DOI: https://doi.org/10.30837/EK.2025.002

Geseleva N.,
PhD (Engineering), Associate Professor of Digital Economy and System Analysis Department, State University of Trade And Economics
ORCID ID: https://orcid.org/0000-0001-9188-9738
Proniuk G.,
PhD (Engineering), Associate Professor of Safety Engineering Department, Kharkiv National University of Radio Electronics
ORCID ID: https://orcid.org/0000-0001-7648-0360
Stytsenko T.,
PhD (Engineering), Associate Professor, Head of Safety Engineering Department, Kharkiv National University of Radio Electronics
ORCID ID: https://orcid.org/0000-0003-4530-0253

SYSTEMATIC ANALYSIS OF MIGRATION PROCESSES AS RISK FACTORS FOR SUSTAINABLE DEVELOPMENT OF SOCIETY

One of the manifestations of the internationalization and democratization of the economic and socio-cultural life of mankind, as well as the consequences of acute interethnic contradictions, direct clashes between countries and peoples, emergency situations and natural disasters are large-scale intra-country and inter-country movements of population and labor resources in various forms. The world community, which until recently did not directly feel the size, characteristics and consequences of migration processes at the international level, is faced with the need to coordinate the efforts of many countries to resolve acute situations and collectively regulate migration flows. Migration consolidates sparsely populated outskirts, supplying new areas of development with labor force, ensuring education and work. With the help of migration, people have the opportunity to find their place in life.

As an economic category, migration is a territorial movement of the population in connection with a change of residence between countries, regions, settlements. This is «an economic phenomenon, and whatever the motives - political, religious, national – it is ultimately determined by the search for a new place of employment», as well as the resolution of economic, family and other problems that arose in the previous place of residence.

Migration of population is divided by time sign, by territorial principle, by legal status, by motives, and by direction.

According to time sign, migration is divided into:

– permanent (long-term) migration is characterized by the number of people arriving or leaving for permanent residence. In some countries, a foreigner is considered an immigrant (emigrant) if he is present (or absent) in the country for a certain period of time;

– temporary (short-term) migration is entry or exit related to current needs without changing citizenship and permanent residence. However, in many countries, the number of seasonal workers (sometimes quite significant) is excluded from the number of temporary migrants;

– pendulum migration is a special type of migration depending on time and is the movement of workers to their place of work from one region to another and back to their place of residence if the person's absence from their permanent place is less than one week.

According to territorial features, migration is divided into:

– internal – i.e. movement within the country, for example, between its regions, from village to city;

– external – moving outside the country.

According to the legal status, migration is classified as registered and unregistered.

According to the motives, voluntary and forced migration is distinguished.

Immigrants are divided into several types depending on the reasons for their

movement, their legal status and the goals they pursue when moving. Here are the main categories:

– labor migrants. People who move to another country in search of work, often from regions with high unemployment or low wages. They play an important role in the economies of host countries, but sometimes face limited rights and discrimination;

– refugees and asylum seekers. Refugees flee their countries because of threats to their lives or persecution. Asylum seekers are those who are still waiting for their status to be recognized. Host countries are obliged to provide basic conditions, but may have difficulty integrating large numbers of refugees;

– family migrants. The relocation is related to reunification with family members already living in the host country. Migrants often face cultural barriers when integrating;

– migrant students. These migrants come to obtain higher or specialized education. Integration opportunities depend on the country's migration policy;

– illegal migrants. People who move to another country without proper documentation or remain there after their visa has expired. They often work in the shadow economy;

– economic investors. These are wealthy people who move and invest in the country's economy. They attract capital to host countries, but sometimes cause controversy due to inequality;

– temporary migrants. The movement is temporary. People come for a limited period of time for work, study or other purposes. Do not have long-term residence rights.

When analyzing the essence of migration processes, the determining factor is the needs and interests of a person, determined by the search for the optimal place of work and the scope of work for the purpose of self-realization and self-development in labor. Recognition of needs and interests as the driving force of the spatial movement of the population is determined by human behavior, which is subordinated

to fundamental principles – utility maximization, that is, obtaining the best effect from the use of one's own labor.

This interpretation of the essence of migration movement is based on the understanding of man as the highest value of society. At the same time, processes such as the social division of labor, the location of production, its technical equipment, labor incentives, the presence of production, and social infrastructure can only slow down or intensify labor mobility.

