PREDICTION OF ENVIRONMENTAL PERFORMANCE BASED ON COUNTRY'S ECONOMIC ATTRACTIVENESS

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ABSTRACT

In the article, the authors investigate the relationship between the basic parameters of the environmental performance and key indicators of the country's economic development, in particular such as the Human Development Index, Global Competitiveness Index, international tourism development and others. The analysis tools include correlation model and a decision tree, which based on the application of the RapidMiner software package and a database of more than 120 countries of the world. The study revealed a significant correlation between the Environmental Performance Index (EPI) and Human Development Index (0.83), the level of competitiveness of the economy (0.79) as well as GDP per capita (0.72). Besides, the calculated decision tree showed that the key factor influencing the EPI level is the income level of the population. The calculations show that countries with GDP per capita above certain level per year belong to the cluster of either high or medium environmental efficiency and their ecosystem are significantly influenced by the human development index. In the contrary, when the level of GDP per capita in economy is very low, the dominant value is no longer the human development index, but the number of registered enterprises in the country (the more intensive entrepreneurial activity the higher probability that country will have low environmental performance). The presence of a strong relationship between the environmental index (EPI) and human development index (0.83) suggests the need to improve the quality of human capital, especially in the countries of the third cluster of low environmental efficiency.

Keywords: Environmental Performance, Circular Economy, Human Development, Global Competitiveness, Economic Attractiveness, Decision Tree.

JEL Classification: F64, O15, J2.

INTRODUCTION

Scientific publications write a lot about the need to develop a "*green*" and circular economy, and this topic is often number one in discussions at the world economic forum. However, as the analysis has shown, in countries such as Ukraine, Kazakhstan, Russia, businesses often perceive the raising of "*environmental friendliness*" standards as a whim of rich countries. In this regard, the governments of developing countries are constantly questioning the timeliness of the transition to a green or circular economy model, because this is associated with large investments, which, according to some politicians, should be attributed to a later period, when "*the country can afford them*."

The dynamics analysis of material productivity in the world shows Figure 1 that the cost of resources has increased slightly, but in much lower dimensions than global GDP, so

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from an economic point of view, there are virtually no incentives to move from extensive to intensive use of resources.

Source: OECD data

Figure 1
MATERIAL PRODUCTIVITY DYNAMICS IN THE WORLD (AVERAGE BY COUNTRY, USD/KG) IN COMPARISON WITH THE DYNAMICS OF GDP (BILLION USD)

At the same time, climate change and environmental impacts are increasingly causing economic crises and problems.

In this article, we propose to consider a model for assessing the relationship between basic environmental parameters and key indicators of the country's economic development. Our hypothesis is that the ideas of circularity are progressive, and therefore have a positive effect on society and the economy as a whole; on the other hand, we believe that the country's economy and its subjects must achieve certain criteria in order to positively influence the environment. However, this approach requires scientific justification, as well as building a model and testing it.

REVIEW OF LITERATURE

At the beginning of the twenty-first century, the idea of "*green*" economic growth reached a new level of implementation, expressed in a new UN initiative, the so-called "*new global green course*", which relies on combining the tasks of development and preservation of the environment through the priority development of ecological growth niches and the latest environmentally friendly technologies. The essence of this idea was the introduction of environmental standards into the world economy, focusing on the maximum reduction of the carbon and energy intensity of production (Li & Jiang, 2012; Mathews, 2017).

In 2020 World Economic Forum recognized *Valuing the Environment* as one of the key components of the development agenda today. Moreover, among the key directions are circular economy practices, decarbonization, and nature-based solutions that can re-orient development towards more responsible economic growth (Broeckhoven et al., 2021).

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ENVIRONMENTAL PERFORMANCE, CIRCULAR ECONOMY AND COUNTRY'S GLOBAL COMPETITIVENESS

The Fourth Industrial Revolution is known to be proclaimed in 2016 as a response to society's total informatization, technology rapid development, and changing global orientations of humankind, caused by environmental problems and limited resources for human functioning. K. Schwab (2017) emphasizes that the synthesis of digital technologies and the formation of production and technological systems based on the circular economy characterize the Fourth Industrial Revolution. Boulding's work was one of the first works on the circular economy concept compared to the planet Earth's closed functioning with a spaceship (Geisendorf & Pietrulla, 2018). Meadows et al. (2019) continuing Boulding's opinion, note that the Earth's resources are not only limited and interconnected, but also considering five factors (population growth, agricultural production, limited resources, industrial production, and environmental situation), cannot maintain the economic growth rate after 2100.

McDonough & Braungart (2002) further developed the ideas, considering such factors as resources, labor and waste, and the principles of a circular economy through the prism of companies' competitiveness. The authors note: "*new criterion of efficiency of enterprises creates to balance traditional economic goals with social and environmental problems*". Studying the principles of the circular economy, its separate direction related to the sharing economy, in particular in the automotive industry, is often mentioned (Reshetnikova et al., 2021).

A significant stage in the theories development of the circular economy is the creation and operation of the E. McArthur Foundation, which aims to "*inspire generations to rethink, redesign and build a positive future*". The Foundation plans to achieve this goal due to the circular economy principles: "*the circular economy provides a holistic basis for redesigning the systems' level and, as such, offers the opportunity to use innovation and creativity to build a positive, restorative economy*" (MacArthur, 2013).

George et al. (2019) supported the Foundation ideas trying to build a theoretical model of a circular economy "*with two types of economic resources, namely: waste and recyclables*". The authors prove the irrelevance of Kuznets' economic hypothesis (1955) and ecological curve (KEC) by showing that the environment quality cannot be maintained or improved by economic growth. Logically, researchers' focus on the circular economy is the production process and its infrastructure. Sinclair et al. (2018) note: "*small-scale, flexible and localized production systems reduce resource and transport emissions and extend product life*".

