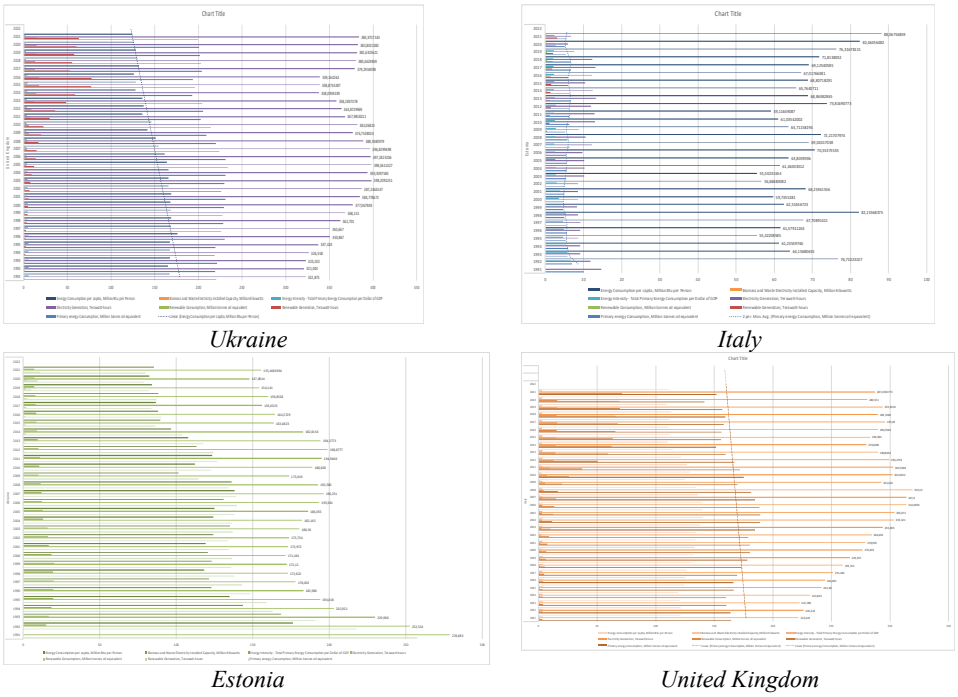

Fig. 6. Economic breakthrough indicators within the energy component of global economic security of Ukraine, Italy, Estonia and Great Britain (1991-2021).

In 2021, the country announced that by 2030 it would stop producing electricity from oil shale, which has a large carbon footprint. Its share of electricity production has already declined sharply in recent years, from 86% in 2013 to 40% in 2020. According to the indicator of Marine protected areas (% of territorial waters), Great Britain has the largest share (44%) among the studied countries, Lithuania is the second (25%), Poland has a share of 23%. Global energy intensity had been gradually increasing since 1990, but in 2020, an increase of only 0.6 % was recorded, to 4.63 MJ/US dollars (2017 PPP); in the context of the COVID-19 crisis, GDP and total energy supply declined by 3.2% and 3.8% respectively [18]. In the countries under study, positive trends towards reducing energy intensity have been observed for 20 years. Compared to 2002, in 2021, the largest decrease in energy intensity was demonstrated by Lithuania (59%), Ukraine (55%), Latvia (44%), Poland (43%) and the United Kingdom (43%), which indicated great progress in the development of energy efficiency. At the same time, in 2021, Estonia was in 1st place in terms of energy efficiency, its Total Primary Energy Consumption per Dollar of GDP was 2.43.

The United Kingdom took second place, and Lithuania was third; their indicators of Total Primary Energy Consumption per Dollar of GDP were 2.47 and 2.71, respectively. In 2021, among the studied countries, the US had the following indicators of Primary energy Consumption and Energy Consumption per capita: 2220.59 Million metric tons of oil equivalent and 294.9 Million BTU per person, respectively. In the structure of the primary energy consumption of the USA in 2021, the main share belonged to oil (36%); natural gas was 32%; renewable energy sources were 12%, including the main contribution from wind energy; coal was 11%; and nuclear energy was 8%. In 2022, wind and solar energy will account for 14% of US electricity generation. The sources of energy used in various sectors of the United States economy are different.

