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Article

Competitiveness of higher education systems: Exploring the role of migration flow

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Abstract: Intellectual capital is one of the most crucial determinants of long-term economic development. The countries compete for highly skilled labor and talented youth. State regulatory interventions aim to, on the one hand, facilitate the retention of foreign high-productivity intellectual capital in the host country, transforming 'educational' and 'scientific' migrants into residents, and on the other hand, prevent the outflow of their own qualified workforce. The paper aims to outline the role of the nation's higher education system in the influx and outflow of labor resources. A two-stage approach is applied: 1) maximum likelihood—to cluster the EU countries and the potential candidates to become members of EU countries based on the integrated competitiveness of their higher education systems, considering quantitative, qualitative, and internationalization aspects; 2) logit and probit models—to estimate the likelihood of net migration flow surpassing baseline cluster levels and the probability of migration intensity changes for each cluster. Empirical findings allow the identification of four country clusters. Forecasts indicate the highest likelihood of increased net migration flow in the second cluster (66.7%) and a significant likelihood in the third cluster (23.4%). However, the likelihood of such an increase is statistically insignificant for countries in the first and fourth clusters. The conclusions emphasize the need for regulatory interventions that enhance higher education quality, ensure equal access for migrants, foster population literacy, and facilitate lifelong learning. Such measures are imperative to safeguard the nation's intellectual potential and deter labor emigration.

Keywords: education; literacy; knowledge; labor emigration; competitiveness

1. Introduction

The growing competitiveness within the global intellectual capital market prompts governments to establish favorable circumstances that facilitate the movement of highly skilled labor. Reports on international migration (International Organization of Migration, 2022; Veeramoothoo, 2022) indicate a rising surge in educational migration. This phenomenon offers migrants the prospect of accessing high-quality education, consequently bolstering their marketability within the workforce (Veeramoothoo, 2022). Concurrently, for the host nation, this translates into an opportunity to draw in fresh reserves of intellectual capital, acting as a cornerstone for future progress. Given this scenario, governments are actively formulating and revising educational development strategies to harmonize with the prevailing trends and challenges within the worldwide economic landscape. The asymmetry of intellectual capital migration flows between economically developed and developing

countries imposes constraints on the innovation (Dalati et al., 2020) and economic growth of less developed nations (Galor and Moav, 2004; Sultana et al., 2022; Payab et al., 2023). The competition for highly skilled labor resources intensifies with each passing year. Economically advanced countries contribute to enhancing the efficiency of their education systems and facilitating the swift integration of migrants into the multicultural environment of the host country, thereby mitigating social, economic, and cultural barriers.

In each country, specific mechanisms and tools for attracting intellectual capital are in place: educational system reforms (Skvarciany and Vidžiūnaitė, 2022; Byrkovych et al., 2023; Owusu et al., 2023); increased government spending on education (Dementyev and Kwilinski, 2020; Kwilinski et al., 2022); engagement of the business sector in education (Akimov et al., 2020; Kwilinski et al., 2021; Miśkiewicz et al., 2021); implementation of scholarship programs (Dzwigol et al., 2020; Szczepańska-Woszczyna and Gatnar, 2022; Kwilinski, 2023); establishment of grants for scientific research (Kharazishvili et al., 2021); and creation of networks of research and design laboratories (Dzwigol, 2019a, 2019b, 2021a, 2021b, 2022, 2023; Prokopenko and Omelyanenko, 2020). It should be noted, that a multitude of worldwide initiatives are currently in progress, placing a strong emphasis on the internationalization of education and the promotion of academic mobility. These efforts involve the meticulous administration of various scholarships and grant programs, including renowned initiatives such as Erasmus and Jean Monnet. These initiatives have significant implications for the relationship between educational internationalization, academic mobility, and the movement of people across borders, as evidenced in prior research (Dzwigol et al., 2020; Szczepańska-Woszczyna and Gatnar, 2022; Kharazishvili et al., 2021).

