The Impact of the War on Ukrainian Higher Education: Forecasting Student Migration Using an ARIMA Model

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Abstract: In this study, we proposed scientific and methodological approach involves forecasting the number of migrants using the ARIMA model, combining the following steps: formation of the research information base; identification of the structural form of the ARIMA model; model evaluation and verification of its adequacy; forecasting. For the empirical study, the determinant "total outbound internationally mobile tertiary students studying abroad, both sexes, Ukraine" for 2004-2024 was taken, according to UNESCO data. The results obtained demonstrated a stable upward trend in migration processes from the 2000s to 2019, with a significant increase in the period 2014-2018, triggered by the 2008 crisis and the escalation of the armed conflict in eastern Ukraine in 2014. However, in 2019, a decline in the number of Ukrainian students abroad was observed, attributed to the onset of the COVID-19 pandemic. As a result of the full-scale Russian invasion of Ukraine in 2022, a substantial increase in academic migration became evident. Forecast values indicate that the number of student youth migrants will reach 132,462 in 2025, 146,610 in 2026, 158,456 in 2027, 168,375 in 2028, and 176,681 in 2029. Forecasting migration flows can assist government agencies in developing effective migration policies aimed at attracting international students and planning higher education policies, including funding, infrastructure, and student support.

Keywords: Higher education, student migration, war impact, forecasting, ARIMA model.
JEL Classification: I20, J24, C53.

1. INTRODUCTION

Student migration is a complex and multifaceted phenomenon that has attracted significant attention from researchers, policymakers, and society at large. This phenomenon influences the socioeconomic development of both individual countries and the global community, shaping new trends in education, culture, and economics. In the context of the modern world, where globalization and integration processes are accelerating, Ukrainian students are increasingly choosing to study abroad. This is driven by a number of factors, including the pursuit of higher quality education, the desire for international experience, the enhancement of competitiveness in the labor market, and social mobility. Despite the growing popularity of international education, the process of Ukrainian student migration is accompanied by a number of challenges and complexities. The war in Ukraine, which began in 2014 (with Russia's full-scale invasion in 2022), has been a defining factor that has significantly impacted the country's educational policies, economy, and social structure. The conflict has led to massive losses of human resources, particularly among the younger generation, who are leaving the country in search of a safer and more stable environment for their studies. This process has not only been a response to pressing needs for personal and professional development but has also been a consequence of the exacerbation of the socio-political situation in Ukraine. In the context of an ongoing armed conflict, student migration is taking on new dimensions. Alongside traditional motivations such as quality of education and employment prospects, students are also grappling with issues of safety, access to resources, and social support. These factors significantly influence their decisions regarding studying abroad, which in turn has serious implications for the country's demographic situation and intellectual potential. The scholarly literature on student migration examines this issue from various perspectives, including the economic, social, and cultural implications. However, in Ukraine, the topic of educational migration remains understudied, highlighting the need for

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in-depth research. The aim of this article is to quantitatively assess the actual and potential scale of student youth migration in Ukraine.

Forecasting student migration enables us to understand how changes in the number of students studying abroad will affect Ukraine's economy, particularly expenditures on education and social programs. Forecasting the scale of migration can help identify potential risks, such as a "brain drain," and determine opportunities for developing the domestic education system to attract students back to the country. Based on forecasts, the government can develop effective strategies and programs aimed at supporting students studying abroad to encourage their return to Ukraine. Forecasts can serve as a foundation for developing educational policies that take into account the needs of the labor market and anticipated trends in Ukrainian students' education. Understanding the scale of Ukrainian student migration facilitates the development of international cooperation programs, exchanges, and partnerships between universities. Based on forecasts, support programs can be created for students studying abroad to ensure their adaptation and increase their chances of a successful career. Forecasts can serve as a foundation for further research into the impact of migration on the country's socioeconomic development, as well as for studying trends in education. Thus, forecasting the scale of Ukrainian student migration is a crucial tool for decision-making at various levels: from government agencies to higher education institutions. Therefore, forecasting the educational migration of Ukrainian students is highly relevant and timely, as it allows us to understand the challenges faced by the state, higher education institutions (HEIs) during wartime, and to identify ways to optimize educational policies in order to support national development and stability.

2. LITERATURE REVIEW

The issue of rapid transformations in educational migration occupies a significant place in contemporary globalization studies, as they shape new opportunities for the development of the international educational space and impact national labor markets. These changes can have both positive and negative consequences. Significant negative changes have occurred in Ukraine's economy due to educational youth migration. Research, such as Shevchuk (2021), has described the fiscal losses from Ukrainian youth migration at the international level, including decreased tax revenues and social security spending. Gurkov (2018) in his article emphasizes that educational migration can lead to a "brain drain," where the most talented students leave the country, negatively impacting its economic development. However, he also notes that the return of students with international experience can lead to a "brain gain," positively influencing Ukraine's innovation potential (Gurkov, 2018). Mizik (2019) analyzes how student mobility impacts the Ukrainian economy. The researcher argues that the growing number of Ukrainian students studying abroad may reduce financial resources for higher education in Ukraine; however, if students return, their new knowledge and experience can become crucial for economic growth and development (Mizik, 2019). Ishchenko & Ponomarenko (2020) focus on the socio-cultural consequences of student migration. They note that international student mobility can foster cultural exchange and increase international ties, which in turn can positively impact Ukrainian society. It can also help improve intercultural communication and strengthen diplomatic relations (Ishchenko & Ponomarenko, 2020). Trofimova (2022) provides empirical evidence demonstrating how student migration affects various aspects of a country's development. Her research suggests that while there are risks associated with a "brain drain," the benefits of studying abroad can outweigh these risks, especially when students return with new knowledge and experience (Trofimova, 2022). A significant portion of research examines the issue through the lens of factors influencing educational migration. Studies indicate that, as Zakharchenko (2021) notes, students prefer countries with developed economies where there are opportunities for professional growth after graduation. Research by Martynyuk & Kostiuk (2020) also highlights that labor market instability in Ukraine leads to a heightened interest in studying abroad. Moreover, Ivanenko's (2022) work points to a correlation between the level of economic development and student emigration. Hanzia's (2023) research emphasizes that rising education costs in Ukraine compel students to seek more affordable alternatives abroad. The quality of higher education in Ukraine is a significant factor contributing to migration. As Koval et al. (2021) point out, insufficient funding for education and a low level of international accreditation of study programs lead students to choose to study in countries with high educational standards. Furthermore, Berezovska (2020) points to the need to improve the Ukrainian education system to enhance its attractiveness to young people. Moshenets' (2021) research examines the challenges of ensuring the quality of higher education and their impact on student migration. Romanchenco's (2023) study also emphasizes that inadequate quality of education can lead to negative consequences for emigration. Sociocultural aspects, such as the desire to integrate into an international environment and gain new cultural experiences, also influence Ukrainian students' decisions to study abroad. Yuanyuan Xia et al. (2022) underscore the critical importance of implementing reforms within educational personnel policies to effectively address the issue of teacher migration. Chaban et al. (2018) note that intercultural exchanges contribute to the development of interpersonal skills and cultural competence, making studying abroad attractive. Furthermore, Petrenko (2021) emphasizes the importance of social media for Ukrainian students in shaping their migration behavior. Lysenko (2020) adds that sociocultural benefits, such as networking with international students, significantly increase the motivation to study abroad. Fedorenkov (2022) highlights the research focus on the desire for intercultural communication and professional development as additional drivers of student migration. Political instability in Ukraine, including the war in the eastern part of the country and changes in the political situation, are also significant factors driving students to migrate. Gnatovich (2019) points out that the political situation and social upheavals force young people to seek safer conditions for studying. Melnyk's (2022) research discusses the consequences of war for young people, including opportunities for studying in Europe. Labunska (2023) emphasizes that political instability leads to a growing interest in international education among Ukrainian students. Kozak's (2023) research also indicates that political changes influence students' decisions to study abroad.