For example, in 2021, oil provided approximately 90% of the energy consumption of the transport sector but only 1% of the primary energy consumption of the electricity sector [19]. More efficient drilling and production technologies have led to increased production of natural gas from shale and narrow geological formations. Increased production generally contributed to lowering natural gas prices before 2020, which, in turn, contributed to increased use of natural gas in the electricity sector and industry [20]. Among the studied countries, the US has the largest volume of biomass and waste energy electricity installed capacity - 18.9 million kilowatts [21]. As part of the study, a cluster analysis of the economic breakthrough indicators in Ukraine, the USA, Poland, Italy, Estonia, Latvia, Lithuania and Great Britain was carried out. The analysis was performed using the method of clustering seven components, namely technological and innovative, social, educational and scientific, financial, business-environment, environmental, energy (*Appendix 1*). As a result of the analytical research, 6 clusters were chosen and they correspond to the linkage Distance from 5 to 10. In this way, it was possible to group the countries according to 50 indicators into six clusters At the next stage, with the help of separate statistical data of each country, we will cluster the countries according to these 50 indicators, that is, we will distribute them according to similar characteristics of the indicators (Fig. 7). The data in Figure 6 indicate that each country forms a separate cluster, except for the Baltic countries. Preliminary processing of the social security indicators made it possible to apply the most common method of object clustering (the Euclidean distance) and use two methods of cluster analysis (a hierarchical method and K-means method) to determine the homogeneity of the countries in terms of their potential for “economic breakthrough”. The results were obtained using the *StatSoft Statistica 10* software package. Let us take a closer look at the characteristic changes in the system of the economic breakthrough indicators during the period under study in order to give economic meaning to such clustering by the K-means method.

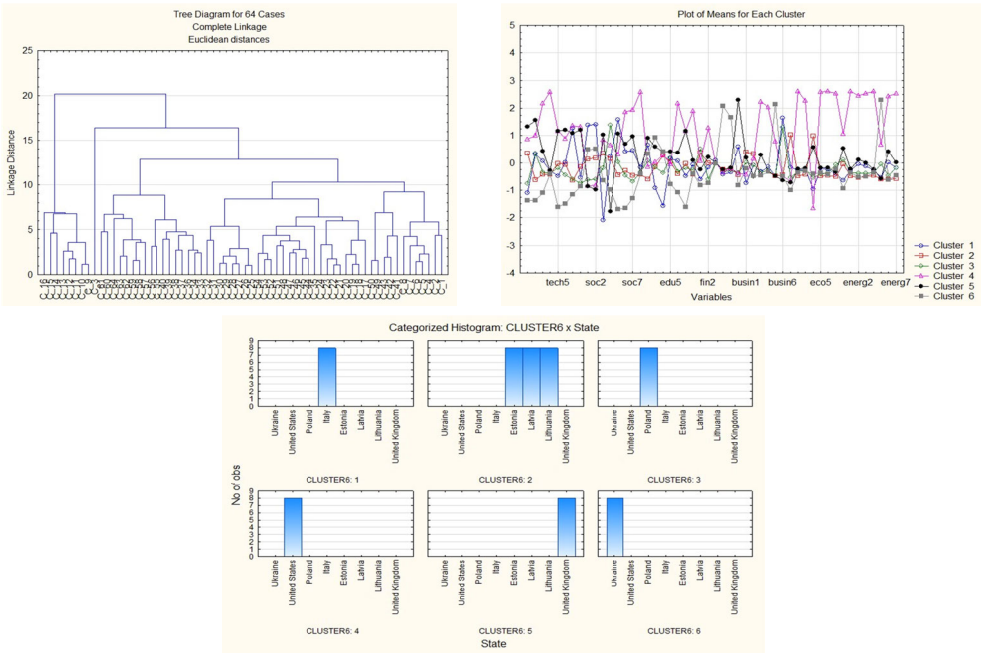

Fig 7. A tree-l ike diagram of 50 economic breakthrough indicators; a graph of mean values for each cluster and the visualization of the distribution of the countries by clusters, 2001-2021 (assuming there are 6 clusters).

The tree-structure clustering method creates clusters according to the defined distances between objects (indicators). As a result of the hierarchical cluster analysis, the following stable associations of regions were singled out:

1. *K1 – Italy* (a relatively low share of high-tech products in the total volume of exports, high indicators of savings on education, high indicators of the amount of R&D per 1 million people, a high share of medium and high-tech exports, a high life expectancy index, a relatively low share of education expenditure)
2. *K2 – Estonia, Latvia*, *Lithuania* (the highest rates of reduction of energy intensity, a high level of energy efficiency, the lowest indicators of Carbon Dioxide Emissions and Total Greenhouse Gas Emissions, the lowest consumption of primary energy)
3. *K3 – Poland* (a high share of medium and high-tech exports, a high index of human capital, a large amount of R&D per 1 million people, a high level of social contributions relative to labour income, a low share of GDP for financing education, a decrease in the energy intensity index)
4. *K4 –the USA* (the highest indicators of Primary Energy Consumption and Energy Consumption per capita, relatively low growth rates of the ICT sector, development of joint entrepreneurship, the largest volume of biomass and waste energy electricity installed capacity)
5. *K5 – Great Britain* (high indicators of GNI per capita at purchasing power parity, the highest indicators of Marine protected areas (% of territorial waters), a high share of medium and high-tech exports, a high life expectancy index, a fairly high share of education expenditure, a decrease in the energy intensity index, a high environmental performance index (EPI).
6. *K6 – Ukraine* (a high share of GDP for financing education, a high share of total own expenditure on the support and development of education, a high level of population savings on education, a moderate index of the growth of the ICT industry, an insignificant amount of R&D per 1 million people, a high level of unemployment, a low level of GNI per capita)