For instance, the Lisbon European Council (Blue Card Network, 2021) set the goal for the Community in March 2000 to become the most competitive and dynamic knowledge-based economy capable of sustainable economic growth (Pudryk et al., 2023) with more jobs and greater social solidarity. Taking these premises into account, in October 2007, the European Commission adopted the Framework Directive for the purpose of the admission of skilled and educated migrants to the EU, which became the initial version of the EU Blue Card Directive. Additionally, a directive to simplify migration procedures by unifying applicant processes was introduced. In 2009, the European Council adopted the EU Blue Card directive, followed by the Single Permit Directive in 2011 (Blue Card Network, 2021). It should be noted that scholars (Kharazishvili and Kwilinski, 2022; Miśkiewicz et al., 2022; Kwilinski, 2023; etc.) have outlined that digitalization, the internationalization of education, contributes to the migration of intellectual capital, with the goal of achieving equal access to quality education. One of the ways to minimize the outflow of intellectual capital is by enhancing the quality of education within the country. This paper aims to outline the role of the nation's higher education system in the influx and outflow of labor resources. The paper fills the scientific gap in linking migration and the education system by developing approaches 1) to cluster the analysed countries based on the integrated competitiveness of their higher education systems, considering quantitative, qualitative, and internationalization aspects based on maximum likelihood and 2) to estimate the likelihood of net migration flow surpassing baseline cluster levels and the

probability of migration intensity changes for each cluster based on logit and probit models.

The paper has the following structure: review of literature—exploring the theoretical landscape on linking migration and efficiency of education system in the country to justify the research hypothesis; methodology—describing the stage of the investigation, explaining the methods and instruments to check the research hypothesis; findings—explaining the results of the investigation; discussion—outline the obtained findings and comparison analysis of the obtained results with the past studies; conclusion—describing the core results of investigation, policy implications, limitations and further directions for future investigations.

2. Review of the literature

Scholars (Artuc et al., 2015; Hassan et al., 2022) argue that one-third of all migration flows are directed towards countries that are not part of the Organization for Economic Cooperation and Development. Using a gravity model, Artuc et al. (2015) analyse the influence of education, historical affiliations, and gender factors on the migration of intellectual capital. Saravia and Miranda (2004) establish that contemporary economic development is knowledge-based, which leads to intensified migration of intellectual capital due to the unmet societal and sectoral needs for higher education. Saravia and Miranda (2004) emphasize that the higher education system acts as a channel for labor migration from less to more developed countries. Scholars identify that the possibility of obtaining high-quality education encourages brain drain, negatively impacting a country's future economic and innovative growth. In light of this, Saravia and Miranda (2004) stress that less developed countries should incorporate innovative ideas in their education systems, establish networks of research laboratories, and increase research funding in strategically important knowledge domains.

Based on the results of regression analysis, Docquier and Rapoport (2012) indicate that the education gap between migrants and residents typically widens with the difference in earnings between destination and source countries of highly skilled migrants. On the other hand, the relative abundance of highly skilled migrants in the destination country increases with the wage difference among workers depending on their qualification level. This correlation strengthens when adjusting the wage differential to account for taxes. Researchers Ka and Xiao (2016) identify that intense global competition for intellectual capital, coupled with low-quality education and research in higher education institutions in China, drives the intensified emigration of Chinese students, particularly those with financial means, to pursue higher education abroad. It is noteworthy that in response to the brain drain challenge, the Chinese government has ramped up processes of higher education internationalization, enhancing education quality through training and incorporating new ideas and best global practices, including the encouragement of transnational higher education development to reshape the higher education landscape. Beine et al. (2003) explored the relationships between the education of migrants and human capital development. Using data from 50 countries, researchers identified a slowdown in economic growth in countries where the coefficient of intellectual capital migration exceeds 20% and/or

where the share of people with higher education exceeds 5%. Welch and Zhen (2008), investigating the phenomenon of Chinese scholars in Australian universities, concluded that the emigration of scholars results in both positive and negative effects for both the country of origin and the destination country. Specifically, the emigration of highly skilled Chinese individuals fosters connections between China and their destination country. Past studies (Miyagiwa, 1991; Usman et al., 2022; El Morabety and El Morabety, 2022) have confirmed the hypothesis that brain drain enhances the education and income of migration destination countries. Additionally, technology and knowledge transfer due to circular migration increases labour productivity and the quality of education in the destination country.