In the context of internationalization of economic relations, openness of national labor markets, and formation of an innovative and competitive model of the economy, labor migration has significantly intensified as a permanent process characterized by dynamic changes – waves, duration, pace, and scale. The variability and dynamism of territorial labor movements is characterized not only by the scale and regularity of migration, but also by their duration, that is, it occurs over time, which objectively requires its consideration when analyzing migration processes.

Thus, the migration process is a complex structured system of social order, associated with the movement of the economically active population in space and time, determined by its needs and interests, with the aim of realizing labor potential in the main sphere of human life – labor.

Theoretical analysis of the essence of the migration process as a complex system of social order, characterized by integral qualities, requires, first of all, an analysis of its system-forming components, that is, functional subsystems, the interaction of which ensures its functioning as a holistic phenomenon.

Immigration trends in Europe are a complex and dynamic process that depends on current factors such as political, social, social and climate changes. Here are some important aspects:

1. Main sources of migration:

– Middle East and North Africa: Ongoing conflict, instability and economic hardship in these regions are driving migration to Europe;

– Sub-Saharan Africa: High levels of poverty, political instability and climate

change in countries in this region also lead to significant numbers of migrants seeking to reach Europe;

– Eastern Europe and Asia: Citizens of the former Soviet Union, as well as South and Southeast Asia, migrate to Europe in search of a better life and economic opportunities.

2. Main directions of migration:

– Strong economies such as Germany, France, the UK, the Netherlands and the Scandinavian countries remain key destinations for migrants due to access to jobs, social protection and high standards of living;

– Southern European countries such as Spain, Italy and Greece often serve as the first point of entry for migrants, especially from North Africa, but many move further north.

3. Changes in migration policy:

– Tightening controls: Following the 2015 migrant crisis, the EU took steps to tighten borders, including deals with Turkey and Libya to curb migrant flows;

– Quotas and redistribution: Some EU countries have introduced migrant redistribution systems to relieve pressure on border countries such as Italy and Greece;

– Economic migration: Countries with labor shortages, such as Germany, have begun to ease the conditions for attracting skilled workers.

4. Integration of migrants:

– Integration programs vary by country, including language training, access to education and jobs;

– Some countries face challenges related to cultural differences, rising xenophobia and political tensions.

5. Future trends:

– Climate migration: As climate change increases, migration from regions affected by droughts, floods and other natural disasters is expected to increase;

– Demographic changes: Europe's ageing population requires a labor force from abroad, which could increase migration;

– Tech Migration: The technology sector continues to attract skilled workers from developing countries.

An analysis of the total number of residence permits (fig. 1) issued in the European Union countries for 2021–2023 shows a steady increase, which can be attributed to various economic and geopolitical factors [1]:

– 2021: 2.9 million permits issued. This was a year of gradual recovery from the COVID-19 pandemic, with an increase in the number of economic migrants;

– 2022: 3.5 million permits – an increase of 20.7% compared to 2021. The key driver was the war in Ukraine, which led to an influx of refugees and temporary protection programs in EU countries such as Poland and Germany;

– 2023: 3.7 million permits, up 4.7% from 2022. Growth driven by increased student visas and stabilizing economic migration.

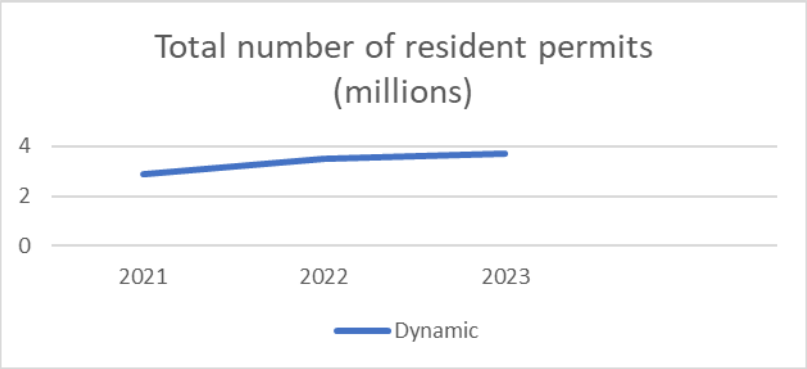

Figure 1 – Dynamics of the total number of residence permits in the EU

Source: compiled by the author

An analysis of residence permits (fig.2) issued for employment reasons shows changes in their share and total number over the past three years (2021–2023):

– 2021: About 1.1 million permits were issued (37.9% of the total). This is due to the recovery of economies from the pandemic;

– 2022: The number increased to 1.3 million (37.1%). Despite the crisis in Ukraine, economic reasons remained the main factor of migration to the EU;

– 2023: Near 1.3 million permits (33.8%). Despite the stable number, the share has decreased due to an increase in migration for humanitarian reasons.