Bobrov (2022) notes that political instability drives students to seek educational stability abroad. According to statistics presented in the UNESCO report (2022), the number of Ukrainian students studying abroad is increasing. Approximately 40% of Ukrainian students plan to continue their studies at foreign universities (UNESCO. (2022). Research conducted by Frolova et al. (2023) highlights that European Union countries have become the most popular destinations for Ukrainian students. Hryshchuk (2023) analyzes the latest statistical data on Ukrainian student migration and its implications for the Ukrainian education system. Lapteva's (2023) research indicates that the increase in migration is linked to educational programs in Europe. Ostapchuk (2022) emphasizes the growing number of students choosing to study in North American countries.

The ARIMA model was first introduced by Box & Jenkins (1976) as a tool for analyzing and forecasting time series data. It combines an autoregressive process (AR), an integrated component (I) to remove trends, and a moving average (MA) to account for stochastic dependencies. The works of Hayashi (2000) and Hamilton (1994) delved deeper into the mathematical foundations of ARIMA, providing detailed descriptions of the model identification, estimation, and diagnostic checking procedures. The ARIMA model has found widespread application in the financial sector for forecasting exchange rates, stock prices, and economic indicators. For instance, Mell's (2015) research demonstrates the effectiveness of ARIMA in forecasting stock markets. In agriculture, ARIMA is used to estimate crop yields and agricultural commodity prices (Jones, 2017). Kaur's (2018) study highlights the potential of ARIMA for forecasting water consumption. The combination of ARIMA with neural networks (ARIMA-ANN) to improve forecast accuracy is presented in Zhang's (2003) work. Similar approaches, proposed by Tseng et al. (2009), demonstrate the effectiveness of integrating ARIMA with other methods to reduce forecast errors. In Ukraine, the ARIMA model is actively used for forecasting economic processes. For example, Romanenko's (2019) research demonstrates its effectiveness in forecasting GDP. Sidorenko's (2020) work focuses on analyzing currency fluctuations. It is important to note that ARIMA is often compared to other models such as SARIMA, VAR, and LSTM. Frank's (2021) research indicates that ARIMA models are outperformed by machine learning models in terms of long-term forecast accuracy, but they remain more interpretable and convenient for short-term analysis. Future research is aimed at improving ARIMA's adaptability to non-stationary data and integrating it with big data methods (Smith, 2022). Kim's (2021) work demonstrates the use of ARIMA in conjunction with social media sentiment analysis. The ARIMA model remains relevant due to its versatility and adaptability, despite the development of more complex models. Its application in various fields, including migration forecasting, agriculture, and economics, confirms its effectiveness.

The aim of this research is to assess the actual and potential scale of student migration from Ukraine by applying the ARIMA model to identify key trends and forecast the dynamics of migration flows in the short and medium term. This will contribute to the development of evidence-based strategic decisions in the field of education policy aimed at minimizing the negative consequences of migration and optimizing the development of the country's human capital.

3. METHODOLOGY

The methodology for forecasting the volume of Ukrainian student migration based on the ARIMA (Autoregressive Integrated Moving Average) model involves several stages, including the formation of a research information base, identification of the structural form of the ARIMA model, verification of its adequacy, and forecasting.

Stage 1. Before working with the ARIMA model, data on the volume of Ukrainian student migration is collected and prepared. The data is presented as a time series reflecting changes in the volume of migration over a certain period (annually). According to UNESCO data, it is advisable to consider the indicator "Total outbound internationally mobile tertiary students studying abroad, both sexes, Ukraine (UIS estimate)", which includes 19 years (from 2004 to 2022). Before modeling, it is important to conduct a preliminary data analysis. A graphical representation of the data (*e.g.*, a line graph) helps to identify trends, seasonality, and anomalies.

Stage 2. Identification of the structural form of the ARIMA model. Stationarity is an important aspect for the ARIMA model, since it is based on the assumption that the statistical properties of the time series do not change over time. To check stationarity, we use, namely, visual analysis of the graph, visual analysis of the autocorrelation function (ACF) and partial autocorrelation function (PACF), unit root tests. If a stationary series is obtained, then we proceed to the next point, if not, we apply the operator of taking the successive difference and repeat the testing. In practice, the successive difference is taken, as a rule, no more than two times.

So, if the series is not stationary, differentiation is applied. So, let's perform 1st order differentiation, the difference between the current value and the previous one:

$$y_t^{'} = y_t - y_{t-1}$$

where, $y_t -$ total outbound internationally mobile tertiary students studying abroad , both sexes, Ukraine in a snapshot t;

$t -$ year of observations;

$y_t^{'}$ - new series obtained after the first differentiation.

If the data is still not stationary, a second differentiation may be necessary:

$$y_t^{''} = y_t^{'} - y_{t-1}^{'}$$

where, $y_t^{''}$ - new series obtained after second differentiation.

