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The Impact of Migration of Highly Skilled Workers on The Country's Competitiveness and Economic Growth

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ABSTRACT

The links between the migration of highly skilled workers and economic growth (in terms of GNI per capita) and the competitiveness of countries have been studied. The study is based on statistics from developed countries and using correlation-regression analysis and modelling, as well as cluster analysis using the package of processing and analysis of statistical information STATISTICA. The analysis found that the immigration of workers with higher education has a significant impact on strengthening the competitiveness and economic development of countries – this is confirmed by the impact of talent migration, which is assessed by the values of case studies ('The Human Flight and Brain Drain' sub-index Fragile States Index and 'Brain gain' sub-index' in the Global Talent Competitiveness Index and 'Highly educated workers' sub-index in the OECD indicators of talent attractiveness). Their impact on macroeconomic indicators is higher compared to the links with social development indicators. Of course, this does not mean that such links should not be seen as important in public economic development management, as they illustrate the level of efficiency achieved in creating favourable conditions for realizing the potential of highly skilled workers, including pull-factors for their immigration. But in the macroeconomic management of a competitive economy, according to our research, actions aimed at attracting highly skilled migrants have the most significant and obvious impact. Other links can be taken into account and used in modelling for the development of institutional support for proactive migration policy for highly qualified workers.

INTRODUCTION

In today's globalized world, there is a steady increase in international migration. The International Organization for Migration (IOM, 2020) estimates that the number of international migrants in 2019 was almost 272 million. At the same time, 35% of the total number are highly qualified migrants with higher education (McKinsey & Company, 2020b). The level of emigration of such persons is always higher than that of their less educated compatriots in all countries and at each level of development (Kerr et al., 2017). There are several reasons for this pattern: highly qualified individuals are likely to have relevant and in-demand skills; they tend to integrate more easily into the society because they have better linguistic and cultural knowledge of the foreign country; have better access to global sources of information through the use of social and professional networks; can access financial resources and loans to cover the financial costs of migration. As a result, higher emigration rates are observed in middle-income countries, where migrants can cope with migration costs (unlike many in poorer countries) while having incentives to emigrate (unlike many in rich countries).

According to experts, a further increase in the annual immigration flow of highly skilled workers is expected compared to other types of migration (Acostamadiedo et al., 2020). Compared to the average for 2009–2018, experts expect three times as many highly skilled workers to migrate to the EU-28 in 2030 (Ibid.). At the same time, under the implementation of the most probable scenario (unilaterality and economic convergence), the migration of highly qualified workers is expected to increase by 134%. The global shortage of talent, which is constantly growing in the era of the knowledge economy, also contributes to the spread of highly skilled workers (Fig. 1). At the same time, the shortage of talent is inherent in the vast majority of countries, as only 18% of countries do not report the lack of a sufficient number of highly qualified workers (ManpowerGroup, 2020).

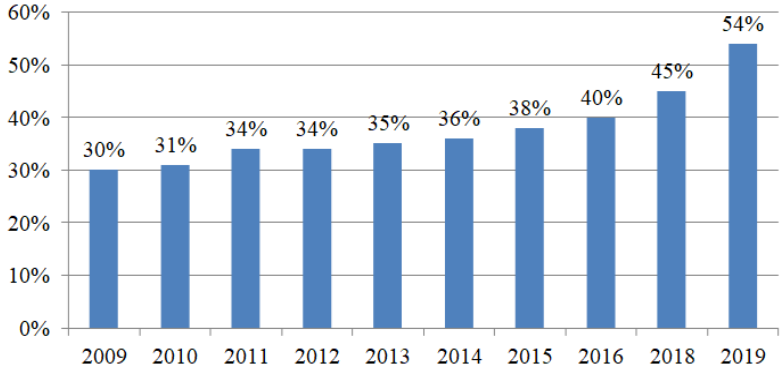

Figure 1. Global talent shortage

Source: compiled by the authors according to the data from (ManpowerGroup, 2020).

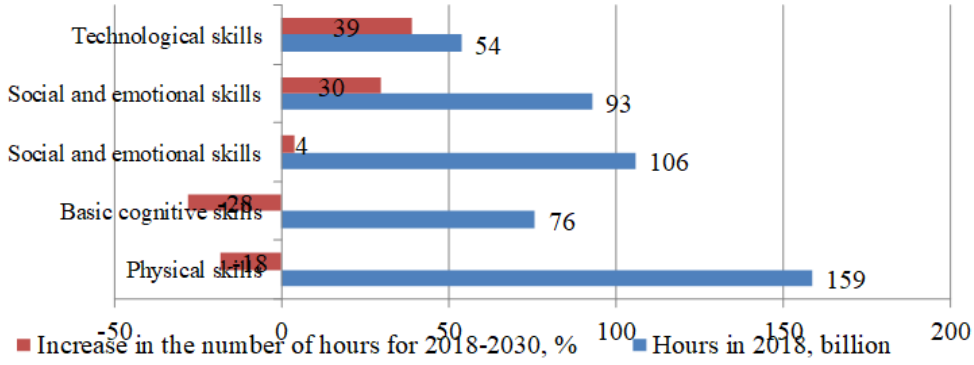

Figure 2. Expected growth in demand for technological, social and emotional skills in Europe

Source: compiled by the authors according to the data from (McKinsey&Company, 2020a).