Interesting is the bibliometric study of Rial et al. (2018), who studied the change in scientific thought in 2006-2017. Scientists have come to the following conclusion: "*Works on the circular economy and the environment have significant potential, and they are open to research areas of sustainable development or industrial production*". According to them, the most active countries were China, Britain, Italy, the Netherlands, and Germany. In the opinion of many authors, in the long term, it is the market economy and its competitive mechanism, close to living nature, that can stimulate the transition to the recycling of resources against the background of their rise in prices, accompanying their depletion, including without sequestering global consumption (Preston, 2012; Stahel, 2013).

Since the early 2010s, initiatives to develop a circular economy were intensified at all government levels. China and Japan were the first to develop a circular economy through the introduction of the particular law. That created the institutional basis for business development based on the digital economy. All over the world, countries started developing the circular economy concept and adapt it to the challenges they face. In particular, the

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European Union launched programs to conserve resources, promote recycling, and engage digital technologies to create sustainable development.

To implement the circular economy foundations, the European Commission is implementing the Action Plan "*For a cleaner and more competitive Europe.*" The document notes that the EU cannot independently implement the European Green Agreement's ambitious goals for a climate-neutral, resource-saving, and circular economy. The reports highlight the urgent need for a more global approach: The global transformation to a circular economy involves a shift from a linear, high-emission resource system with high emissions, waste generation, and negative impacts on ecosystems and natural capital to circular, less resource-intensive systems, more efficient and better while providing opportunities for practical activities and high quality of life (European Commission, 2020). The *UN Global Environment Outlook* (GEO) process, which includes the Sustainable Development Goals, Multilateral Environmental Agreements, other critical environmental aspects, and, in particular, links with social and economic development, which is useful for better environment contextualization, can be considered a global initiative, and to understand the relationship between the environment, people and the economy.

ENVIRONMENTAL PERFORMANCE AND HUMAN DEVELOPMENT

First, it must be said that consideration of the relationship between Environmental performance and human development is carried out in the context of the so-called Green Human Resource Management concept (GHRM) (Renwick et al., 2013 Ahmad, 2015). Amrutha & Geetha (2020) analyzed the publication activity on the GHRM topic in the context of issues of environmental, sustainable development and social responsibility, for the period from 1995 to 2019, which showed a sharp increase in the number of such studies since 2010. The authors identified three most actively developing areas: human resource management practices, green workplace behavior and organizational sustainability, which clearly demonstrate a transformation in the understanding of the role of people and GHRM in ensuring the environmental sustainability of an organization.

It should be noted that quite a few economists study the relationship between the state of the environment and the level of human capital development, in the context of Chinese enterprises and the economy (Paillé et al., 2014; Roscoe et al., 2019). For example, in a field study, scientists Paillé et al. (2014) studied the relationship between strategic human resource management, internal environmental concern, organizational citizenship behaviour for the environment, and environmental performance. The study was conducted in a Chinese context and showed that the organization's civic behavior towards the environment fully mediates the relationship between strategic human resource management and environmental performance, and that internal environmental concerns mitigate the impact of strategic human resource management on the organizational citizenship behavior for the environment.

In another article, scholars Roscoe et al. (2019) explore the relationship between GHRM practices, factors contributing to a green organizational culture, and a company's environmental performance. They conducted a large-scale survey of 204 employees in Chinese manufacturing companies and found that pro-ecological human resource management practices, including recruitment, training, assessment and incentives, support the development of factors that contribute to a green organizational culture.

The need for GHRM as a new approach to ensuring the environmental responsibility and sustainability of organizations is driven by two factors: the need to spread green ideas and values, and the search for new tools to improve environmental performance. Consequently, the GHRM is the focus of a large number of scientists. At the same time, we can highlight still many questions for further research, among which are the following:

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1. development of tools for integrating GHRM into the circular management system in a changing environment;
2. formation of research methods and assessment of GHRM practices;
3. creation of an empirical basis for assessing the possible social, economic and environmental results of greening human resources, taking into account the specifics of existing management practices, legal requirements and stakeholders.

Thus, despite the fact that many scientists are engaged in the issue of countries' competitiveness, circular economy, human potential, nevertheless, the analysis of the country's global competitiveness and its economic attractiveness in terms of ecology and innovation has not yet been fully studied. In addition, there are almost no systematic approaches to strengthening competitive positions from these aspects.

CONCEPT FRAMEWORK AND RESEARCH MODEL

At the basis of the model, it is proposed to consider the relationship between indicators of the efficiency of the country's environment and its economic attractiveness. It should be noted that environmental performance includes many parameters. Adequate assessment of the state of the environment in a particular country is possible only with the use of a certain set of indicators (and not any separate indicator), since a universal indicator that characterizes the state of the environment in sufficient detail has not yet been found.

With the help of environmental indicators, it seems possible to quantify various parameters that describe the ecosystem in terms of the state of the environment and natural resources. This provides an information and analytical base for more efficient environmental management and development of a strategy for environmental protection in the region.

In accordance with this, it is proposed to use complex indicators characterizing the quality of air, water resources, biodiversity and habitat, the level of heavy metals, climate and energy, agriculture, forests, fisheries and others.

Enviromental Performance

As an indicator that reflects the country's circular economy development state, we use the Environmental Performance Indicator (EPI). The data analysis used for determining the EPI 2018 shows that the calculation uses 24 individual environmental indicators which aggregated into a hierarchy of ten categories: 1) Air quality, 2) Water and sanitation, 3) Heavy metals, 4) Biodiversity and habitat, 5) Forests, 6) Fishing, 7) Climate and energy, 8) Air pollution, 9) Water resources, 10) Agriculture.

Those categories are further combined into two, which form targeted policies - environmental protection and ecosystem viability - and finally, a standard Indicator. To provide meaningful comparisons, the developers calculate the scores for each of the 24 indicators, placing them on a standard scale, where 0 means the worst performance and 100 - the best one. The country remoteness from achieving international sustainable development goals determines its location on such a scale. The figures are then multiplied by the weights and summed for the final EPI calculation.

Economic Attractiveness of the Country is also a complex concept and in different sources, the components that it includes vary significantly. The *Global Competitiveness Index* is one of the main compounded indicators that reflects a country's ability to compete with other countries in the context of the Fourth Industrial Revolution. It is determined annually by the World Economic Forum together with a network of partner organizations (leading research institutes and organizations existing in different countries of the world) according to a methodology based on a combination of publicly available statistics and the results of a global survey of company executives (Fabus, 2018).