Thus, based on the obtained stationary time series, we construct its sample autocorrelation functions (ACF) and partial autocorrelation functions (PACF), which determine the formulation of several hypotheses about the possible orders of autoregression (p) and moving average (q). The parameter d is determined based on the stationarity of the data (-th order of differentiation). Note that lower order models

are used, usually with p+q ≤ 3 (if there is no seasonal component). At this stage, the autocorrelation functions (ACF) and partial autocorrelation functions (PACF) usually do not coincide exactly with the theoretical counterparts, but are close enough to them. Therefore, based on the analysis, the parameters of the ARIMA model (p, d, q) are determined, where:

p - autoregression order,

d - order of integration (number of differentiations),

q - moving average order.

After determining the parameters, the ARIMA model (p, d, q) is constructed as follows:

$$y_t = c + \phi_1 y_{t-1} + \phi_2 y_{t-2} + ... + \phi_p y_{t-p} + \theta_1 e_{t-1} +$$

$$\theta_2 e_{t-2} + ... + \theta_q e_{t-q} + e_t$$

where, ϕ_i - autoregression coefficients that describe the influence of previous values on the current;

θ_j - moving average coefficients describing the influence of previous random errors on the current value;

e_t - random time noise t;

c - constant.

Stage 3. Model Evaluation and Adequacy Check. The parameters of the ARIMA model are evaluated: the p-value should be less than 0.05 ($p \le 0.05$). To analyze the model's adequacy, the residuals, which are the differences between the observed values and the values predicted by the model, are examined. The regression residuals should resemble "white noise" and be uncorrelated (have zero autocorrelation)

To verify the normal distribution of residuals, a histogram and a normal probability plot are constructed. The histogram values should closely follow the normal curve, indicating that the sample density of the residuals is well approximated by the normal distribution. The values on the normal probability plot should approximate a straight line.

Stage 4. Forecasting the Volume of Student Youth Migration in Ukraine. After successfully passing the validation tests, the model can be used to forecast future migration volumes. Forecasts for h - future periods can be calculated using the formula:

$$\hat{y}_{t+h} = \mu + \phi_1 y_{t+h-1} + ... + \phi_p y_{t+h-p} + \theta_1 e_{t+h-1} + \theta_q e_{t+h-q}$$

where, $\hat{y}_{t+h}$ - predicted value for the h - th period.

μ - average value (if the model does not contain a constant).

4. RESULT AND DISCUSSION

The results of the proposed scientific and methodological approach to assessing the potential scale of student migration from Ukraine, consisting of four main stages, are as follows.

Stage 1. Formation of the research information base. According to UNESCO data, the volume of student youth migration in Ukraine has shown a steady upward trend since the 2000s until 2019. Notably, the number of Ukrainian students choosing to study abroad increased significantly during the period 2014-2018 (Fig. **1**). This dynamic had several main reasons: political and economic instability, simplified admission to foreign universities, and the search for better quality education. The difficult economic situation in Ukraine, starting with the 2008 crisis and exacerbated in 2014 by the start of the armed conflict in eastern Ukraine, became a catalyst for migration processes, including educational migration. Young people are seeking to obtain an education that will open up employment opportunities in other countries. In particular, in the 2010s, there was significant progress in the development of bilateral educational programs and the provision of scholarships for Ukrainian students, which also stimulated studying abroad. The European Union has strengthened its partnership with Ukraine in the field of education, particularly within the Erasmus+ program. Many Ukrainian students choose to study abroad in countries with higher university rankings and more developed educational infrastructure. Countries such as Poland, Germany, Czech Republic, and the USA have become popular destinations, offering high-level programs and opportunities for international mobility. However, in 2019, there was a decline in the number of Ukrainian students studying abroad (Fig. **1**). The reasons for this decrease can be explained by several factors: the onset of the COVID-19 pandemic and improved opportunities within Ukraine. Although the pandemic was officially declared in 2020, the first cases began to emerge in late 2019, causing uncertainty and partially restricting international mobility. This influenced many students' decisions to stay in Ukraine. In particular, the Ukrainian government began implementing reforms in the education sector, increasing funding for research and international cooperation, which reduced the trend of student outflow. Gradually, since 2020, the number of Ukrainian students planning to study abroad has been increasing (Fig. **1**), as foreign universities develop adapted educational programs and scholarships for Ukrainians. According to recent UNESCO reports, due to the full-scale Russian invasion of Ukraine in 2022, there has been a sharp increase in academic migration, as many universities were forced to suspend operations or switch to remote learning. There has also been an increase in support programs for Ukrainians abroad.

Stage 2: Identification of the structural form of the ARIMA model. The statistical package Statistica was used to forecast the indicator "Total outbound internationally mobile tertiary students studying, Ukraine". The original time series was plotted (Fig. **1**), visually demonstrating a steady upward trend. The presence of a trend component can be observed by analyzing the graph, with a sharp increase in student migration processes from 2004-2018 and from 2020-2024. The presence of a trend is explained by the escalation of the armed conflict in eastern Ukraine (Russia's full-scale war against Ukraine) and socio-political-economic instability. Thus, the presence of a trend component indicates the non-stationarity of the time series.

The autocorrelation function (ACF) and partial autocorrelation function (PACF) of the indicator "Total outbound internationally mobile tertiary students studying abroad, Ukraine" are graphically depicted in Figs. (**2** and **3**), respec-

tively. The ACF of the time series (Fig. **2**) exhibits a linear additive trend, confirming the non-stationarity of the time series. Autocorrelation analysis indicates a linear relationship between the change in autocorrelation coefficients and the time lag, and the transition to first differences eliminates this dependence (d=1). The PACF (Fig. **3**) characterizes an autoregressive model of the first order (one autoregressive parameter, p=1). Thus, at Lag=1, a large value of the partial autocorrelation is observed, and subsequently, the values decay and become insignificant.