Haupt and Janeba (2009) confirmed the hypothesis that brain drain has a statistically significant impact on the redistribution of income between skilled and unskilled workers. They found that the reduction in migration costs initially contributes to an increase in the net income for both skilled and unskilled workers but then leads to a decrease in net income for all households. The crucial factor in income differentiation is the level and quality of education of labor resources. Odhiambo (2013), through the example of Kenya, investigated the reasons and motives for the brain drain from the country. Odhiambo (2013) identified that the government should implement practices to disseminate the best experiences of returning emigrants. Additionally, in this context, the researcher emphasizes the expansion of retraining programs for re-emigrants. Hornstein and Taylor (2018) analysed migration processes in Croatia that intensified after joining the European Union and systematized the directions for restricting the brain drain from the country. One of the key mechanisms for reducing the number of emigrants is reforming the education system and implementing employment programs for young people. Furthermore, Hornstein and Taylor (2018) emphasized the need to strengthen informal education, particularly lifelong learning. Ionescu and Polgreen (2009), while investigating the relationship between state spending on education and the emigration of American youth between states, identified a positive statistically significant correlation among the studied parameters. The results indicated that investment in higher education attracts students to the country/state. Thus, if a state does not benefit from increasing funding for higher education, a positive relationship between state spending in this area and student emigration after completing their studies becomes evident (Sina et al., 2020). However, this relationship can transform into a reversed one if state expenditures for education development yield the expected effects (increasing intellectual capital within the country, conducting scientific research, developing innovative technologies, etc.).

Djajić et al. (2019) investigated the relationship between state expenditures on education and the intensity of intellectual capital outflow from the country. The scholars identified a causal relationship between state spending on education and the intentions of young people to seek employment abroad. The scholars Justman and Thisse (1997) confirmed the hypothesis that the mobility of intellectual capital negatively affects state education funding. This, in turn, leads to a reduction in state investment in the development of intellectual capital. Djajić et al. (2012) examined youth mobility and identified that one mechanism to limit their emigration is the introduction of a state subsidy program for education in the source countries, as well as the imposition of restrictions on cross-border migration in destination countries. In

this context, Stark and Wang (2002) justified mechanisms for the interchange and optimal combination of migration and education subsidies in both source and destination countries. Pires (2015), in addition to brain drain issues, investigated the phenomenon of "brain waste." Pires (2015) concludes that for source countries, migration reduces incentives for youth to obtain education and improve their skills. For destination countries, the increase in the number of immigrants leads to an influx of unskilled labor. In this regard, state educational policies that provide subsidies for students ensure the growth of intellectual capital in the source country (Forid et al., 2020). It has been demonstrated that effective state educational policies and equal access to education for both residents and immigrants contribute to the transnational transfer of knowledge (Dzwigol et al., 2023; Kwilinski et al., 2022a), best practices (Vaníčková et al., 2020; Dacko-Pikiewicz, 2019; Dzwigol et al., 2021; etc.), and innovative technologies (Prokopenko et al., 2018; Kwilinski, 2019; Kwilinski et al., 2022b; etc.).

Akindipe (2020), using Nigeria as an example, confirmed the hypothesis regarding the relationship between state funding for education, the number of strikes by higher education faculty, and the number of emigrants whose purpose is education. Based on the results obtained, Akindipe (2020) suggests increasing state funding for education and strengthening cooperation between higher education institutions and the business sector. Researchers Chadha et al. (2016) confirm the hypothesis that the quality of higher education significantly influences the number of emigrants of highly skilled labor resources in India. Torrisi and Pernagallo (2020) provide an assessment of the nature and strength of the impact of job satisfaction among scientific collaborators on their tendency towards emigration. The analysis focuses on Italian researchers who emigrated abroad and those who work in Italy. Baruch et al. (2007) identified the main motivations for youth to stay in the destination country: self-improvement, educational quality, and diaspora support.

Considering the abovementioned analysis, this study checks the following hypothesis:

Hypothesis 1: The competitiveness of the national higher education system affects the attraction of new labor resources to the country and reduces their emigration abroad.