At the same time, the knowledge and skills that modern workers must possess significantly change (Fig. 2). Thus, according to projected estimates, the demand for employees with technological skills (advanced IT skills / programming, research) will increase by 39% by 2030. Social and emotional skills (between personal skills and empathy, teaching and learning of others) will also become more popular. A relatively small increase will also be characteristic of higher cognitive skills (quantitative and statistical skills, project management). At the same time, a significant decline in demand for basic cognitive and physical skills is expected. To confirm the reality of the projected trends, we can cite the example of US industries with the largest shortage of highly skilled migrants, among which IT is the most attractive sector for employment of migrants with higher education (66% of the total in 2019) (McCarthy, 2019).The arrival of highly qualified migrants does not only create an increase in the human capital of the destination country, but also creates an appropriate competitive environment for local residents, stimulates training and acquiring new knowledge and skills. At the same time, this phenomenon allows obtaining economic benefits for the recipient country. Thus, a statistical analysis conducted in the United States showed that an increase in immigration by one percentage point leads to an increase in GDP growth of 0.1% (Malinovska, 2018).

1. LITERATURE REVIEW

The constant growth of migration flows, the shortage of workers with the appropriate level of knowledge, skills and abilities are attracting the attention of more and more scientists around the world to study the issue of migration of highly qualified workers. However, today there is no single approach to the definition of this concept. Thus, Czaika and Parsons (2016) define a highly skilled migrant as a person working in a profession that falls into the first three categories of the International Standard Classification of Occupations: managers, senior officials and legislators; professionals; technicians and specialists employed in jobs commensurate with higher education. Kone and Özden (2017) include all people with higher education as highly qualified migrants. It is worth noting that a fairly common approach is to identify the concepts of "migration of highly skilled workers" and "brain drain", using them as synonyms (Schiff, 2018). For more than 50 years of history of this term, the results of scientific research in this area demonstrate the diversity of approaches to defining the meaning of the concept of "brain drain" (table 1).

Table 1. Researchers' approaches to the definition of "brain drain"

Author	*Definition*
Adeyemi et al. (2018)	The movement of people, especially the most skilled and competent people or labour force, from less developed to more developed countries, where human capital is believed to be more valued.
El Saghir et al. (2020)	Migration of educated and skilled people from a less developed region or country to a more economically stable one.
Sundac and Stumpf (2016)	Migration of highly educated people who, dissatisfied with the situation in the country of origin, are looking for better living conditions abroad.
Karaduman and Çoban (2019)	Transfer of knowledge and skilled human capital through migration.
Bongers et al. (2018)	Emigration of highly skilled workers looking for better employment opportunities and better wages from relatively low-income countries to high-income countries.
Beaumont et al. (2017)	Migration of highly qualified and highly educated people from one country to another; consists of the transfer of human capital, which leads to the loss of highly educated people in the sending country, and the receipt of human capital in the host country.

Source: Authors' compilation

Analysing the above definitions, we should first note the direction of brain drain, which can be traced in most definitions: from developing countries to developed countries (with high incomes). This interpretation is quite controversial, as the brain drain can occur between countries with relatively the same level of income and quality of life. Thus, Beaumont et al. (2017) study the intra-European emigration (temporary or permanent) of highly qualified people, analyse its trends, substantiate its three main reasons: 1) opening borders between EU countries, 2) joint government agreements on hiring professionals to fill the labour market deficit, and agreements on studying abroad; 3) increase of internal mobility in the EU due to the development of budget airlines and reduction of telephone prices.

Cavallini et al. (2018) investigate the main directions of intra-European brain drain. The results suggest that highly skilled workers prefer the northern parts of the EU (Sweden, Ireland, Estonia, Denmark and several regions of the UK) and the urban environment. Less attractive regions for such professionals are largely located in Italy. Similar trends in circular migration by level of development of countries were found in the studies of Cseh Papp et al. (2018) and Máté et al. (2018). Some researchers also identify the main factors that motivate highly skilled workers to look for work abroad: better employment opportunities, higher wages, better living conditions. These are the so-called pull factors of labour mobility that lead to the immigration of human capital. When mobility concerns highly skilled workers, pull factors play a more important role than push factors. The social and economic conditions of the host regions are one of the most important factors determining the mobility of highly skilled workers. Among these factors are active economic growth, higher wages, strong social security, high per capita wealth, language similarity, cultural similarity, easier access to the labour market, higher employment (EC, 2018). At the same time, a two-pronged approach by researchers to the study of the migration of highly skilled workers is widespread. Thus, Beaumont et al. (2017) combine two concepts: brain drain (loss of highly educated people) and brain gain (human capital gain). Typically, these concepts are used as opposites, i.e. brain gain in the recipient country is generated by the brain drain for the donor country. Therefore, the study of the issue of brain drain also requires a focus on issues related to the phenomenon of brain gain. According to the generally accepted approach, brain gain is the increase of the number of people in a region/country who have high skills and/or competencies due to immigration (Cavallini et al., 2018).