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Many researchers focus on investment and macroeconomic stability in the context of a country's economic attractiveness (Trusova et al., 2020). At the same time, an approach that includes migration and tourism components seems to be more complete. In particular, according to Lee (2016), the attractiveness of a country should be considered in terms of international business, tourism and immigration and, in a broad sense, it is defined as the degree to which a country is preferable to others in the eyes of relevant stakeholders based on certain criteria, including tangible and intangible elements.

The economic attractiveness of a country largely depends on the degree to which the investment climate is favourable, i.e., on a combination of political, economic, social, cultural, organizational, legal and geographical factors that induce or repulse investors to invest in a particular economic system (the country's economy, region, enterprise) (Galgánková, 2020).

As we can see for the relationship with big international business, foreign investments play an important role in creating beneficial conditions for economic development. Attracting foreign investment allows the recipient country to receive a number of benefits, the main of which are to improve the balance of payments; transfer of the latest technologies and know-how; integrated use of internal resources; development of export potential and reduction of the level of dependence on imports; achieving a socio-economic effect (increasing employment, building social infrastructure, etc.). Opportunities to attract investment to the country depend, first of all, on the conditions for investors, i.e. on the investment attractiveness of the country (Makarenko et al., 2019). At the same time, more and more investment projects include parameters of social and environmental responsibility.

The level of development of international tourism is an important aspect of a country's economic attractiveness. After all, the attractiveness of a region reflects the opinion of visitors about its supposed ability to satisfy their needs and encourages them to spend time there. Thus, the more a particular destination can meet the needs of tourists, the more it will be perceived as attractive and the more likely it will be chosen (Vengesayi, 2003). In other words, since tourists are attracted to a destination due to its special attributes, it is believed that a place with more attractive attributes is more likely to be selected and revisited (Lee et al., 2010).

In modern conditions, human capital, more than physical assets or financial capital, is becoming a sustainable competitive advantage. The theory of human capital has proved that the productive, intellectual, creative qualities of a person are the main force of social and economic progress. Human capital has a significant impact on the formation of effective institutions that contribute to the development of society. Therefore, the study and scientific understanding of the mutual influence of human capital and the environment in the context of the transformation of economic relations are relevant and in demand not only by science, but also by practice (Contractor & Mudambi, 2008).

Thus, in the basis of the model, it is proposed to consider the following relationships Figure 2.

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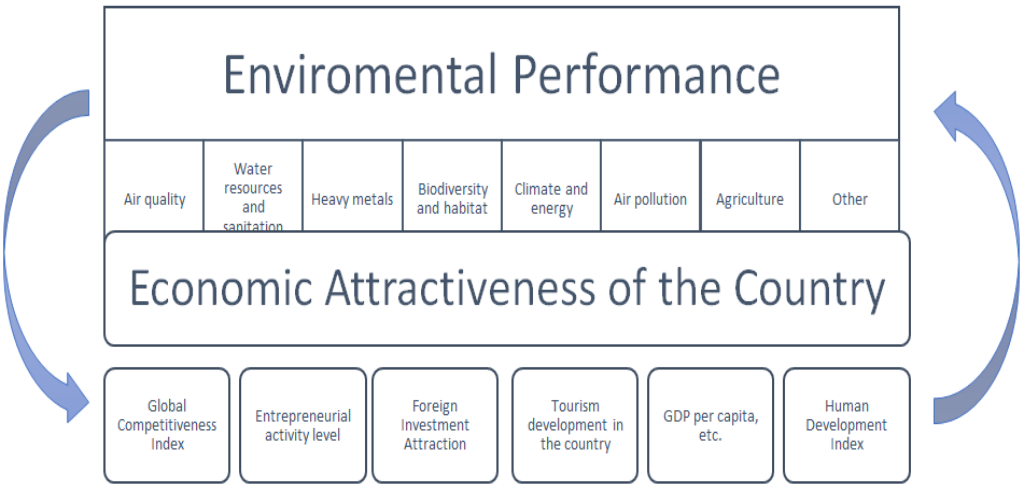

Figure 2
RELATIONSHIP BETWEEN THE ENVIRONMENTAL PERFORMANCE AND THE LEVEL OF SOCIO-ECONOMIC DEVELOPMENT OF THE COUNTRY

RESULTS AND DISCUSSIONS

At the initial stage, we collected static data on environmental performance, new businesses registered, foreign direct investment, GDP per capita, international tourism, Human Development Index, Global Competitiveness Index and Environmental Performance Index to calculate the model Table 1 below.

Table 1
KEY INDICATORS FOR CALCULATING THE MODEL

Index	Type	Source
Country Code (ISO)		
New businesses registered (number) 2018	Attribute X(1)	New businesses registered (number) 2018
Foreign direct investment, net (BoP, current US$) 2018	Attribute X(2)	Foreign direct investment, net (BoP, current US$) 2018
GDP per capita 2018	Attribute X(3)	GDP per capita (current US$) - 2018. World Bank Data.
International tourism, receipts (% of total exports) 2018	Attribute X(4)	International tourism, receipts (% of total exports) 2018. World Bank Data.
Human Development Index (HDI 2018)	Attribute X(5)	Human Development Index – 2018. UN
Global Competitiveness Index (GCI 2018)	Attribute X(6)	The global competitiveness report 2018. In World Economic Forum
Environmental Performance Index (EPI_2018)	Y	2018 Environmental Performance Index

Source: compiled by the authors

Further, a correlation analysis was carried out between the collected statistical data (see table below), which showed a strong relationship between the environmental efficiency index (EPI) with 1) the development of human capital (0.83), 2) the level of competitiveness of the economy (0.79) as well as 3) GDP per capita (0.72) in Figure 2.