3. Methodology

The object of investigation is EU countries and the potential candidates to become members of EU countries for 2010–2020. All data were generalized from the following open databases and agencies: World Data Bank (2023) and United Nations Development Programme (2023). Based on past studies (Pudryk et al., 2023; Kwilinski et al., 2022c; Hussain et al., 2021; etc.), this investigation applies the maximum likelihood method (MLM) (Equation (1)) to cluster EU countries based on the competitiveness of national higher education systems:

$$f(x) = \left(\frac{1}{(2 \times \pi)^{\left(\frac{q}{2}\right)} |\Sigma|^{\left(\frac{1}{2}\right)}}\right) \times \exp\left\{-\frac{1}{2} \times (x-\mu)^T \times \Sigma^{-1}(x-\mu)\right\} \quad (1)$$

where, x—vector representing the competitiveness of national higher education systems; q—number of features; μ—vector of means, representing the average

competitiveness in each feature; Σ—covariance matrix of the vector of parameter means x; $|\Sigma|$—determinant of the covariance matrix; T—transpose operator; $\sigma^2 = (x-\mu)^T \times \Sigma^{-1}(x-\mu)$—Mahalanobis distance.

The MLM is a statistical technique that seeks to group data points into distinct clusters based on their likelihood of belonging to a particular cluster. This method operates on the principle that data points within the same cluster share similar statistical characteristics, and by estimating the likelihood of observations belonging to certain clusters, it allows for the identification of these underlying patterns. The clustering parameters included the following indicators (**Table 1**): students in tertiary education—as % of total population (X1); the quality of higher education based on the Global Competitive Index (X2); the education quality index according to the Human Development Index (X3); and mobile students from abroad enrolled by education level (X4).

Table 1. Clustering parameters for assessing the competitiveness of national higher education systems.

Country	X1	X2	X3	X4	Country	X1	X2	X3	X4
Belgium	4.5	5.9	0.9	52,143	Malta	3.3	4.8	0.824	1999
Bulgaria	3.3	4.5	0.779	16,499	Austria	4.8	5.6	0.866	74,631
Czechia	3	5.1	0.89	45,871	Poland	3.8	5.1	0.866	55,191
Denmark	5.3	5.8	0.921	32,371	Portugal	3.6	5.2	0.763	35,755
Germany	4	5.6	0.943	333,133	Romania	2.7	4.5	0.762	30,294
Estonia	3.4	5.5	0.882	5043	Slovenia	3.7	5.4	0.899	5071
Ireland	4.7	5.6	0.918	24,913	Slovakia	2.6	4.6	0.824	12,730
Greece	7.4	4.8	0.833	27,789	Finland	5.4	6.1	0.927	23,794
Spain	4.4	5.1	0.838	77,062	Sweden	4.2	5.7	0.914	30,912
France	4	5.3	0.812	246,378	Iceland	5.1	5.7	0.918	1546
Croatia	4	4.6	0.803	5722	Norway	5.4	5.8	0.928	12,399
Italy	3.2	4.8	0.791	54,855	Switzerland	3.7	6	0.9	55,698
Cyprus	5.7	4.9	0.827	13,085	United Kingdom	3.9	5.6	0.918	489,019
Latvia	4.2	5.1	0.883	8380	Serbia	3.6	4.3	0.783	11,505
Lithuania	4	5.3	0.89	6697	Turkey	9.5	4.6	0.727	154,505
Luxembourg	1.2	4.9	0.802	3455	Ukraine	3.1	5	0.792	54,382
Hungary	2.9	4.6	0.819	35,479					

Considering the studies (Kwilinski et al., 2023; Prokopenko et al., 2014), the probability of a country's inclusion in the respective cluster was carried out using algorithms for computing expected estimates of model parameters and maximizing the logarithmic likelihood function of its statistical distributions. This approach helps mitigate the issue of latent variables and incomplete data on the initial model parameters.