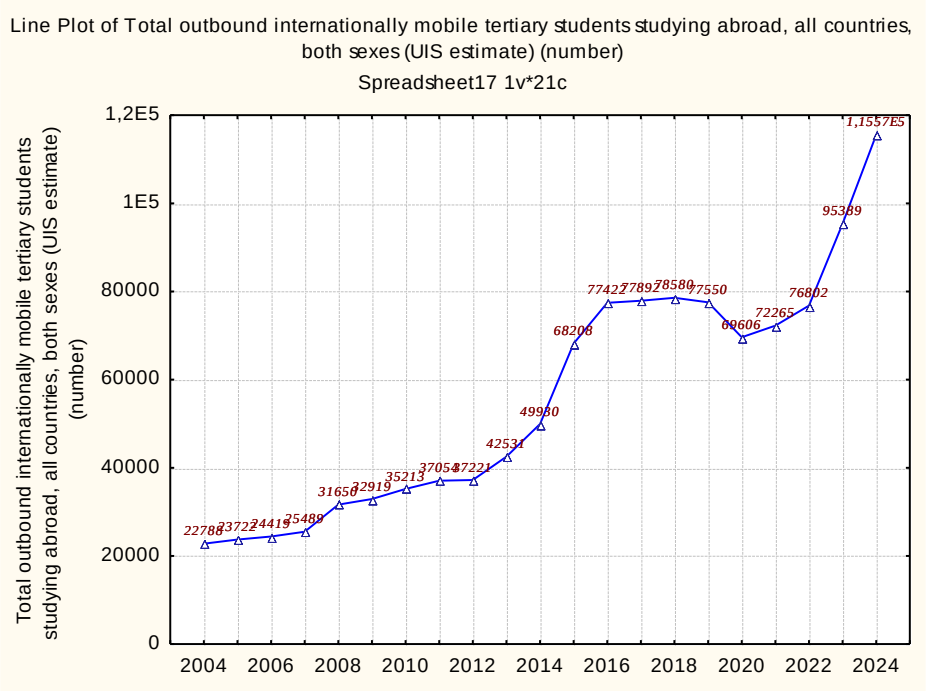

Fig. (1). Time series graph of «Total outbound internationally mobile tertiary students studying abroad, both sexes, Ukraine (UIS estimate) from 2004-2024.
Source: UNESCO. Education: Inbound internationally mobile students by country of origin http://data.uis.unesco.org/index.aspx?queryid=3806

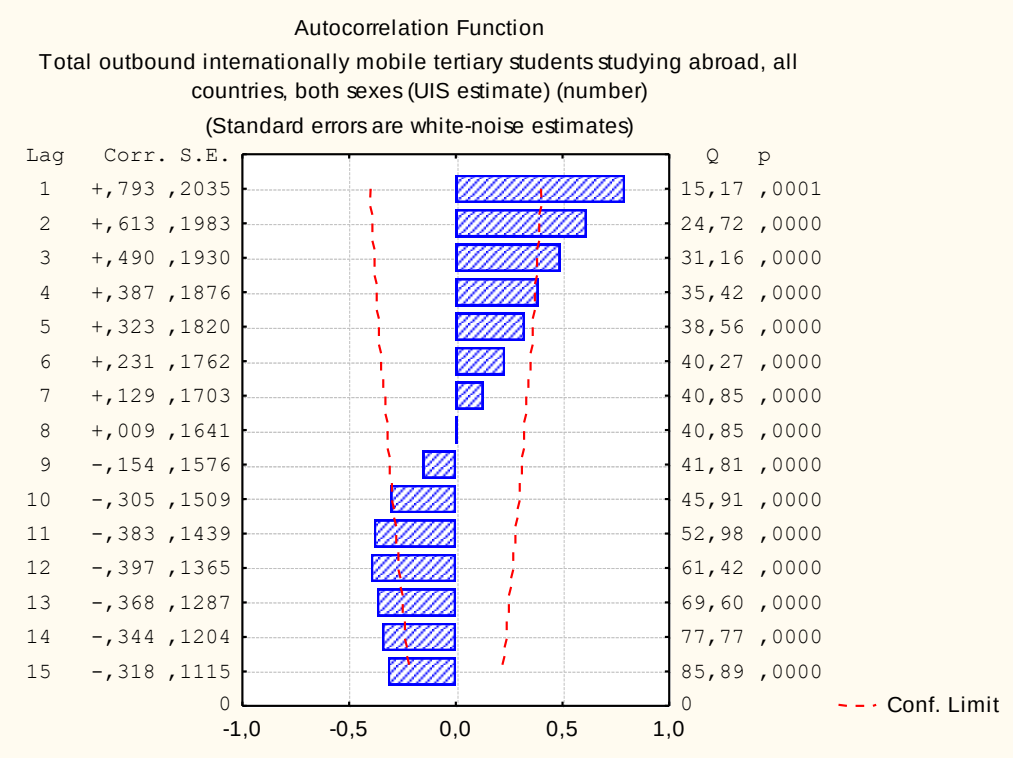

Fig. (2). Graph of the autocorrelation function of a time series «Total outbound internationally mobile tertiary students studying abroad, both sexes, Ukraine (UIS estimate).

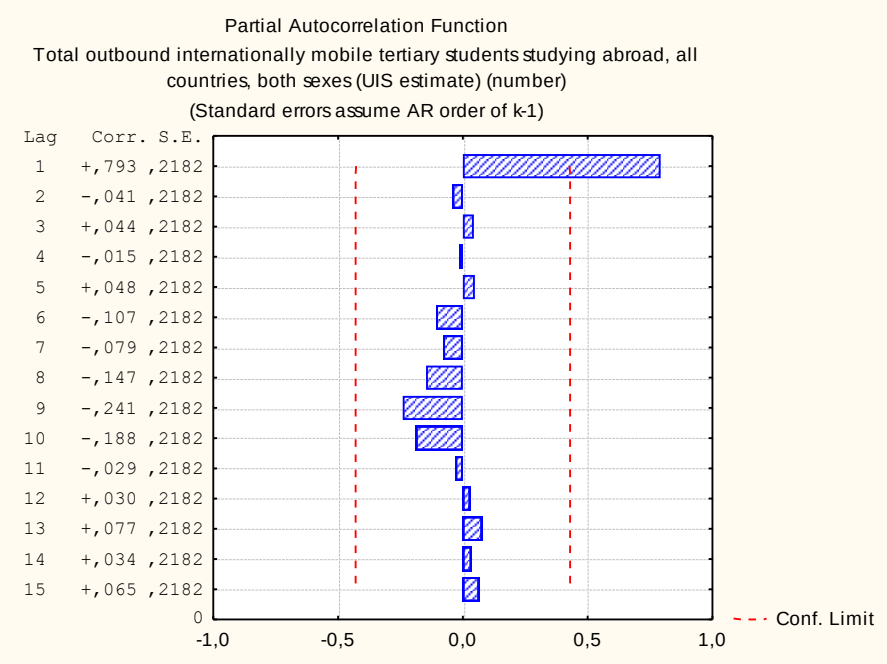

Fig. (3). Graph of the partial autocorrelation function of the time series «Total outbound internationally mobile tertiary students studying abroad , both sexes, Ukraine (UIS estimate).