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Table 2
CORRELATION MATRIX

Attribute	EPI (2018)	New businesses registered (number) 2018	Foreign direct investment, net (BoP, current US$) 2018	GDP per capita 2018	International tourism, receipts (% of total exports) 2018	HDI 2018	GCI 2018
EPI (2018)	1,00	0,16	0,36	0,72	-0,14	0,83	0,79
New businesses registered (number) 2018	0,16	1,00	-0,11	0,07	-0,20	0,16	0,27
Foreign direct investment, net (BoP, current US$) 2018	0,36	-0,11	1,00	0,41	-0,12	0,24	0,34
GDP per capita 2018	0,72	0,07	0,41	1,00	-0,31	0,72	0,81
International tourism, receipts (% of total exports) 2018	-0,14	-0,20	-0,12	-0,31	1,00	-0,28	-0,34
HDI 2018	0,83	0,16	0,24	0,72	-0,28	1,00	0,89
GCI 2018	0,79	0,27	0,34	0,81	-0,34	0,89	1,00

Source: developed by authors based RapidMiner

In the second step, we focus on clustering countries by environmental performance (EPI). According to the research purpose, there is a need to rank countries by the circular economy development level. Based on the EPI values for 2018, 3 main clusters are identified: 1) high level; 2) intermediate level; 3) low level. The maximum and minimum values were calculated to consider the change in each period's dynamics, and this difference was further divided into three groups Table 3.

Table 3
THE CLUSTERING PARAMETERS CALCULATION OF COUNTRIES ACCORDING TO ENVIRONMENTAL PERFORMANCE INDICATORS (EPI)

Cluster	Maximum value	Minimum value
High level	Max(y(1),y(2),…y(n))	Max(y(1),y(2),…y(n))-A
Intermediate level	Max(y(1),y(2),…y(n))-A	Max(y(1),y(2),…y(n))-2*A
Low level	Max(y(1),y(2),…y(n))-A	Min(y(1),y(2),…y(n))

Wherein:
y(1), y(2), …y(n) –EPI of the countries in a particular year;
Max – maximum function for a number of values;
Min – minimum function for a number of values;
A – the interval between the largest and smallest values for each level is calculated as:

$$A = \frac{Max(y1, y2 \dots y(n)) - Min(y1, y2, \dots y(n)}{3}$$

Source: compiled by the authors

Applying the above methodological approach to the environmental indicators analysis, we divided the countries into clusters Table 4.

Table 4
COUNTRIES DISTRIBUTION BY EPI CLUSTERS

Development cluster (2018)/region	high	intermediate	low
Europe	Switzerland, France, Denmark, Malta, Sweden, United Kingdom, Luxembourg, Austria, Ireland, Finland, Iceland, Spain, Germany, Norway, Belgium, Italy, Netherlands, Greece, Cyprus, Portugal, Slovakia, Lithuania	Bulgaria, Czech Republic, Slovenia, Latvia, Albania, Croatia, Hungary, Romania, Estonia, Poland, Macedonia, Serbia, Turkey, Oman	Bosnia and Herzegovina
Middle East	Israel	Qatar, Kuwait, Jordan,	Iraq

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		Lebanon, UAE, Iran, Saudi Arabia	
Asia and Oceania	Japan, New Zealand, Australia, Taiwan	Singapore, Brunei, South Korea, Sri Lanka, Malaysia, Philippines, Mongolia, China, Thailand	Vietnam, Indonesia, Myanmar, Cambodia, Pakistan, Nepal, India, Bangladesh
America	USA, Canada	Costa Rica, Colombia, Dominican Republic, Uruguay, Venezuela, Cuba, Panama, Peru, Brazil, Mexico, Argentina, Jamaica, Chile, Ecuador, Bolivia, Nicaragua, Paraguay, El Salvador, Guatemala, Honduras	Haiti
Africa		Trinidad and Tobago, Morocco, Tunisia, Egypt, Namibia, Algeria, Nigeria, Botswana, Sudan, Zambia, Tanzania, Ghana, Senegal	Kenya, Mozambique, Gabon, Ethiopia, South Africa, Zimbabwe, Togo, Cameroon, Eritrea, Benin, Angola, Congo
Countries of the former USSR		Turkmenistan, Belarus, Russia, Azerbaijan, Armenia, Georgia, Kyrgyzstan, Kazakhstan, Ukraine, Moldova	Tajikistan, Uzbekistan

Source: Compiled by the author

Highly developed countries have the highest rates of circular economy development, leaders in innovative development: Europe, USA, Canada, Israel, and Japan. Countries with low technological development and resource-intensive economic model (countries of the former USSR and Africa), respectively, have the lowest values of environmental performance indicators. The vast majority of the world's countries belong to the central cluster growth in the environmental performance indicators.

At the third stage, using the RapidMiner software package, we built a decision tree to predict which cluster of environmental efficiency the country will belong to, depending on its indicators of economic attractiveness (the list is shown in Table 5, and the database is presented in Appendix 1). The plotting results are shown in the Figure 3 below.

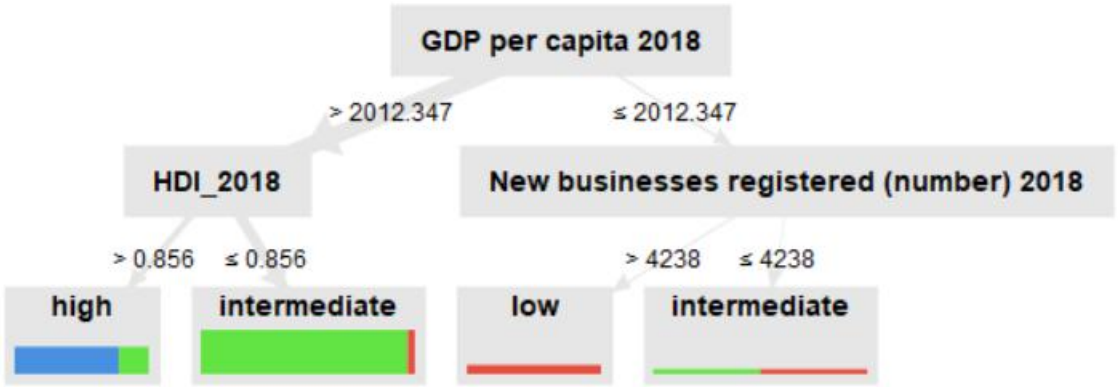

Figure 3
PLOTTING RESULTS

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Table 5
MODELING OF DECISION TREE FOR PREDICTION OF EPI CLUSTER