The estimation of the probability of exceeding the net migration flow in countries of the respective clusters over its volume in the baseline cluster, as well as the probability of changing the intensity of migration processes for each cluster, was conducted using logit and probit models (Grubanov-Boskovic et al., 2021; Drożdż et al., 2021). The logit model is based on the logistic function and transforms the linear combination of predictor variables into a probability value that ranges between 0 and 1. It models the log-odds of the probability of a binary outcome. The logit model can be represented as:

$$\ln\left(\frac{p}{1-p}\right) = \beta_0 + \beta_1 Y \quad (2)$$

where p—the probability of the binary outcome; Y—predictor variable; β_0, β_1—coefficients to be estimated.

Similar to the logit model, the probit model also transforms the linear combination of predictor variables into a probability value. However, it uses the cumulative distribution function of the standard normal distribution (the "probit" function) to model the relationship. Mathematically, the probit model can be represented as:

$$p = \Phi(\beta_0 + \beta_1 Y) \quad (3)$$

where p is the probability of the binary outcome and Φ is the cumulative distribution function of the standard normal distribution.

Based on Equations (2) and (3), the comprehensive model for evaluating the probability of surpassing migration flow thresholds and alterations in migration intensity across distinct clusters is presented as follows:

$$M_i^* = \alpha_i Y_i + w_i \quad (4)$$

$$\begin{cases} M_i = 0, \text{if } M_i^* < 0, \\ M_i = 1, \text{if } M_i^* \geq 0. \end{cases} \quad (5)$$

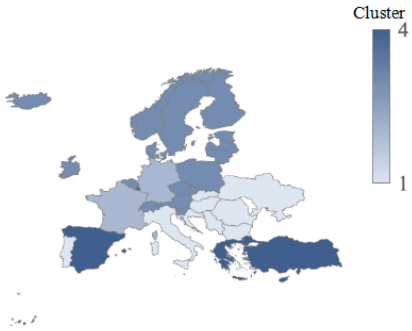
where M_i^*—net migration flow in country i over the last five years; Y_i—the higher education competitiveness in country i of each cluster; α_i—calculated coefficient of the model; and w_i—stochastic error of the model.

Mode Equation (4) estimates the coefficients α_i through methods such as maximum likelihood estimation, aiming to find the parameter values that best fit the observed data and maximize the likelihood of the observed outcomes.

4. Findings

The empirical findings allow the identification of four clusters of countries (**Figure 1**). Within the first cluster comprising Bulgaria, Croatia, Italy, Hungary, Malta, Portugal, Romania, Slovakia, Serbia, and Ukraine, a noteworthy evolution is occurring in the realm of higher education management. These nations are undergoing a significant departure from the conventional model of centralized state control, transitioning towards a more decentralized framework that accentuates institutional autonomy. This shift underscores an increasingly acknowledged awareness of the advantages linked with endowing universities and higher education institutions with increased self-governance and flexibility. This evolving trend not only reflects a reevaluation of the traditional governance structures within these countries but also signals a broader recognition of the critical role that institutional autonomy plays in fostering innovation, competitiveness,

and responsiveness within higher education. By granting institutions more flexibility, these countries are positioning themselves to better harness the potential of their higher education sector as a catalyst for innovation, economic growth, and cultural advancement.



Cluster	Country (probability of entering the cluster)
1	Bulgaria (1.00*), Croatia (0.96*), Italy (0.96*), Hungary (0.99*), Malta (0.95**), Portugal (0.97*), Romania (1.00*), Slovakia (0.98*), Serbia (1.00*), Ukraine (0.94**)
2	Germany (1.00*), France (1.00*), United Kingdom (1.00*)
3	Belgium (1.00*); Czech Republic (0.98*), Denmark (1.00), Estonia (1.00*), Ireland (1.00*), Latvia (0.99*), Lithuania (1.00), Austria (1.00*), Poland (0.89), Slovenia (1.00*), Finland (1.00*), Sweden (1.00*), Iceland (1.00*), Norway (1.00*), Switzerland (1.00*)
4	Greece (1.00*), Spain (0.96*), Cyprus (1.00*), Luxembourg (1.00*), Turkey (1.00*)

Figure 1. Results of country clustering based on the overall level of competitiveness of the national higher education system.

Note: The probabilities of entry into the cluster are indicated in brackets, *, **—statistical significance at the 1% and 5% levels, respectively.