Along with the concepts of brain drain and brain gain, the term “human capital flight” is gaining popularity in scientific circles, referring to the movement of highly qualified and well-educated people to countries other than their country of residence or the country where they learned these skills (Zfar and Kantola, 2019). Net losses during this process of emigration are called brain drain, while net benefits are called brain gains.In today’s world, the availability of highly qualified workers is one of the main prerequisites for sustainable economic development of any country. Governments seek to promote the proper education and training of their populations. At the same time, the migration of highly skilled workers has an impact not only on demographic and social processes, but also on the economic development of the country as a whole. In this aspect, there is a continuous scientific discussion on the consequences of the migration of such specialists for donor and recipient countries, on its impact on economic growth, on the ranking of countries in various global indices.Janeska and Lozanoska (2016) consider the trends in brain drain from the Republic of Macedonia and their consequences over the past two decades. Since 2008, the Republic of Macedonia is one of the ten countries with the most intensive brain drain. At the same time, the direct effect of brain drain is manifested in the reduction of economic growth and innovation opportunities of the country due to the reduction of human capital. The effects of feedback are also unfavourable, as the return of highly educated immigrants is insignificant and accidental. At the same time, the increase in brain drain is not accompanied by an increase in remittances, does not have a significant impact on the diaspora and technology transfer. The study also highlights the negative social consequences of brain drain, in particular, this phenomenon accelerates the aging population in general and the working age population in particular.

The impact of brain drain on the socio-economic situation in the Baltic States is analysed by Svazas and Liberyte (2019). The developed research methodology allows assessing the impact of brain drain on the national economy as a whole, including such indicators as life expectancy, school life expectancy, GDP per capita, etc. Socio-economic consequences of this phenomenon are changes in the labour market, exacerbate the shortage of skilled workers, aging population, inefficient use of funds invested in the education system, financial difficulties. After conducting a comparative analysis, the authors concluded that the problem of brain drain in Lithuania and Latvia is extremely relevant, and its consequences hinder the socio-economic development of these countries. At the same time, this problem is not a threat to Estonia at the moment, as Estonia has a positive migration balance. The close relationship between low economic growth and brain drain is evidenced by the results of a study (Adeyemi et al., 2018) on the example of Nigeria, Ethiopia and Kenya. This is facilitated by a number of factors, such as institutional failures, high levels of corruption, as well as the lack of social facilities such as a quality health and education system, roads and pipelines, etc. Using the least squares method and empirical analysis, the authors argue that remittances and human capital development play a significant role in how brain drain

affects economic growth in Africa, including the negative relationship between brain drain, remittances and economic growth.

The inverse relationship between brain drain and economic growth has also been demonstrated by the example of Pakistan (Farooq and Ahmad, 2017). The researchers used the OLS model to test the impact of brain drain on economic growth. The stationarity of the variable is demonstrated / confirmed by the extended Dickey-Fuller-test and the Phillips-Parron-test. Thus, the main problems associated with the brain drain are the lack of human capital and the loss of public funds spent on education, as the knowledge gained is applied in another country. At the same time, the phenomenon of brain growth is a phenomenon when a country acquires skilled workers without spending public money on their education. The aim of the study Knezackova and Vesela (2018) was to identify European countries that can attract highly educated migrants. Using statistical methods, the authors prove the hypothesis that highly educated migrants come to countries with higher economic levels. Therefore, the country's ability to attract highly qualified migrants is an important competitive advantage for the country's further development.

It should be noted that more and more researchers are using an integrated approach, using concepts such as brain drain, brain growth and brain return. Liminta and Serati (2016) introduced a new model that explains the common migration flows associated with brain drain, brain growth, and brain return. The developed individual country's well-being indicator (LISE) measures the level of individual well-being for each country. With this indicator, you can understand what are the drivers of migration flows, whether it is possible to prevent the phenomena associated with brain drain, or to stimulate the phenomena associated with brain growth in different countries. The authors empirically tested the reliability of the individual well-being index in a sample of 12 countries. At the same time, there is a close relationship between these concepts and the competitiveness of countries, the main measure of which is the Global Competitiveness Index. To confirm this thesis, Sundac and Stumpf (2016) used the method of linear regression. The author proves that there is a link between global competitiveness and brain drain: if competitiveness increases, brain drain will decrease and highly educated workers will remain in their country. Therefore, if a country wants to become a knowledge-based society, it must prevent a brain drain by providing highly skilled workers with decent working conditions, opportunities for continuous professional development, and a rise in living standards in the country as a whole.