There are huge gaps between the countries in the values of the economic breakthrough indicators within the considered components of global economic security. That is why clustering shows both the difference and the similarity of the potential for economic growth and causes the formation of a separate cluster. Consequently, this method of calculating distances provides an opportunity to identify close clusters of like-minded countries of the Euro-Atlantic zone.

4 Conclusions

Geopolitical and energy cataclysms that occurred at the beginning of 2023 are further compounded by the relatively new threat of challenges of Russia's war in Ukraine and they could provoke major economic, environmental and social crises in the next decade. Before the Russian invasion of Ukraine, the global economy was expected to grow by about 5% in 2022. However, the war in Ukraine caused serious disruptions in energy markets and led to a drop in economic growth. In spite of this, the EU and other countries continue to provide financial, humanitarian and military support to Ukraine. The emergence of various risks has created a new landscape for the next decade and changed the direction of global economic security. This has led to the development of a new dynamic Euro-Atlantic security system, the full members of which are the United States, Great Britain, Italy, Lithuania, Poland, Canada, Italy, Estonia and Latvia.

The need to support economic growth during rapid and unexpected global challenges is determined by the accelerated recovery of Ukraine and the progressive development of the countries that offer Ukraine unconditional support.

This requires the development of a long-term strategy, Euro-Atlantic experience of coordination and monitoring of the indicators that measure the results of an economic breakthrough. A complete system that was compiled comprises seven functional components (technological and innovative, social, educational and scientific, financial, the business environment, energy and environmental) of global economic security and fifty indicators of economic breakthroughs of eight countries of the Euro-Atlantic zone (the USA, Great Britain, Poland, Italy, Latvia, Estonia, Lithuania, Ukraine) including the analysis of energy and environmental components.

The conducted analysis proved the importance of external technological and innovative support of Ukraine from European and other partners. For the post-war reconstruction of Ukraine, it is necessary to establish a full production cycle of manufacturing industrial products with a high level of added value and the ability to successfully replace similar imports in the domestic market. To ensure an increase in the volume of activities of the ICT sector, it is necessary to improve the fiscal policy, modernize the systems of personnel training and the implementation of industry investment projects, stimulate the development of a digital infrastructure, improve the informatization of society, and develop the national ecosystem of digital transformation.

The process of hierarchical cluster analysis made it possible to establish a set of consistent regional associations. For instance, Italy's export market has a relatively low share of high-tech products. However, the country demonstrates high indicators of savings on education and the volume of research and development per 1 million people. Italy also boasts a high share of medium and high-tech exports. The life expectancy index in the country is high, and the share of education expenditure is relatively low.

Estonia, Latvia and Lithuania stand out among the rest due to their exceptional success in reducing energy intensity. These countries have achieved impressive levels of energy efficiency and now they maintain the lowest recorded figures for both carbon dioxide emissions and total greenhouse gas emissions. Furthermore, their primary energy consumption is the lowest in the world. Poland's economy thrives thanks to a significant percentage of medium and high-tech exports, accompanied by a high human capital index. The country also invests huge resources in research and development per capita and has a high level of social contributions relative to labour income.

Although the percentage of GDP allocated for education funding is lower than expected, Poland showed a decrease in its energy intensity index, indicating a shift to greener practices. The USA had the highest levels of primary energy consumption and energy consumption per capita, and relatively low growth rates in the sector of information and communication technology (ICT). However, the country is developing joint ventures and it boasts the largest installed capacity of electricity from biomass and waste. Great Britain, according to the classification system, boasts high figures of GNI per capita at purchasing power parity. The UK allocates a significant proportion of its spending to education and it has experienced a decline in its energy intensity index. In addition, it has a high environmental performance index or EPI.

During the next decade, the economy will become the source of increasing conflicts between nations. There is also concern that the recent surge in military spending and the proliferation of advanced technology could spark a global arms race in the field of next-generation weapons. In the long term, it is quite possible that global risks will be characterized by confrontations that will include asymmetric warfare. This could involve the use of state-of-the-art weapons on a potentially more devastating scale than anything else seen in the last few decades.

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