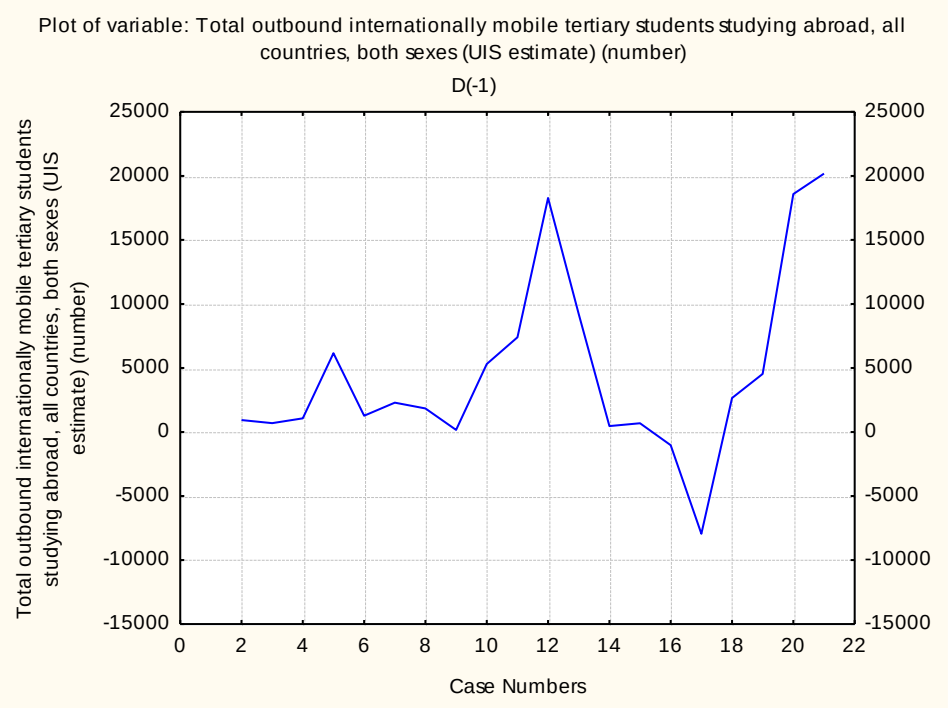

Fig. (4). Graph of the first differences of the time series «Total outbound internationally mobile tertiary students studying, Ukraine 2004-2024.

The first difference of the time series "Total outbound internationally mobile tertiary students studying, Ukraine from 2004-2024" is plotted in Fig. (**4**). As noted, analyzing (Fig. **1**) and the autocorrelation function plot (Fig. **2**), we conclude that the time series is non-stationary. Therefore, we consider the first difference of the series, assuming that the first difference series will be stationary. At the next stage, a difference transformation with parameter (Lag = 1) was applied to the time series. Clearly, the graph of the transformed series (Fig. **4**) becomes stationary. Thus, the conducted analysis allowed us to identify the parameters of the ARIMA (1,1,0) model: autoregressive parameter (p=1), difference order (d=1), and moving average parameter (q=0).

Stage 3: Model evaluation and adequacy check. A table of parameter estimates for the ARIMA (1,1,0) model is constructed (Fig. **5**). The model coefficient estimates are statistically significant: the p-value is significantly less than 0.05 (p=0.000467), the standard error is relatively small

Paramet.	Input: Total outbound internationally mobile tertiary students studying abroad, all countries, both sexes (UIS estimate) (number) (Spreadsheet2)Transformations: D(1) Model:(1,1,0) MS Residual= 3701E4					
	Param.	Asympt. Std.Err.	Asympt. t(19)	p	Lower 95% Conf	Upper 95% Conf
p(1)	0,837336	0,198586	4,216496	0,000467	0,421691	1,252981

Fig. (5). Estimates of the parameters of the ARIMA model (1,1,0).

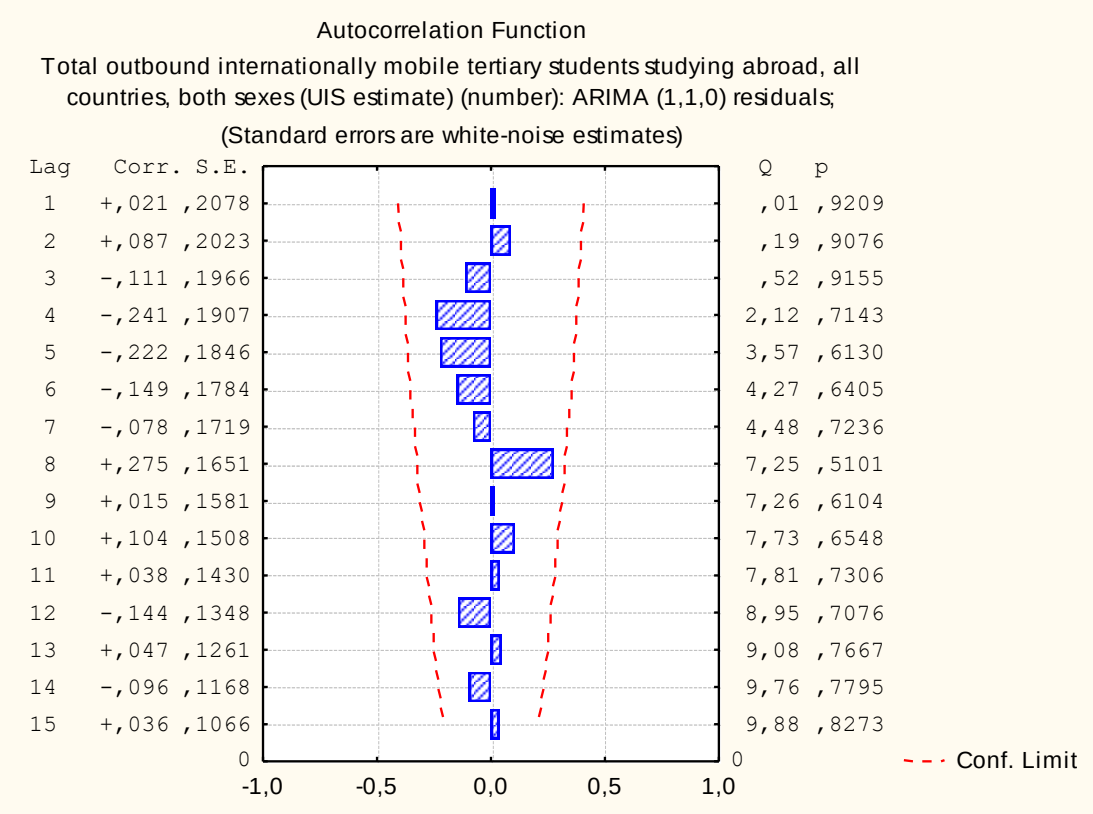

Fig. (6). Graph of the autocorrelation function of the residuals of the time series «Total outbound internationally mobile tertiary students studying abroad , both sexes, Ukraine (UIS estimate).