This statement is also proved by the results of the Schiff's study (2017) on the example of migration from Islamic countries to the United States during the period from 2007 to 2015. Using the Generalized Method of Moments (GMM), the authors proved that the competitiveness index has a negative and significant effect on brain drain. In addition, the gap between well-being and wages has a significant and positive relationship with brain drain in the countries studied. The variable of the unemployment rate also has a positive and significant relationship with brain drain. According to the study, the low competitiveness of Islamic countries contributes to a significant brain drain from the above countries. Scientists like Mishchuk et al. (2019) considering the socio-economic impact of the intellectual potential of young people on economic and human development, used the regression method to predict the most obvious indicators of the loss of intellectual capacity of the country. On the example of data about Ukraine as a donor country, it is proved that intellectual migration can have significant devastating consequences for national competitiveness. In particular, the authors proved significant risks for the reproduction of the country's intellectual potential. As found in another study, such an impact is particularly noticeable in cross-border regions with the possibility of subjective comparisons of the effects of labour migration, which often becomes a risk of migration losses of highly skilled workers and problems in the business environment (Bilan et al., 2020). Thus, passive external migration policies can have a detrimental effect on talent-driven national competitiveness in terms of innovation and development.

2. DATA AND METHODOLOGY

To study the relationship between the migration of highly skilled workers, economic growth and competitiveness of the country, the authors formed and tested the following hypotheses:

H1 – migration of highly skilled workers significantly affects the change of the Global Competitiveness Index of the country;
H2 – migration of highly skilled workers significantly affects the change in GNI per capita.

To select indicators that assess the level of brain drain and growth, the attractiveness of countries for immigration of highly skilled workers and countries from which such specialists tend to emigrate, the authors analysed global indices in this area (Table 2). To confirm the hypotheses, Table 2 also lists global indices and indicators on which the migration of highly skilled workers can have a significant impact, as talented and skilled people play a key role in the country's prosperity, contribute to economic growth and better living conditions for the population.

Table 2. Indicators of migration of highly skilled workers in global indices

Title	*Coverage of countries*	*Components*	*Indicator*	*Symbol*
The Global Competitiveness Index (http://www3.weforum.org/docs/WEF_TheGlobalCompetitivenessReport2019.pdf)	141	Institutions; infrastructure; ICT adoption; macroeconomic stability; health; skills; product market; labour market; financial system; market size; business dynamism; innovation capability.	score	y_1
Global Knowledge Index (https://knowledge4all.com/Methodology.aspx?language=en)	134	Pre-university education; technical, vocational education and training; higher education; research, development and innovation; information and communication technologies; economy; general enabling environment.	value	y_2
Human Development Index (http://hdr.undp.org/en/content/human-development-index-hdi)	189	Life expectancy at birth; expected years of schooling; mean years of schooling; gross national income (GNI) per capita.	value	y_3
Prosperity index (https://www.prosperity.com/rankings)	167	Safety and Security; personal freedom; governance; social Capital; investment environment; enterprise conditions; market access and infrastructure; economic quality; living conditions; health; education; natural environment.	score	y_4
The Social Progress Index (https://www.socialprogress.org/?tab=2&code=NOR)	149	Basic human needs; foundations of wellbeing; opportunity.	score	y_5
The Global Innovation Index (https://www.wipo.int/edocs/pubdocs/en/wipo_pub_gii_2019.pdf)	129	Institutes; human capital and research; infrastructure; market sophistication; business sophistication; knowledge and technology outputs; creative outputs.	score	y_6
GNI per capita (https://data.worldbank.org/indicator/NY.GNP.PCAP.CD)	200	The dollar value of a country's final income in a year, divided by its population.	US$	y_7
The OECD indicators of talent attractiveness. 'Highly educated workers' sub-index (https://www.oecd.org/migration/talent-attractiveness/; https://fragilestatesindex.org/indicators/e3/)	35	Workers with Master or Doctoral degrees.	score	X_1
The Fragile States Index. 'The Human Flight and Brain Drain' sub-index (https://fragilestatesindex.org/indicators/e3/)	178	The economic impact of human displacement (for economic or political reasons) and the consequences this may have on a country's development.	score	X_2
The Global Talent Competitiveness Index. 'Brain gain' sub-index (https://www.insead.edu/sites/default/files/assets/dept/globalindices/docs/GTCI-2019-Report.pdf)	125	High-skilled migration.	score	X_3
The Hays Global Skills Index. 'Labour Market Flexibility' sub-index (https://www.hays-index.com/)	34	The influence of governments on the policy of employing talented people from abroad.	score	X_4

Source: compiled by the authors.

The choice of international indices is justified on the basis of the theoretical analysis of the essence of migration of highly qualified workers (Literature Review). Therefore, the authors selected international indices, the calculation methodology of which contains indicators related to assessing the attractiveness of countries for highly skilled migrants, brain drain and brain gain. These include OECD talent attractiveness indicators, the first comprehensive tool to identify the strengths and weaknesses of OECD countries

in their ability to attract and retain three categories of talented migrants: highly educated workers (those with Master's and doctoral degrees), foreign entrepreneurs and foreign university students. An important indicator of the migration of highly skilled workers is the Human Flight and Brain Drain Indicator, which assesses the impact of displacement on the country's economic development. Such migration can be both voluntary - due to the deteriorating economic situation in their country and the search for better opportunities abroad, and forced (persecution or repression). Estimates of this indicator should be interpreted on the basis that the lower the score is, the better it is. That is, a low score indicates an improvement in the area of brain drain and relative stability in this area, while an increase in the score negatively characterizes the situation with brain drain in a particular country.