The second cluster includes 3 countries (Germany, France, and the United Kingdom). Key elements of the educational policy in countries of this cluster include ample opportunities for state funding of educational and scientific reforms in higher education, institutional autonomy of higher education institutions in terms of fund allocation, well-developed university management, strong interaction between the academic environment and the entrepreneurial sector, high quality of research, and the potential of academic staff. The third cluster comprises 15 European countries (Belgium, Czech Republic, Denmark, Estonia, Ireland, Latvia, Lithuania, Austria, Poland, Slovenia, Finland, Sweden, Iceland, Norway, Switzerland). The countries in this cluster are actively implementing reforms in higher education, and the number of private educational institutions is increasing. The fourth cluster consists of 5 countries (Greece, Spain, Cyprus, Luxembourg, Turkey). The educational policy characteristics in countries of this cluster include a focus on state-targeted development of higher education institutions and the allocation of state financial resources based on the achievement of these targets.

The empirical results (**Table 2**) indicated that the projected probability of an increase in net migration flow is the highest in countries of the second cluster (66.7%) and is significant enough in countries of the third cluster (23.4%). However, for countries in the first and fourth clusters, the probability of this increase was statistically insignificant.

Table 2. The probability of changes in the intensity of migration processes in a country depends on the probability of its inclusion in the respective cluster based on the competitiveness of the national higher education system.

Cluster	Logit-model		Probit-model	
	Coefficient	**Probabilities**	**Coefficient**	**Probabilities**
The probability of the net migration flow of the respective cluster exceeding the net migration flow of the first cluster				
2	2.891	0.074	1.712	0.064
3	0.811	0.512	0.439	0.501
4	0.811	0.598	0.439	0.599
The probability of further changes in net migration flow				
1	0.101	0.292	0,101	0.292
2	0.667	0.014	0.667	0.014
3	0.234	0.053	0.234	0.053
4	0.221	0.264	0.221	0.264

The empirical results indicate that the higher education model functioning in Ukraine does not contribute to attracting highly productive intellectual capital from abroad. In contrast, it increases the risks of "intellectual labor emigration" (brain drain). For instance, the probability of net migration flow in Germany, France, and the United Kingdom exceeding that in Ukraine (and other countries in the second cluster) is maximum, reaching 2.89 (logit model) and 1.71 (probit model). Moreover, there is no probability (prob. = 0.292) for Ukraine, indicating the statistical insignificance of the result that the net migration flow will change in the future due to prospective changes in the higher education system. Conversely, this probability is quite high for countries in the second and third clusters. The findings highlight the necessity of strengthening regulatory interventions to improve the quality of higher education, ensure equal migrant access to it, promote population literacy, and provide opportunities for its enhancement in line with the "lifelong education" concept. These steps are crucial to preserve the nation's intellectual potential and prevent labor emigration.

5. Discussion

In comparison to previous studies (Bilan et al., 2020; Oliinyk et al., 2021), the current research highlights the pivotal role of a nation's higher education system's competitiveness level in shaping labor migration dynamics. This study utilized a sophisticated approach by employing clustering techniques that integrated algorithms for calculating expected parameter estimates within a statistical model and optimizing the logarithmic likelihood function of its statistical distributions. In contrast to prior research (de Wit, 2019), this investigation distinguished and categorized countries into four clusters based on their higher education competitiveness. Notably, the initial cluster showcased a remarkable shift from state control to institutional autonomy within higher education institutions—a transformation that was not as explicitly detailed in prior studies (Kabók et al., 2017; Mukhamedov et al., 2020; Buser et al., 2021). Furthermore, the findings from logit and probit modelling shed light on the substantial likelihood of net migration flow surpassing that of Ukraine in countries

such as Germany, France, and the United Kingdom. These probabilities were notably higher, with values of 2.89 (logit model) and 1.71 (probit model), underscoring the heightened attractiveness of these countries for skilled migrants. In contrast, the previous study (Mukhamedov et al., 2020) might not have emphasized these specific clusters and their associated migration probabilities to such a significant extent. Moreover, the analysis also indicated that prospective changes in Ukraine's higher education system might not statistically impact its net migration flow, which offers a fresh perspective when compared to past studies that might have examined migration prospects solely from an economic or demographic standpoint.