(0.198586), and the t-statistic (4.216496) indicates the statistical significance of the parameter p (highlighted in red).

The residual autocorrelation function (ACF) plot (Fig. **6**) and the residual partial autocorrelation function (PACF) plot (Fig. **7**) are presented. The adequacy of the ARIMA (1,1,0) model is confirmed by the Box-Pierce Q-statistic (Q=9.88) and the probability (p=0.8273), indicating that the residuals are "white noise" (Fig. **6**). The regression residuals resemble "white noise," meaning there are no periodic fluctuations, systematic shifts, and the residuals are uncorrelated (have zero autocorrelation). Notably, the function values do not exceed the two symmetric lines that define the 95% confidence intervals for the autocorrelation coefficient (satisfactory level of significance) (Figs. **6**, **7**).

A histogram (Fig. **8**) and a normal probability plot (Fig. **9**) were constructed to assess the normality of the residuals. The histogram is closely aligned with the normal curve, indicating that the sample density of the residuals is successfully approximated by a normal distribution (Fig. **8**). In (Fig. **9**), all points on the graph are located close to a straight line, confirming the normal distribution (adequacy of the constructed ARIMA (1,1,0) model).

Stage 4: Forecasting the volume of Ukrainian student migration. A graph (Fig. **10**) is constructed, showing the number of students studying abroad. This number is expressed in absolute terms (number of individuals). The forecast part of the graph is based on the results of the ARIMA (1,1,0) model and reflects how the number of students may change in the future, based on the analysis of past trends. The forecast graph includes a 95% confidence interval, which shows the possible deviations of actual values from the forecast. According to the forecast (Figs. **10**, **11**), namely, in 2025 the number of student migrants will be 132,462, in 2026 – 146,610, in 2027 – 158,456, in 2028 – 168,375, and in 2029 – 176,681. It should be noted that, considering the trends of recent years and the escalation of the armed conflict in Ukraine, a sharp increase in the volume of student migration can be expected. Thus, the authors believe that the forecast values will tend towards the upper bound of the confidence interval, acquiring a more rapid growth dynamics.

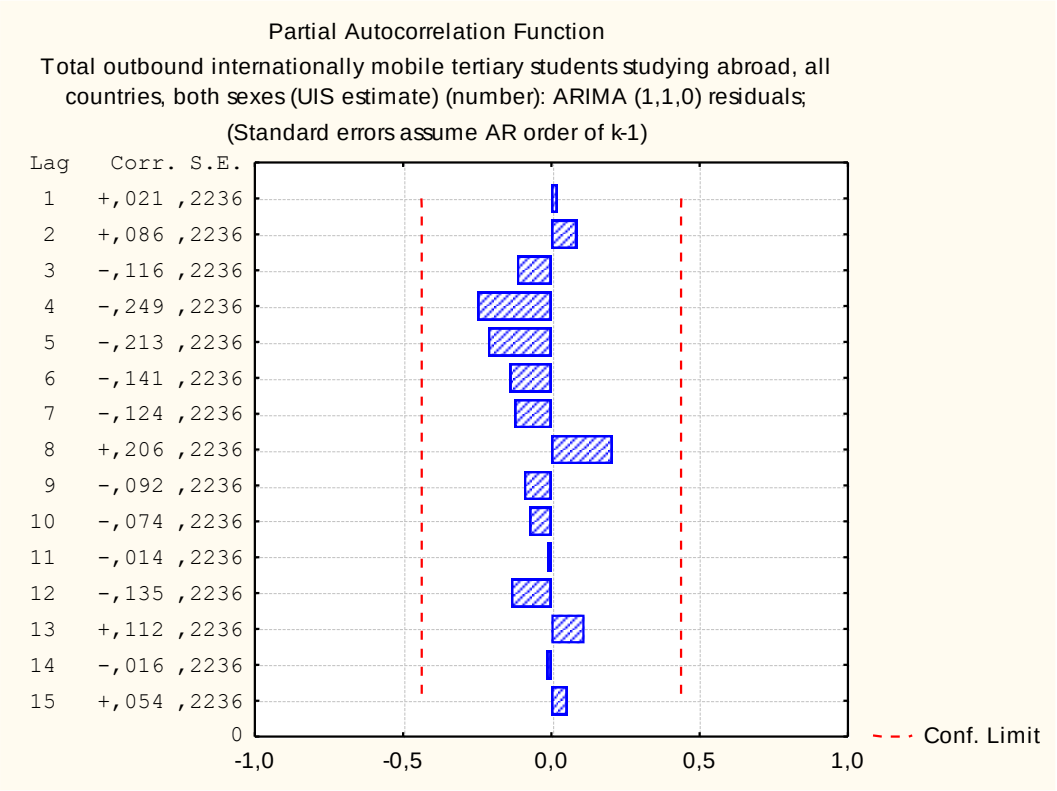

Fig. (7). Graph of the partial autocorrelation function of the residuals of the time series «Total outbound internationally mobile tertiary students studying abroad , both sexes, Ukraine (UIS estimate).