The Global Talent Competitiveness Index contains the Talent Attraction sub-index, which in the context of national competitiveness should be considered both in terms of attracting foreign resources (through foreign direct investment) and talented people (through the migration of highly skilled workers). To assess the latter component, the indicator "brain gain" is used. The Hays Skills Index is an important tool for assessing the challenges that organizations face in finding the most in-demand skilled workers. As part of a study on the migration of highly qualified workers, the Labour Market Flexibility Sub-Index allows assessing the impact of governments on the efficiency of the labour market, in particular on the simplification of procedures for hiring talented people from abroad. The lower the value of this indicator is, the better the state policy is consistent with the dynamics of the labour market. Conversely, a higher score means that there are significant barriers to the employment of highly skilled migrants. To test the hypotheses about the relationship of the independent variables (X_1-X_4) and dependent variables that may be affected (Y_1-Y_7) in Table 2, we used the method of correlation-regression analysis with the calculation of Pearson's correlation coefficients in Excel environment. The STATISTICA data analysis package was used to further identify the patterns of influence of factor characteristics on the results in the form of competitiveness and GNI per capita. The combination of results made it possible to identify the most obvious links between the factors of migration of highly skilled workers to macroeconomic performance.

2. RESULTS

The relationship between the migration of highly skilled workers and individual international indices and economic growth was analysed on the example of 25 OECD countries in 2019, based on the calculation of Pearson's pairwise correlation coefficient (Table 3).

Table 3. The results of the correlation analysis of the relationship between the migration of highly skilled workers with global indices and GNI per capita

No.	*Country*	y_1	y_2	y_3	y_4	y_5	y_6	y_7	X_1	X_2	X_3	X_4
1.	Australia	78,7	61,3	0,77	78,64	88,02	50,34	54910	0,63	1	70,33	4,3
2.	Austria	76,6	64,7	0,75	80,26	86,40	50,94	51300	0,54	1,4	53,71	4
3.	Belgium	76,4	64,8	0,76	76,26	86,77	50,18	47350	0,53	2	58,8	3,7
4.	Canada	79,6	60,8	0,8	80,01	88,81	53,88	46370	0,61	1,7	78,86	4,1
5.	Chile	70,5	51,5	0,65	68,70	80,02	36,64	15010	0,46	3,8	60,97	6,5
6.	Czech Republic	70,9	57,5	0,75	73,43	84,36	49,43	22000	0,51	3	40,68	3,5
7.	Denmark	81,2	67,6	0,76	83,96	90,09	58,44	63240	0,57	1,9	56,41	3,5
8.	Estonia	70,9	59,9	0,78	76,31	83,98	49,97	23220	0,55	4,3	44,82	*
9.	Finland	80,2	69,7	0,8	82,39	89,56	59,83	49580	0,54	2	48,54	*
10.	Germany	81,8	64,6	0,75	81,14	88,84	58,19	48520	0,57	2,1	76,22	6,9
11.	Greece	62,6	47,2	0,69	66,51	82,48	38,90	20320	0,4	3,3	13,74	*
12.	Hungary	65,1	52,9	0,68	65,93	78,77	44,51	16140	0,49	3,6	26,51	*
13.	Latvia	67	54,3	0,71	69,94	80,42	43,23	17730	0,46	5,1	21,24	*
14.	Luxembourg	77	69,1	0,69	80,95	87,66	53,47	73910	0,58	1,7	86,4	3,6
15.	Mexico	64,9	47,2	0,61	59,53	71,51	36,06	9430	0,38	5,3	45,99	7,1
16.	New Zealand	76,7	62,6	0,78	81,24	88,93	49,55	42670	0,61	2,3	80,31	4,1
17.	Norway	78,1	65,3	0,77	83,96	90,95	51,87	82500	0,58	1,3	68,32	*
18.	Poland	68,9	54,1	0,75	69,30	81,25	41,31	15200	0,45	4,7	26,03	6,8
19.	Slovak Republic	66,8	54	0,66	70,25	80,43	42,05	19320	0,53	4	15,93	*
20.	Slovenia	70,2	58,6	0,77	73,66	85,80	45,25	25750	0,58	3,6	25,67	*
21.	Sweden	81,2	69,1	0,8	83,04	89,45	63,65	55840	0,63	1,1	62,16	4,9
22.	Switzerland	82,3	73,2	0,76	83,64	89,89	67,24	85500	0,62	1,7	100	3,8