This study's innovative methodology, clustering technique, and emphasis on specific clusters' migration probabilities provide an enriched understanding of the relationship between higher education competitiveness and labor migration. These findings differentiate this research from previous (Heywood and Wei, 2004; Buser et al., 2021) studies and contribute to a more comprehensive understanding of the intricate dynamics governing skilled labor movement.

6. Conclusion

This empirical investigation explores the relationship between the competitiveness of a country's higher education system and its impact on net migration flow. The study employs advanced clustering methods to categorize countries based on their higher education competitiveness, revealing four distinct clusters with varying reform approaches. The findings suggest that certain clusters, such as Germany, France, and the UK, exhibit a higher likelihood of attracting skilled migrants, while the study underscores the need for regulatory measures to preserve human capital and counter labor emigration challenges. To enhance the competitiveness of higher education systems and reduce net migration flow in EU countries and Ukraine, several policy implications could be outlined:

1) Implement comprehensive reforms to enhance the quality of higher education institutions. Focus on curriculum modernization, research infrastructure, and pedagogical approaches that foster innovation and critical thinking (Wróblewski and Dacko-Pikiewicz, 2018). Encourage collaboration between academia and industry to align education with market needs (Kotowicz et al., 2022; Saługa et al., 2020, 2021). Increase investment in research and development, as thriving research environments attract both local and international talent (Kwilinski et al., 2020; Prokopenko and Miśkiewicz, 2020). Establish research centers, provide competitive research grants, and foster an environment that promotes cutting-edge discoveries (Dzwigol, 2022).
2) Develop strategies to enhance internationalization, such as attracting foreign students and scholars. Offer scholarships and exchange programs to create a diverse academic community that fosters cross-cultural learning and collaboration (Pudryk et al., 2023). Ensure equal access to quality education for all, irrespective of socioeconomic background.
3) Develop lifelong learning initiatives that allow individuals to enhance their skills throughout their careers. These initiatives take the form of online courses, workshops, and certification programs that cater to professionals at different

stages of their careers. Encouraging a culture of continuous education, upskilling, and reskilling is crucial in maintaining a workforce that remains competitive and adaptable to the ever-evolving landscape of job requirements (Zhanibek et al., 2022; Rybnikova et al., 2022). By promoting a mindset of lifelong learning, both EU countries and Ukraine can ensure that their workforce remains up-to-date with industry advancements and can seamlessly transition to new roles as the economic landscape shifts.

4) Establish programs that entice skilled individuals to return to their home countries after completing studies or working abroad. Provide incentives such as research grants, attractive employment opportunities, and supportive ecosystems for entrepreneurship (Pudryk et al., 2023).

5) Collaborating closely with labor market stakeholders is essential to ensure that higher education systems are producing graduates equipped with the skills and knowledge needed by industries. Establishing strong partnerships with businesses, industries, and professional organizations allows universities to gain insights into current and future workforce needs. Developing flexible curricula that respond to emerging job trends and technologies is a crucial aspect of this collaboration. Higher education institutions should regularly review and update their course offerings to integrate the latest advancements and industry developments. This can involve creating interdisciplinary programs, offering specialized tracks within existing degrees, or introducing new courses that address cutting-edge topics. Furthermore, universities could establish advisory boards composed of industry experts, entrepreneurs, and alumni to provide guidance on curriculum design and program development. These boards could offer insights into the skills and competencies that are in demand and help ensure that graduates are well prepared to contribute effectively in their chosen fields.

Despite the valuable findings, several limitations should be acknowledged in this study. First, the clustering approach relies heavily on the chosen parameters and indicators, which might not capture the full complexity of higher education systems' competitiveness. Additionally, the study's timeframe (2010–2020) might not encompass all relevant changes in the education landscape. Second, the models used to predict migration flows are based on certain assumptions and simplifications, potentially leading to oversight in capturing all influencing factors accurately. Last, the study's focus on EU countries and Ukraine might limit the generalizability of findings to other regions with different socioeconomic and educational contexts, such as Asian countries and the USA.

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