Accuracy: 86.96%	true high	true intermediate	true low	class precision
pred. high	6	1	0	85.71%
pred. intermediate	0	12	1	92.31%
pred. low	0	1	2	66.67%
class recall	100.00%	85.71%	66.67%	

Source: developed by authors based RapidMiner

Based on the analysis, it can be concluded that the key factor influencing the efficiency of the environment in the national ecosystem is the level of income of the population. Countries with GDP per capita above $ 2012 / year are included in the cluster of either high or medium environmental efficiency (according to the EPI level). For their ecosystem, a significant impact of the level of human capital development (HDI) has been revealed. In addition, countries with a high level of human capital development (more than 0.856) and GDP per capita (more than $ 2012 per year) in most cases (33% of total) belong to the cluster of high environmental efficiency. Where the HDI is below 0.856, but GDP per capita is above 2012 $ per year, countries belong mainly to the cluster of average environmental efficiency. However, when the level of GDP per capita is below $ 2012 / year, the dominant value is no longer the human capital development index (HDI), but the number of registered enterprises in the country. It was revealed that if this is a relatively large number - more than 4238 / year - then the country will enter a cluster of low environmental efficiency (low EPI). Otherwise, the country will be included in the cluster of average environmental efficiency. This can be explained by the fact that the level of environmental responsibility of business in countries with low per capita income is very limited. Consequently, the lack of environmental standards for business models with increasing entrepreneurial activity causes serious damage to the environment.

CONCLUSION

Summing up, the hypothesis about the close relationship of country's global competitiveness and economic attractiveness with its environmental performance was tested. The results obtained prove that the ecological values increase in the ecosystem with the growth of incomes of the population, the increase in the economic attractiveness of the country and its level of global competition. The study revealed a significant correlation between the Environmental Performance Index (EPI) and Human Development Index (0.83), the level of competitiveness of the economy (0.79) as well as GDP per capita (0.72). The presence of a strong relationship between the environmental index (EPI) and human development index (0.83) suggests the need to improve the quality of human capital, especially in the countries of the third cluster of low environmental efficiency.

The use of the RapidMiner software complex allowed us to build a decision tree for predicting the cluster of environmental efficiency with a different combination of factors affecting the development of the country's economic system: new businesses registered, foreign direct investment, GDP per capita, international tourism, Human Development Index, Global Competitiveness Index and Environmental Performance Index.

The calculations show that ccountries with GDP per capita above $ 2012 per year belong to the cluster of either high or medium environmental efficiency. Their ecosystem are significantly influenced by the human development index (HDI). Moreover, countries with a high HDI (more than 0.856) and GDP per capita (more than $ 2012 per year) in most cases (33%) will be associated with the cluster of high environmental efficiency. If the country's HDI is below 0.856, but GDP per capita is above 2012 $ per year, it will be mainly affiliated

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to the cluster of average environmental performance. However, when the level of GDP per capita is below $ 2012 per year, the dominant value is no longer the human development index, but the number of registered enterprises in the country. It was revealed that if this is a relatively large number - more than 4238 per year - then the country will enter a cluster of low environmental performance. Otherwise, the country will be included in the cluster of average environmental efficiency.

Thus, in countries with an intermediate and high level of environmental performance, there is a direct link between productivity and the human development, therefore, investing in human capital is strategically important for both companies and the country as a whole. For low-income countries, it is important to accelerate the process of creating an education system and ensuring access to the results of scientific and technological development in more developed countries. International investments, programs of international organizations in the field of health and the environment are important. Insufficient investment leads to the use of extensive factors in the development of national economies. The use of "*dirty technologies*", a high level of resource intensity of production, these and other factors in the conditions of even increasing entrepreneurial activity cause serious damage to the environment.

For middle-income countries, it is important to improve the quality of education, taking into account the orientation towards environmental principles of business and life. In the production of goods and services, it is important to form new competencies for managers. Solving the problem of circularity of business models requires the development of educational programs focused on the training of consultants, designers, designers of cyclical production of local and global scales. It is necessary to study the experience of the countries of the first cluster (high EPI) in terms of the formation of new value approaches in organizing the training of company personnel and managers of territorial development.

The formation of institutional foundations, national and regional programs and projects are vital prerequisites for business development and entrepreneurship based on resource-efficient technologies and business models of circularity. The focus on the business environmental friendliness demands a change of principles, methods and techniques of corporate management. For the production development based on a circular economy, it is essential to invest in the appropriate infrastructure development and specialists' training in environmental management. Multinational corporations are implementing new after-sales customer service systems on a circular basis, which provides new competitive advantages in local and international markets.

Appendix

Appendix 1
INITIAL DATA FOR THE CALCULATION OF DECISION TREE AND CORRELATION MODEL

Country	Country Code	Region	Cluster	EPI 2018	New businesses registered (number) 2018	Foreign direct investment, net (BoP, current US$ mln) 2018	GDP per capita 2018	International tourism, receipts (% of total exports) 2018	HDI 2018	GCI 2018
Switzerland	CHE	EU	high	87,42	25 637	112 318	86 430	4,41	0,955	82,6
France	FRA	EU	high	83,95	201 087	68 851	41 526	7,95	0,898	78
Denmark	DNK	EU	high	81,6	36 982	-1 638	61 599	4,53	0,939	80,6
Malta	MLT	EU	high	80,9	5 527	-11 618	30 672		0,894	68,8
Sweden	SWE	EU	high	80,51	45 590	13 762	54 589		0,943	81,7
United Kingdom	GBR	EU	high	79,89	664 974	-24 763	42 993		0,928	82
Luxembourg	LUX	EU	high	79,12	7 309	73 819	116	4,89	0,913	76,6