23.	Turkey	62,1	44,1	0,65	55,42	67,49	36,95	9610	0,35	4,7	28,36	*
24.	United Kingdom	81,2	67,5	0,78	80,70	87,98	61,30	42370	0,55	2,5	94,59	5,1
25.	United States	83,7	69,7	0,7	77,75	83,62	61,73	65760	0,59	1,9	91,93	4,8
26.	Correlation coefficient (X_1)	0,832	0,845	0,720	0,895	0,863	0,786	0,759				
27.	Student's critrion	7,192	7,578	4,976	9,622	8,192	6,097	5,591				
28.	Correlation coefficient (X_2)	-0,843	-0,806	-0,609	-0,838	-0,819	-0,763	-0,869				
29.	Student's criterion	|-7,516|	|-6,530|	|-3,682|	|-7,365|	|-6,845|	|-5,661|	|-8,423|				
30.	Correlation coefficient (X_3)	0,843	0,744	0,367	0,678	0,569	0,726	0,763				
31.	Student's criterion	7,516	5,340	1,892	4,424	3,318	5,063	5,661				
32.	Critical value (X_1, X_1, X_3)	2,069	2,069	2,069	2,069	2,069	2,069	2,069				
33.	Correlation coefficient (X_4)	-0,444	-0,608	-0,489	-0,636	-0,643	-0,475	-0,624				
34.	Student's criterion	|-1,854|	|-2,865|	|-2,098|	|-3,084|	|-3,141|	|-2,020|	|-2,988|				
35.	Critical value	2,145	2,145	2,145	2,145	2,145	2,145	2,145				

* data is not available

Source: Authors' calculations

According to the results of correlation analysis, it can be argued that the indicators of talent attractiveness, brain drain and brain gain significantly and strongly influence the Global Competitiveness Index, which is currently the most comprehensive (contains 113 variables) and objective (calculated WEF) indicator to determine a country's ability to compete with other countries. The exception is X_4, for which the correlation coefficient becomes -0.444 and is statistically not significant. At the same time, the direction of their influence differs. Thus, "Human Flight and Brain Drain" is a disincentive, i.e. the migration of highly qualified workers for employment abroad contributes to a decrease in both the Global Competitiveness Index and other global indices. Talent attractiveness and brain drain have a significant impact on the Global Knowledge Index (the value of the correlation coefficient exceeds |0,8|), which recognizes the multidimensional nature of the knowledge system in all contexts and applications related to economic and social structures. Less significant is the relationship between the migration of highly skilled workers and the Human Development Index, which can be explained by the indicators included in the methodology for calculating HDI. In particular, the level of literacy of the population is measured by the average number of years spent on training and the expected duration of training, i.e. the process of formation rather than the use of knowledge is assessed.

There is a significant relationship between the migration of highly skilled workers and the Prosperity Index, which is a measure of the extent to which a country's potential is realized in terms of both productive capacity and collective (social) well-being. Thus, creating a space in which a person can reach their full potential, be healthy, educated and live in a safe environment depends significantly on the level of attractiveness of the country for highly educated migrants and the level of brain drain (correlation coefficients 0.895 and -0.838, respectively). The results of the correlation analysis also revealed a significant relationship between the studied indicators and the Social Progress Index – a multi-indicator index that evaluates the social and environmental indicators of different countries. A feature of the methodology for calculating this index is that traditional economic indicators, such as gross domestic product, are supplemented by data on social and environmental conditions. Thus, the migration of highly skilled workers directly affects the quality of life of the country's population. Thus, in modern conditions, the country's competitiveness is determined by the effective use of knowledge and competencies, the activation of innovation processes based on them, the ability to generate and implement innovations in a timely manner. Today, innovation is an important factor that can ensure the country's high position in the global space. To determine the impact of migration of highly qualified workers on the level of innovation in countries, the authors used the Global Innovation Index. Since the correlation coefficients with the indicators X_1–X_3 exceed |0,7|, it can be argued that the country's innovative development strongly depends on the indicators of brain drain and brain gain, as well as on the attractiveness of the country for highly qualified immigrants.

The results of the correlation analysis prove the existence of a close relationship between the migration of highly skilled workers and economic growth, the basic indicator of which is the GNI per capita (Gross national income per capita (US dollars)). At the same time, the greatest impact on the level of economic growth is exerted by the brain drain (correlation coefficient -0.869), i.e. the growth in the number of emigrants with higher education creates obstacles to the sustainable economic development of the country. To segment countries by the level of migration of highly qualified workers, the authors conducted a cluster analysis using the package of processing and analysis of statistical information STATISTICA. Because the results of the correlation analysis revealed a weak relationship between X_4 and the dependent variables, this indicator was excluded from the clustering procedure. At the initial stage, the standardization of the initial data was carried out (Table 4), the purpose of which is to bring all indicators into a single measurement scale (Table 3) according to the formula:

$$Z_{ij} = \frac{x_{ij} - \bar{x}_{ij}}{\sigma_i}, \quad (1)$$

where Z_{ij} is the standardized value of the *i*-th indicator for the *j*-th country ($i=\overline{1,n}$; $j=\overline{1,m}$); $\bar{x}_{ij}$ – the arithmetic mean value of the *i*-th indicator for the *j*-th country; σ_i – standard deviation of the *i*-th indicator.