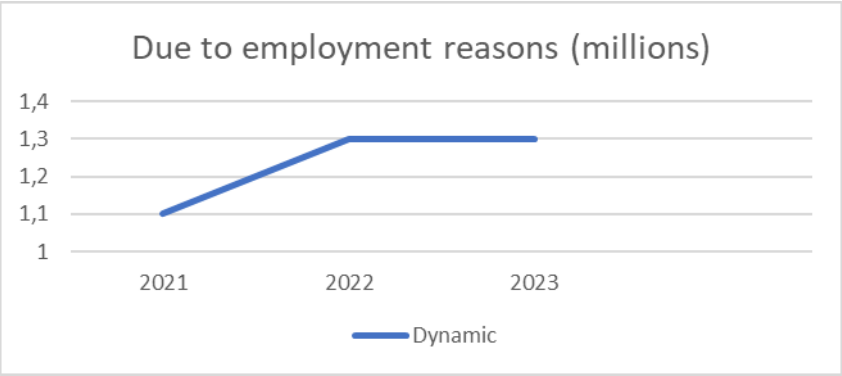

Figure 2 – Dynamics of the residence permits issued for employment reasons

Source: compiled by the author

An analysis of residence permits issued for family reasons for 2021–2023 (fig.3) shows a steady increase both in absolute numbers and in terms of migration trends [2]:

– 2021: Around 800,000 permits were issued (27.6% of the total). Family reasons remain an important factor for migration, especially in countries with large existing migrant communities;

– 2022: The number increased to 927 thousand (26.5%), which corresponds to an increase of 15.9% compared to the previous year;

– 2023: The number of permits reached 986 thousand (26.4%), with an increase of 6.4% compared to 2022.

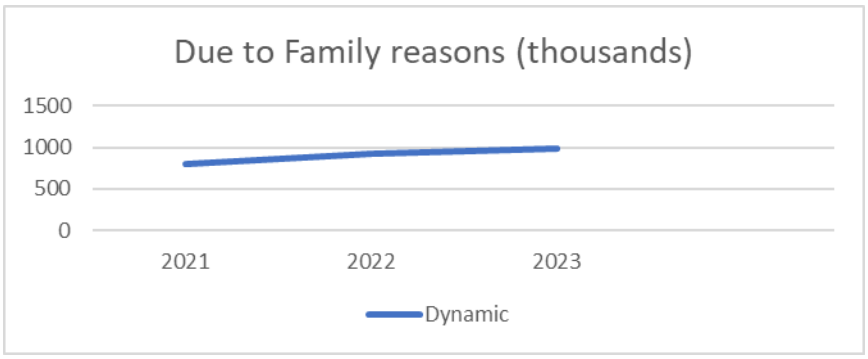

Figure 3 – Dynamics of the residence permits issued for family reasons

Source: compiled by the author

An analysis of residence permits issued for educational reasons for 2021–2023 (fig. 4) shows a significant increase, reflecting Europe's popularity as a destination for study and research [3]:

– 2021: About 450,000 permits were issued (15.5% of the total). This number was consistently high despite the restrictions related to the COVID-19 pandemic;

– 2022: The number increased to 471 thousand (13.5%). The growth of 4.7% is due to the restoration of educational processes after the pandemic and the increase in student mobility;

– 2023: The number of educational permits reached 534 thousand (14.3%), which corresponds to an increase of 13.5% compared to the previous year.