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Austria	AUT	EU	high	78,97	3 830	1 971	51 453	10,03	0,921	76,3
Ireland	IRL	EU	high	78,77	22 398	27 442	79 298	3,24	0,951	75,2
Finland	FIN	EU	high	78,64	14 700	13 724	50 013	5,44	0,937	80,3
Iceland	ISL	EU	high	78,57	2 283	471	74 348		0,946	74,5
Spain	ESP	EU	high	78,39	94 676	-16 391	30 375		0,905	74,2
Germany	DEU	EU	high	78,37	72 844	28 140	47 787	3,16	0,946	82,8
Norway	NOR	EU	high	77,49	29 959	20 067	82 268	4,29	0,956	78,2
Belgium	BEL	EU	high	77,38	24 677	9 073	47 555	2,29	0,93	76,6
Italy	ITA	EU	high	76,96	114 360	-4 291	34 609	7,87	0,89	70,8
New Zealand	NZL	Oceania	high	75,96	56 380	-1 919	43 306	18,99	0,928	77,5
Netherlands	NLD	EU	high	75,46	71 531	63 766	53 019	3,34	0,942	82,4
Israel	ISR	Middle East	high	75,01	17 456	-15 428	41 705	7,31	0,916	76,6
Japan	JPN	Asia	high	74,69	29 243	134 929	39 159	4,87	0,917	82,5
Australia	AUS	Oceania	high	74,12	235 654	-60 527	57 355	14,46	0,943	78,9
Greece	GRC	EU	high	73,6	9 793	-3 506	19 766	26,38	0,881	62,1
Taiwan	TWN	Asia	high	72,84		0				79,3
Cyprus	CYP	EU	high	72,6	14 526	-5 536	29 089	18,13	0,885	65,6
Canada	CAN	America	high	72,18	4 065	18 934	46 455		0,928	79,9
Portugal	PRT	EU	high	71,91	43 114	-6 392	23 551	23,04	0,86	70,2
United States	USA	America	high	71,19		-412 780	63 064	9,36	0,925	85,6
Slovak Republic	SVK	EU	high	70,6	19 720	-1 293	19 365	3,29	0,858	66,8
Lithuania	LTU	EU	high	69,33	6 072	-260	19 167		0,876	67,1
Bulgaria	BGR	EU	intermediate	67,85	45 683	-886	9 428	11,61	0,813	63,6
Costa Rica	CRI	America	intermediate	67,85	8 984	-2 183	12 469	18,83	0,808	62,1
Qatar	QAT	Middle East	intermediate	67,8	14 824	5 709	65 908	14,86	0,845	71
Czech Republic	CZE	EU	intermediate	67,68	30 336	-2 245	23 420	4,32	0,898	71,2
Slovenia	SVN	EU	intermediate	67,57	4 182	-1 089	26 103	7,35	0,912	69,6
Trinidad and Tobago	TTO	Africa	intermediate	67,36		765	17 038	4,68	0,795	57,9
Latvia	LVA	EU	intermediate	66,12	9 864	-745	17 850		0,863	66,2
Turkmenistan	TKM	GUS	intermediate	66,1		0	6 967		0,71	
Albania	ALB	EU	intermediate	65,46	2 990	-1 209	5 284	48,20	0,792	58,1
Croatia	HRV	EU	intermediate	65,45	15 585	-893	15 014	36,85	0,848	60,1
Colombia	COL	America	intermediate	65,22	68 588	-6 409	6 730	12,03	0,764	61,6
Hungary	HUN	EU	intermediate	65,01	24 252	-3 829	16 411	7,14	0,85	64,3
Belarus	BLR	GUS	intermediate	64,98	8 700	-1 371	6 330	2,89	0,823	
Romania	ROU	EU	intermediate	64,78	94 244	-5 840	12 399	3,84	0,823	63,5
Dominican Republic	DOM	America	intermediate	64,71	10 204	-2 535	8 051	37,71	0,751	57,4

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Uruguay	URY	America	intermediate	64,65	2 796	500	18 704	14,31	0,816	62,7
Estonia	EST	EU	intermediate	64,31	19 950	-1 426	23 159	10,25	0,889	70,8
Singapore	SGP	Asia	intermediate	64,23	43 046	-61 076	66 679	3,07	0,936	83,5
Poland	POL	EU	intermediate	64,11	36 879	-15 285	15 468	4,80	0,877	68,2
Venezuela	VEN	America	intermediate	63,89		0			0,733	43,2
Russia	RUS	GUS	intermediate	63,79	317 468	22 592	11 287	3,68	0,823	65,6
Brunei Darussalam	BRN	Asia	intermediate	63,57	731	-516	31 628	2,70	0,836	61,4
Morocco	MAR	Africa	intermediate	63,47	45 132	-2 764	3 227	22,01	0,68	58,5
Cuba	CUB	America	intermediate	63,42		0	8 824		0,781	
Panama	PAN	America	intermediate	62,71	13 068	-4 917	15 545	25,00	0,812	61
Tunisia	TUN	Africa	intermediate	62,35	13 134	-989	3 439	11,95	0,738	55,6
Azerbaijan	AZE	GUS	intermediate	62,33	11 611	358	4 740	11,10	0,754	60
Korea, Rep.	KOR	Asia	intermediate	62,3		26 038	33 423	3,17	0,914	78,8
Kuwait	KWT	Middle East	intermediate	62,28	18 535	2 993	33 399	1,08	0,807	62,1
Jordan	JOR	Middle East	intermediate	62,2	3 289	-963	4 308	41,22	0,728	59,3
Armenia	ARM	GUS	intermediate	62,07	6 137	-247	4 221	27,67	0,771	59,9
Peru	PER	America	intermediate	61,92	79 346	-6 469	6 958	8,07	0,771	61,3
Egypt, Arab Rep.	EGY	Africa	intermediate	61,21		-7 818	2 537	24,61	0,701	53,6
Lebanon	LBN	Middle East	intermediate	61,08		-2 043	8 013	45,37	0,747	57,7
Macedonia	MKD	EU	intermediate	61,06		0	6 087	5,08		56,6
Brazil	BRA	America	intermediate	60,7	189 076	-76 138	9 151	2,30	0,762	59,5
Sri Lanka	LKA	Asia	intermediate	60,61	10 510	-1 546	4 059		0,779	56
Mexico	MEX	America	intermediate	59,69	83 903	-25 365	9 687	4,96	0,776	64,6
Argentina	ARG	America	intermediate	59,3	5 667	-10 071	11 633	7,78	0,842	57,5
Malaysia	MYS	Asia	intermediate	59,22	51 722	-2 539	11 378	8,86	0,805	74,4
United Arab Emirates	ARE	Middle East	intermediate	58,9	24 716	0	43 839		0,889	73,4
Jamaica	JAM	America	intermediate	58,58	3 159	-762	5 360		0,734	57,9
Namibia	NAM	Africa	intermediate	58,46		-138	5 588	9,86	0,645	52,7
Iran	IRN	Middle East	intermediate	58,16	23 689	0	3 598		0,785	54,9
Philippines	PHL	Asia	intermediate	57,65	19 774	-5 833	3 252	10,75	0,711	62,1
Mongolia	MNG	Asia	intermediate	57,51	11 507	-1 924	4 135	6,82	0,735	52,7
Chile	CHL	America	intermediate	57,49	132 740	-6 450	15 888	4,59	0,849	70,3
Serbia	SRB	EU	intermediate	57,49	8 671	-3 714	7 252	7,77	0,803	60,9
Saudi Arabia	SAU	Middle East	intermediate	57,47	12 116	15 005	23 337	5,39	0,854	67,5
Ecuador	ECU	America	intermediate	57,42		-1 388	6 296	8,98	0,762	55,8
Algeria	DZA	Africa	intermediate	57,18	9 472	-586	4 154	0,44	0,746	53,8
Bolivia	BOL	America	intermediate	55,98	3 593	-387	3 549	9,16	0,714	51,4
Georgia	GEO	GUS	intermediate	55,69	25 241	-966	4 723	39,54	0,805	60,9
Nicaragua	NIC	America	intermediate	55,04		-763	2 015		0,659	51,5
Kyrgyz Republic	KGZ	GUS	intermediate	54,86		-139	1 308	18,94	0,696	53
Nigeria	NGA	Africa	intermediate	54,76	86 309	-210	2 028	2,99	0,534	47,5