Table 4. Standardised Values of Source Data

No.		X_1	X_2	X_3
1.	Australia	1,2511	-1,3492	0,5888
2.	Austria	0,0974	-1,0493	-0,0521
3.	Belgium	-0,0308	-0,5996	0,1442
4.	Canada	0,9947	-0,8245	0,9177
5.	Chile	-0,9281	0,7495	0,2279
6.	Czech Republic	-0,2871	0,1499	-0,5545
7.	Denmark	0,4820	-0,6746	0,0520
8.	Estonia	0,2256	1,1243	-0,3949
9.	Finland	0,0974	-0,5996	-0,2514
10.	Germany	0,4820	-0,5247	0,8159
11.	Greece	-1,6972	0,3748	-1,5934
12.	Hungary	-0,5435	0,5996	-1,1009
13.	Latvia	-0,9281	1,7239	-1,3042
14.	Luxembourg	0,6102	-0,8245	1,2085
15.	Mexico	-1,9536	1,8738	-0,3498
16.	New Zealand	0,9947	-0,3748	0,9736
17.	Norway	0,6102	-1,1243	0,5113
18.	Poland	-1,0563	1,4241	-1,1194
19.	Slovak Republic	-0,0308	0,8994	-1,5089
20.	Slovenia	0,6102	0,5996	-1,1333
21.	Sweden	1,2511	-1,2742	0,2737
22.	Switzerland	1,1229	-0,8245	1,7329
23.	Turkey	-2,3381	1,4241	-1,0296
24.	United Kingdom	0,2256	-0,2249	1,5243
25.	United States	0,7384	-0,6746	1,4217

Source: authors' calculations

In the process of cluster analysis, the authors used the method of hierarchical agglomerative clustering, which involves the sequential grouping of objects into larger segments. Then the smaller clusters gradually merge into larger ones. Euclidean distance was used to determine the similarities or differences of countries, i.e. to calculate the distances between observations. To determine the distances between the clusters, Ward's method was chosen, which is based on the procedures of analysis of variance (AOV). With this method, small clusters are normally formed. The resulting dendrogram is shown in Figure 3.

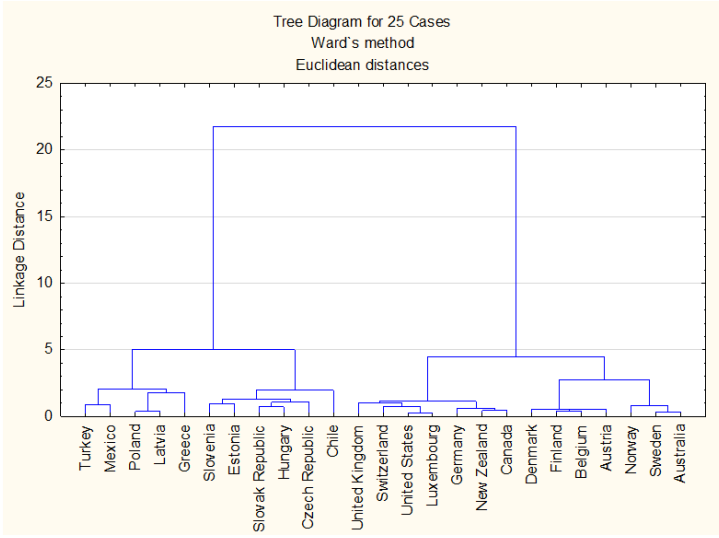

Fig. 3. Dendrogram of OECD countries on migration indicators of highly skilled workers

Source: authors' calculations

The final stage of cluster analysis is to check the quality of the clustering using discriminant analysis. The test resulted in the following statistics:

Wilks' Lambda = 0,02324;
approx. F (9,46) = 19,02631 p < 0,0000

The value of Wilks' statistics is always in the range from 0 to 1. Since the calculated value of Wilks' Lambda is close to 0, this indicates a high discrimination of objects. According to Wilks' Lambda and the value of the F-criterion, we can conclude that this classification is correct. However, to confirm the correctness of the classification, a classification matrix was formed (Fig. 4).

Classification Matrix (Spreadsheet1)
Rows: Observed classifications
Columns: Predicted classifications

Group	Percent Correct	G_1:1 p=,20000	G_2:2 p=,24000	G_3:3 p=,28000	G_4:4 p=,28000
G_1:1	100,0000	5	0	0	0
G_2:2	100,0000	0	6	0	0
G_3:3	100,0000	0	0	7	0
G_4:4	100,0000	0	0	0	7
Total	100,0000	5	6	7	7

Fig. 4. Classification matrix

Source: authors' calculations

Based on the data of the classification matrix, we can conclude that the objects in all four classes were correctly assigned expertly to the selected groups, which is confirmed by the absence of cases of incorrect assignment of objects to clusters. Therefore, clustering is correct. The obtained results confirm the fact of unevenness and asymmetry of the OECD countries' development according to the main indicators of global indices on migration of highly skilled workers, and are also the basis for finding directions of cluster convergence. The main tasks of the latter should be the state stimulation of brain drain by forming a policy of attracting highly qualified migrants, creating a single information system on the conditions and rules of legal employment abroad. Thus, brain drain and brain gain can be key factors in determining a country's level of competitiveness. Competitiveness is one of the most important prerequisites for economic development of the country, and human capital, i.e. the level of knowledge and skills, is a decisive factor in maintaining and increasing competitiveness. The quality of the workforce creates a country's ability to develop, expand, use knowledge and information in such a way as to make the country more competitive and improve the quality of life of its population.