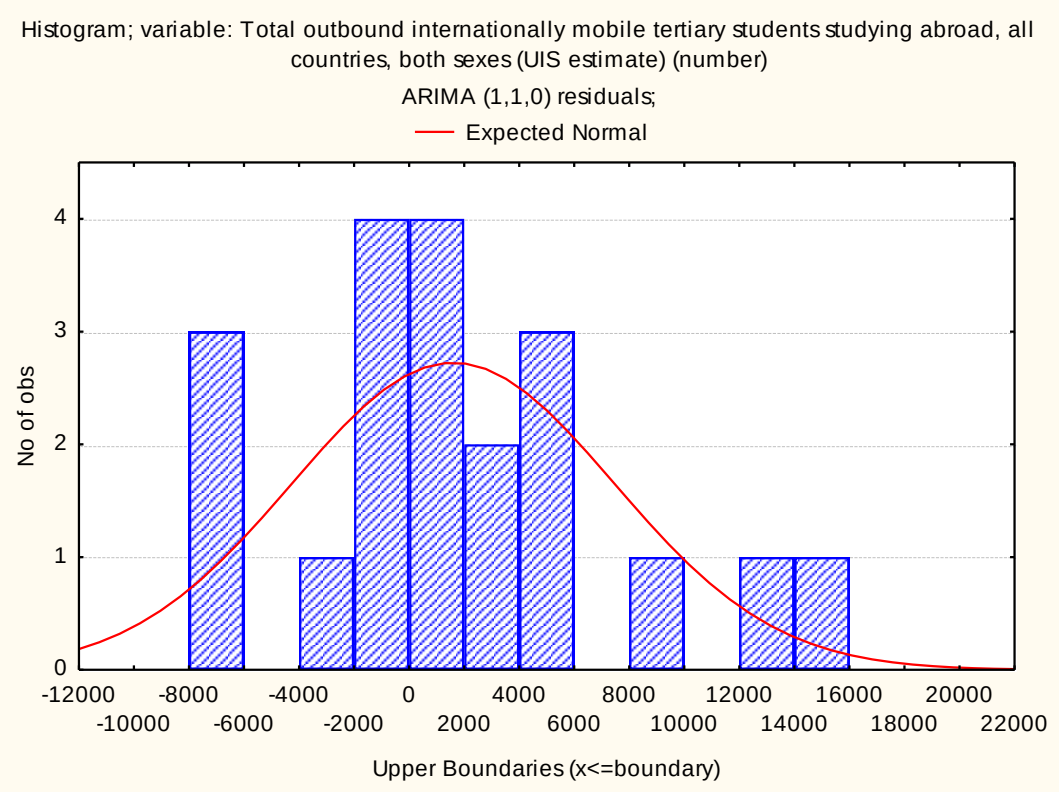

Fig. (8). Histogram of ARIMA model residuals (1,1,0).

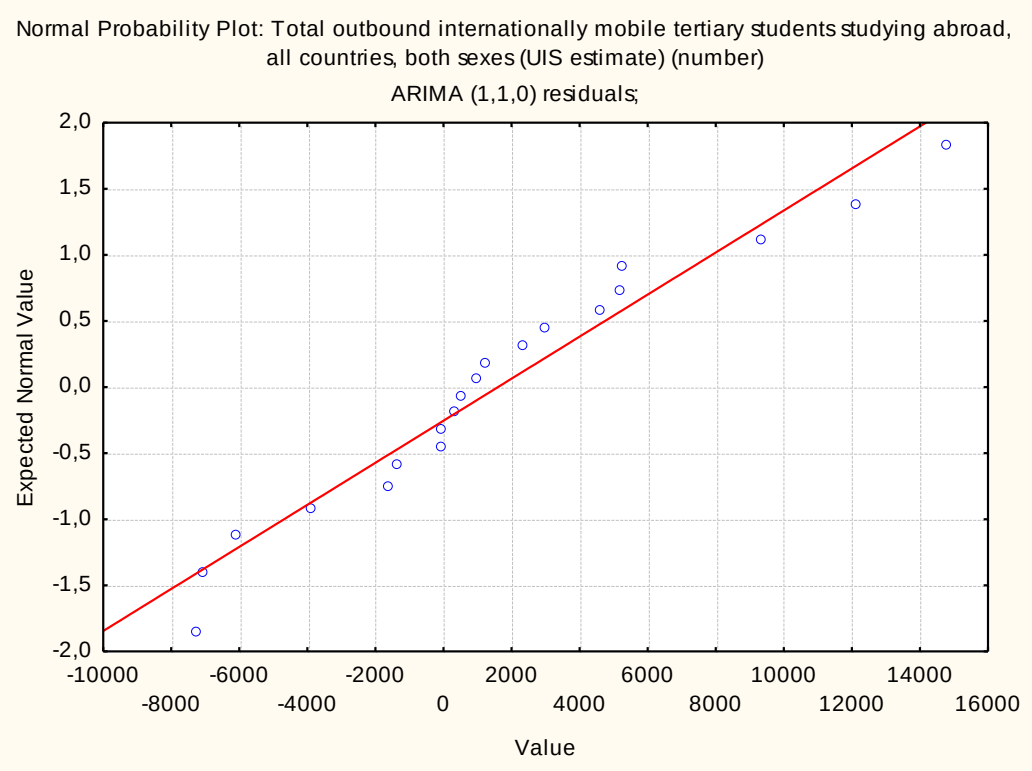

Fig. (9). Graph of the normal distribution of residuals of the ARIMA model (1,1,0).

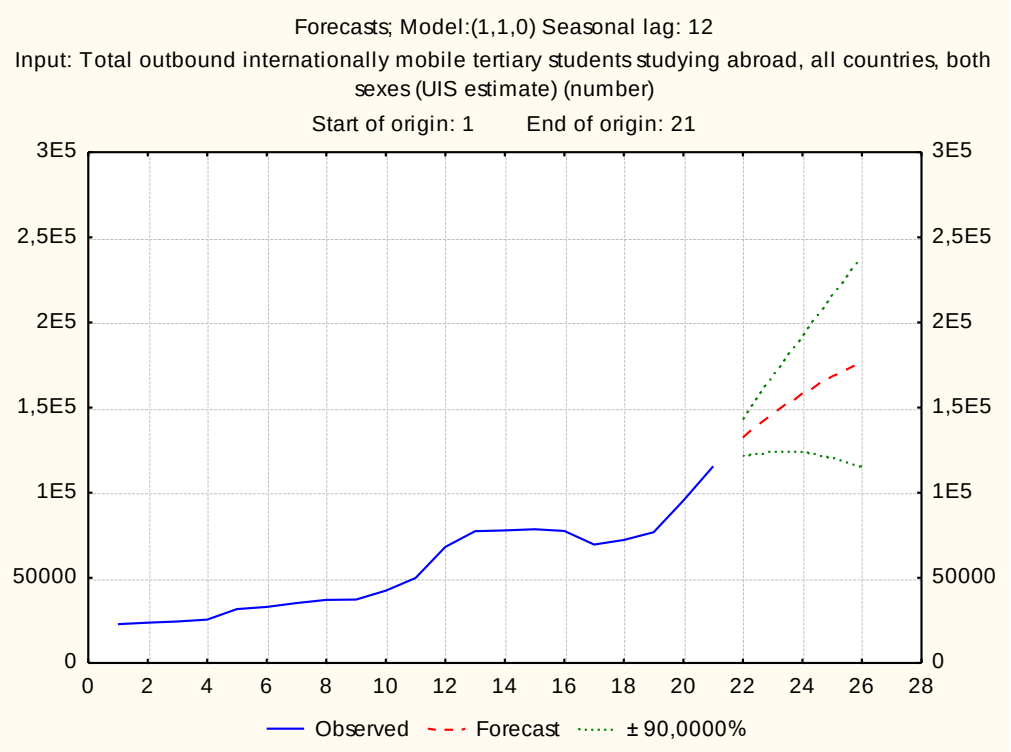

Fig. (10). Graph of forecast values of the indicator «Total outbound internationally mobile tertiary students studying, Ukraine.