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Kazakhstan	KAZ	GUS	intermediate	54,56	23 464	-4 723	9 813	3,95	0,819	61,8
Paraguay	PRY	America	intermediate	53,93	1 018	-458	5 783	2,74	0,727	53,4
El Salvador	SLV	America	intermediate	53,91	2 347	-826	4 053	18,11	0,67	52,8
Turkey	TUR	EU	intermediate	52,96	85 798	-9 235	9 453	15,47	0,817	61,6
Ukraine	UKR	GUS	intermediate	52,87		-4 460	3 097	3,83	0,774	57
Guatemala	GTM	America	intermediate	52,33	5 530	-778	4 478	9,25	0,657	53,4
Moldova	MDA	GUS	intermediate	51,97	4 801	-254	4 230	14,50	0,746	55,5
Botswana	BWA	Africa	intermediate	51,7		-204	8 280	7,76	0,73	54,5
Honduras	HND	America	intermediate	51,51		-895	2 510	8,42	0,633	52,5
Sudan	SDN	Africa	intermediate	51,49		-1 136	826	20,88	0,506	
Oman	OMN	Middle East	intermediate	51,32	5 085	-5 225	16 521	6,42	0,813	64,4
Zambia	ZMB	Africa	intermediate	50,97	10 236	-363	1 516		0,582	46,1
Tanzania	TZA	Africa	intermediate	50,83	5 276	-972	1 043	29,14	0,524	47,2
China	CHN	Asia	intermediate	50,74		-92 338	9 977		0,755	72,6
Thailand	THA	Asia	intermediate	49,88	55 589	4 182	7 297	18,68	0,772	67,5
Ghana	GHA	Africa	intermediate	49,66		-2 908	2 194	4,42	0,606	51,3
Senegal	SEN	Africa	intermediate	49,52	4 003	-795	1 458	10,54	0,516	49
Tajikistan	TJK	GUS	low	47,85	831	-249	853	15,31	0,661	52,2
Kenya	KEN	Africa	low	47,25	44 259	-1 462	1 708	15,43	0,599	53,7
Vietnam	VNM	Asia	low	46,96		-14 902	2 566	3,90	0,7	58,1
Indonesia	IDN	Asia	low	46,92		-12 511	3 894	8,45	0,712	64,9
Mozambique	MOZ	Africa	low	46,37		-2 692	503	5,54	0,452	39,8
Uzbekistan	UZB	GUS	low	45,88	35 968	-623	1 529	9,30	0,717	
Myanmar	MMR	Asia	low	45,32	14 051	-1 768	1 279	10,62	0,579	
Gabon	GAB	Africa	low	45,05	1 106	0	7 957		0,697	45,5
Ethiopia	ETH	Africa	low	44,78	31 198	-3 360	772	46,54	0,478	44,5
South Africa	ZAF	Africa	low	44,73		-1 543	6 373	8,89	0,707	60,8
Zimbabwe	ZWE	Africa	low	43,41	16 810	0	1 352		0,569	42,6
Cambodia	KHM	Asia	low	43,23	7 007	-3 089	1 512	26,24	0,585	50,2
Iraq	IRQ	Middle East	low	43,2		5 074	5 523	2,16	0,671	
Bosnia and Herzegovina	BIH	EU	low	41,84	2 493	-602	6 072	13,38	0,777	54,2
Togo	TGO	Africa	low	41,78	2 587	251	902	15,80	0,51	
Cameroon	CMR	Africa	low	40,81		-657	1 534	8,67	0,56	45,1
Eritrea	ERI	Africa	low	39,34		0			0,456	
Benin	BEN	Africa	low	38,17	3 341	-184	1 241	4,55	0,541	44,4
Pakistan	PAK	Asia	low	37,5	13 229	-1 758	1 482	2,75	0,552	51,1
Angola	AGO	Africa	low	37,44		6 462	3 290	1,35	0,582	37,1
Haiti	HTI	America	low	33,74		-105	1 435	34,86	0,508	36,5
Nepal	NPL	Asia	low	31,44	24 088	-68	1 179	27,78	0,596	50,8
India	IND	Asia	low	30,57	123 942	-30 700	1 997	5,43	0,642	62
Dem. Rep. Congo	COD	Africa	low	30,41		-1 408	557	0,38	0,478	38,2
Bangladesh	BGD	Asia	low	29,56	4 473	-2 402	1 698	0,81	0,625	52,1

REFERENCES

Ahmad, S. (2015). Green human resource management: Policies and practices. *Cogent Business & Management, 2*(1), 1030817.