To detail the relationship between the migration of highly skilled workers and the competitiveness of the country, as well as to confirm H1, the authors developed an appropriate economic and mathematical model using the built-in function "Regression" in Excel software. As a result of a step-by-step assessment of the impact of the parameters listed in Table 3 on the Global Competitiveness Index based on a multi-factor regression model, a three-factor model (2) was identified:

$$y = 57{,}482 + 27{,}478x_1 - 1{,}511x_2 + 0{,}114x_3, \quad (2)$$

where – y – Global Competitiveness Index, score; x_1 – OECD talent attractiveness indicator. Highly educated employees, score; x_2 – The fragility index of the country. Human flight and brain drain, score; x_3 – Global Talent Competitiveness Index. Brain gain, score.

The main statistical indicators that confirm the statistical significance and adequacy of this model are shown in Table 5.

Table 5. Results of checking the adequacy of the economic and mathematical model of global competitiveness according to the main statistical indicators

No.	*Indicators*	*Estimated value*
1.	Multiple correlation coefficient	0,936
2.	Coefficient of determination	0,875
3.	F-statistics	49,193
3.1.	The critical value for this model is F	3,07
4.	t-statistics	
4.1.	x_1	2,396
4.2.	x_2	|-2,165|
4.3.	x_3	3,962
4.4.	The critical value for this model is t	2,079

Source: authors' calculations

The obtained results of statistical indicators allow stating that the constructed three-factor model is characterized by high theoretical capacity and is suitable for practical use. Thus, the existence of a very close link between the migration of highly skilled workers and the country's competitiveness has been proven. At the same time, in modern conditions, the economic development of the country largely depends on the availability and level of human capital use. To detail the relationship between the migration of highly skilled workers and economic growth and to confirm H2, an appropriate economic and mathematical model was developed using the built-in "Regression" function in Excel software. As a result of a step-by-step assessment of the impact of the parameters listed in Table 3 on GNI per capita on the basis of a multifactor regression model, a two-factor model was identified (3):

$$y = 56522{,}38 - 11350{,}14x_2 + 279{,}73x_3, \quad (3)$$

where – y – GNI per capita, US USD; x_2 – the fragility index of the state. Human flight and brain drain, score; x_3 – Global Talent Competitiveness Index. Brain gain, score.

The main statistical indicators that confirm the statistical significance and adequacy of this model are shown in Table 6.

Table 6. The results of checking the adequacy of the economic and mathematical model of economic growth according to the main statistical indicators

No.	*Indicators*	*Estimated value*
1.	Multiple correlation coefficient	0,898
2.	Coefficient of determination	0,806
3.	F-statistics	45,817
3.1.	The critical value for this model is F	3,44
4.	t-statistics	
4.2.	x_2	|-5,051|
4.3.	x_3	2,419
4.4.	The critical value for this model is t	2,074

The obtained results of statistical indicators allow stating that the constructed two-factor model is characterized by high theoretical capacity and is suitable for practical use. Therefore, hypothesis H2 can be considered confirmed.

CONCLUSION

The results of the study confirm the close links between the migration of highly skilled workers and the competitiveness and economic growth of the country. In particular, the direct impact on the indicators of competitiveness and GNI per capita of such indicators as the level of attractiveness of the country for highly educated immigrants and brain gain, as well as the reverse effect of brain drain. The results of modelling these links suggest that in order to strengthen the competitiveness of their countries, governments should encourage the arrival of migrants with higher education. There is also a significant impact on economic growth in the case of highly skilled migrants, as the arrival of such professionals not only replenishes the intellectual capital of the recipient country, but also creates a competitive environment for indigenous people, motivating them to learn throughout life and constantly improve their skills. Therefore, further research should focus on the formation and implementation of public policy to create favourable conditions for immigration of such professionals, visa facilitation, development of both public and non-governmental services to support immigrants, providing appropriate conditions for living with families, training and care for the children of immigrants. Of course, it does not exclude the importance of efforts in other areas of public competitiveness management, including the indicators of social development we analysed. After all, the obtained connections with other indicators characterize the efficiency in creating favourable conditions for the country to be perceived as attractive for potential highly skilled migrants. But the dependences we have obtained allow understanding the directions of the policy of the state in this area, which will have the highest efficiency in the near future. Other links can be taken into account and used in macroeconomic management for the development of institutional support for proactive migration policy for highly qualified workers.

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