The graph allows you to estimate the potential volume of student migration in the future, which helps to form forecast scenarios for relevant policies in the field of education and migration.

	Forecasts; Model:(1,1,0) Seasonal lag: 12 (Spreadsh Input: Total outbound internationally mobile tertiary st Start of origin: 1 End of origin: 21			
CaseNo.	Forecast	Lower 90,0000%	Upper 90,0000%	Std.Err.
24/2025 pik	132462,8	121943,1	142982,4	6083,76
25/2026 pik	146610,2	124604,8	168615,6	12726,27
26/2027 pik	158456,4	123854,0	193058,8	20011,44
27/2028 pik	168375,6	120643,0	216108,2	27604,93
28/2029 pik	176681,4	115638,1	237724,6	35302,80

Fig. (11). Forecast values of the indicator «Total outbound internationally mobile tertiary students studying, Ukraine.

4.1. Discussion

The discussion of potential forecasts for Ukrainian student migration to other countries is an important topic, as it has a significant impact on Ukraine's socio-economic development. In recent years, there has been a growing number of Ukrainian students choosing to study abroad. This is due to a number of factors, including the quality of education, employment opportunities, and the desire to gain international experience. Depending on the political and economic situation in Ukraine, forecasts may vary. If the situation stabilizes, migration may decrease, but if conflicts or economic difficulties continue, the trend towards migration may intensify. Forecasts of Ukrainian student migration are multifaceted and depend on numerous factors, including the economic and political situation in Ukraine, the state of education, and social conditions. It is important to ensure adequate conditions for learning and development in Ukraine to reduce the outflow of students and utilize the potential of those returning with international experience. Rapid transformations in the field of educational migration pose challenges for educational institutions and government bodies, which must adapt to new conditions, creating opportunities for the return of graduates and attracting foreign students. Let us consider the main targets for government policy. Firstly, and most importantly, is the improvement of the quality of higher education in Ukraine. The state should invest in the modernization of curricula, the recruitment of qualified faculty, and the creation of modern learning environments. This will help to reduce the outflow of students abroad and increase the competitiveness of Ukrainian universities. Additionally, it is necessary to develop financial support programs for students wishing to study in Ukraine. This may include scholarships, grants, and student loans. Such measures can encourage young people to stay in Ukraine for higher education. Therefore, government policy should include the creation of internship and employment programs for students in cooperation with businesses. This will allow young people to gain practical experience during their studies and increase their motivation to stay in the country. The next target is to expand exchange programs between Ukrainian universities and foreign educational institutions, which can help students gain international experience without leaving Ukraine for an extended period. This will contribute to improving the academic level of education. Thus, Ukraine should actively participate in international educational initiatives, which will increase the prestige of Ukrainian universities and attract foreign students. In the context of the growing popularity of online education, it is crucial to support and develop digital learning platforms that provide access to high-quality educational resources. Therefore, the government needs to collaborate with businesses to develop educational programs that meet the needs of the labor market. This will enable students to acquire up-to-date knowledge and skills that are in demand in Ukraine.

CONCLUSION

This study evaluated the actual and potential volumes of student migration from Ukraine by applying the ARIMA model to identify key trends (forecasting the dynamics of migration flows in the short and medium term). The study focused on the determinant "total outbound internationally mobile tertiary students studying, Ukraine" for the period 2004-2024, according to UNESCO data. The research revealed a growing trend in migration flows from the 2000s until 2019, characterized by the 2008 crisis and socio-political-economic instability. A sharp increase in migration was observed during the period 2014-2018, coinciding with the onset of the armed conflict in eastern Ukraine. However, in 2019, a decline in the number of Ukrainian students was observed, primarily due to the outbreak of the COVID-19 pandemic. A sharp increase in academic migration was observed in 2022 with the onset of Russia's full-scale aggression against Ukraine. The authors propose a scientific and methodological approach to assess the potential scale of educational migration. Firstly, the structural form of the ARIMA model was identified. Based on the graph of the original series, the autocorrelation function, and the partial autocorrelation function, a trend component was identified, and it was established that the time series is non-stationary. According to the partial autocorrelation function, the autoregressive model is of the first order. Autocorrelation analysis revealed a linear dependence of the change in autocorrelation coefficients on the time lag, and the transition to the first differences eliminated this dependence. Thus, a difference transformation was applied, and the graph of the transformed series became stationary. Secondly, the model was evaluated and its adequacy was verified. The model's coefficient estimates were statistically significant. The graphs of the residual autocorrelation function and the residual partial autocorrelation function confirmed their uncorrelatedness, and the residuals constitute "white noise." Histograms and the normal probability plot of residuals approximate a normal distribution. Thus, the estimated parameters of the proposed ARIMA model are statistically significant. Thirdly, forecast values were constructed, indicating a continued trend of Ukrainian students studying abroad. For example, the number of student migrants is expected to reach 132,462 in 2025, 146,610 in 2026, 158,456 in 2027, 168,375 in 2028, and 176,681 in 2029. The obtained forecast values of student migration in Ukraine provide a solid foundation for developing well-grounded policy targets in the field of education and demographic stability. They ensure a scientifically sound basis for developing effective management decisions aimed at regulating youth flows, particularly by increasing the attractiveness of the domestic higher education system and developing conditions that promote the integration of young professionals into the national labor market. Setting targets based on this data will contribute to the sustainable development of human capital in Ukraine and help prevent poten-

tial negative socio-economic consequences caused by the outflow of young people abroad.

CONFLICT OF INTEREST

The authors declare no potential conflict of interest regarding the publication of this work. In addition, the ethical issues including plagiarism, informed consent, misconduct, data fabrication and, or falsification, double publication and, or submission, and redundancy have been completely witnessed by the authors.

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