Amrutha, V.N., & Geetha, S.N. (2020). A systematic review on green human resource management: Implications for social sustainability. *Journal of Cleaner Production, 247*, 119131.

Broeckhoven, I., Verbeke, W., Tur-Cardona, J., Speelman, S., & Hung, Y. (2021). Consumer valuation of carbon labeled protein-enriched burgers in European older adults. *Food Quality and Preference, 89*, 104114.

Contractor, F.J., & Mudambi, S.M. (2008). The influence of human capital investment on the exports of services and goods: An analysis of the top 25 services outsourcing countries. *Management International Review, 48*(4), 433-445.

Citation Information: Apalkova, V., Nikolaienko, A., & Meshko, N. (2021). Prediction of environmental performance based on country's economic attractiveness. *Academy of Accounting and Financial Studies Journal, 25*(S5), 1-15.

European Commission. Commission staff working document: Leading the way to a global circular economy: state of play and outlook. Brussels, 11.3.2020. SWD (2020) 100 final. URL: https://ec.europa.eu/environment/circular-economy/pdf/leading_way_global_circular_economy.pdf

Fabus, M. (2018). BUSINESS ENVIRONMENT ANALYSIS BASED ON THE GLOBAL COMPETITIVENESS INDEX (GCI) AND DOING BUSINESS (DB): CASE STUDY SLOVAKIA. *Journal of Security & Sustainability Issues, 7*(4).

Galgánková, V. (2020). Competitiveness of V4 Countries Using the Global Competitiveness Index. In SHS Web of Conferences (Vol. 74, p. 06007). EDP Sciences.

Geisendorf, S., & Pietrulla, F. (2018). The circular economy and circular economic concepts—a literature analysis and redefinition. *Thunderbird International Business Review, 60*(5), 771-782.

George, D.A., Lin, B.C.A., & Chen, Y. (2015). A circular economy model of economic growth. *Environmental Modelling & Software, 73*, 60-63.

Kuznets S. (1995). Economic Growth and Income Inequality. The American Economic Review. – Volume XLV. URL: https://assets.aeaweb.org/asset-server/files/9438.pdf

Lee, K.H. (2016). The conceptualization of country attractiveness: a review of research. *International Review of Administrative Sciences, 82*(4), 807-826.

Li, D., & Jiang, J. (2012). Global green new deal and Chinese green economy based on environment and energy materials. *In Advanced Materials Research, 485*, 494-501. Trans Tech Publications Ltd.

MacArthur, E. (2013). Towards the circular economy. *Journal of Industrial Ecology, 2*, 23-44.

Makarenko, Y.P., Kudlaienko, S., Roschyna, Y.V., Rudych, L., & Suray, I. (2019). Strategic investment management and formation of investment strategy of the enterprise. *Academy of Strategic Management Journal, 18*, 1-6.

Mathews, J.A. (2017). Global green shift: When CERES meets Gaia. Anthem Press.

McDonough, W., & Braungart, M. (2002). Design for the triple top line: new tools for sustainable commerce. *Corporate Environmental Strategy, 9*(3), 251-258.

Meadows, D.H., Meadows, D.L., Randers, J., & Behrens, W.W. (2019). The limits to growth. In Green Planet Blues (27-31). Routledge.

Paillé, P., Chen, Y., Boiral, O., & Jin, J. (2014). The impact of human resource management on environmental performance: An employee-level study. *Journal of Business Ethics, 121*(3), 451-466.

Preston, F. (2012). A global redesign? Shaping the circular economy.

Renwick, D.W., Redman, T., & Maguire, S. (2013). Green human resource management: A review and research agenda. *International Journal of Management Reviews, 15*(1), 1-14..

Reshetnikova, I., Apalkova, V., Lytovchenko, I., & Wiktor, J.W. (2021). An evaluation of the economic and green market utility in a circular economy. In E3S Web of Conferences (Vol. 255, p. 01038). EDP Sciences.

Roscoe, S., Subramanian, N., Jabbour, C.J., & Chong, T. (2019). Green human resource management and the enablers of green organisational culture: Enhancing a firm's environmental performance for sustainable development. *Business Strategy and the Environment, 28*(5), 737-749.

Ruiz Real, J., Uribe-Toril, J., De Pablo, J., & Gázquez-Abad, J. (2018). Worldwide Research on Circular Economy and Environment: A Bibliometric Analysis. *International Journal of Environmental Research and Public Health, 15*(12), 2699.

Schwab, K. (2017). The fourth industrial revolution. Currency.

Schwab, K. (2018). The global competitiveness report 2018. In World Economic Forum (Vol. 671).

Sinclair, M., Sheldrick, L., Moreno, M., & Dewberry, E. (2018). Consumer intervention mapping—A tool for designing future product strategies within circular product service systems. *Sustainability, 10*(6), 2088.

Stahel, W.R. (2013). The business angle of a circular economy–higher competitiveness, higher resource security and material efficiency. A new dynamic: Effective business in a circular economy, 1.

Trusova, N.V., Cherniavska, T.A., Kyrylov, Y.Y., Hranovska, V.H., Skrypnyk, S.V., & Borovik, L.V. (2020). Investment attractiveness of the economy of the world countries in the polystructural space of foreign direct investments. *J. Advanced Res. L. & Econ., 11*, 645.

Vengesayi, S. (2003). A conceptual model of tourism destination competitiveness and attractiveness.

Citation Information: Apalkova, V., Nikolaienko, A., & Meshko, N. (2021). Prediction of environmental performance based on country's economic attractiveness. *Academy of Accounting and Financial Studies Journal, 25*(S5), 1-15.