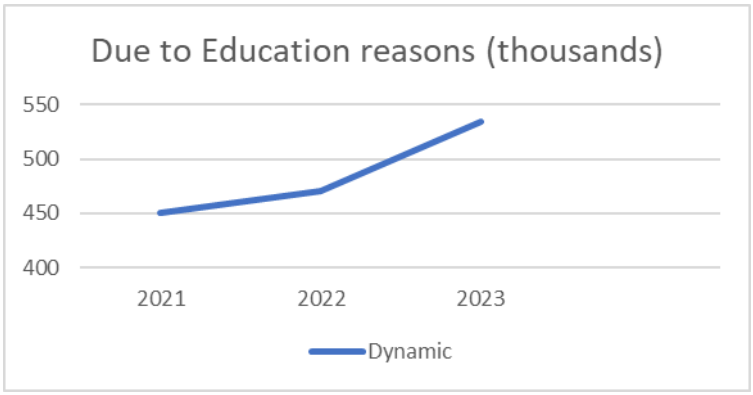

Figure 4 – Dynamics of the residence permits issued for f educational reasons

Source: compiled by the author

An analysis of residence permits issued under international protection for 2021–2023 (fig. 5) shows a clear increase, which is associated with global crises such as armed conflicts and political instability:

– 2021: Some 550,000 permits were issued (19% of the total). This number reflects the impact of humanitarian crises, especially in Syria, Afghanistan and other;

– 2022: The number increased to 907 thousand (25.9%), which is a significant increase compared to the previous year. The main reason was the war in Ukraine, which led to a mass exodus of people to EU countries;

– 2023: The number of permits continued to grow and amounted to 957 thousand (25.6%), which is associated with a steady flow of refugees, primarily from Ukraine, as well as ongoing conflicts in other parts of the world.

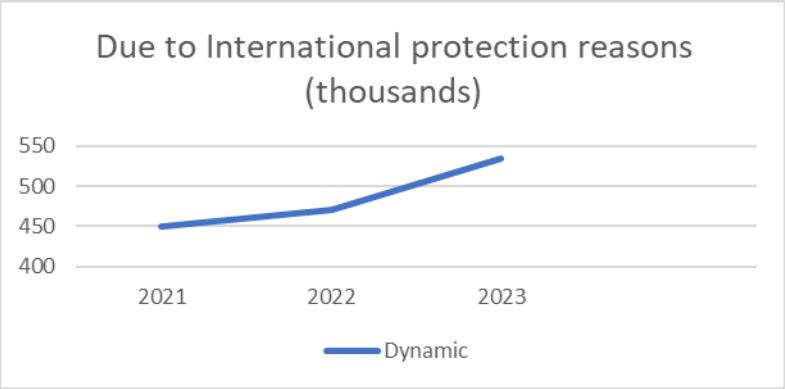

Figure 5 – Dynamics of the residence permits issued under international protection

Source: compiled by the author

In Europe, the distribution of male and female migrants is nearly equal across both the top 10 destination and origin countries. This contrasts with Africa and Asia, where most countries tend to have a slightly higher proportion of male migrants. Notably, among destination countries, Ukraine stands out with a significantly higher percentage of female immigrants compared to males, when compared to other European nations [4].

Migration of Ukrainians to Europe has become a significant phenomenon, especially since 2022, after the start of a full-scale military conflict in Ukraine. More than 4.5 million registrations for Temporary Protection in the EU, 821486 Ukrainian students have already been integrated in Member States' national schools systems and 63321 Asylum applications by Ukrainian nationals in the EU+ [5]. No fewer than 6.168 million Ukrainian refugees were registered across Europe by the end of July 2024, according to the United Nations High Commissioner for Refugees (UNHCR). The war has caused the largest population displacement crisis since World War II, with nearly a third of the population forced to flee their homes [6].

Key facts and statistics:

– Number of immigrants: as of the end of 2023, about 4.8 million Ukrainians had received temporary protection or refugee status in EU countries, making this migration flow the largest in Europe in recent decades. Poland has received the largest number of refugees (over 1.5 million people), followed by Germany (about 1 million), the Czech Republic and Spain;

– Main reasons for immigration: the military conflict in Ukraine has become the main factor in the mass displacement of citizens, especially women, children and the elderly. Many migrants left the country due to threats to their lives, destruction of infrastructure and economic crisis;

– Temporary protection status: the EU has introduced a temporary protection directive that provides Ukrainians with access to housing, education, healthcare and the labor market. This mechanism has made it possible to accelerate the integration of refugees into the societies of host countries;

– Labor migration: even before 2022, Ukraine was one of the largest sources of labor migrants to Europe, especially to Poland and the Czech Republic. Since the start of the war, many Ukrainians who left the country have integrated into the economies of their host countries, filling vacancies in construction, agriculture, health care, and services.

Impact on host countries:

– Social integration: European countries have developed support programs for Ukrainian migrants, including language courses, training programs and employment programs. However, the sudden influx of migrants has put pressure on social welfare, health and education systems;

– Economic effect: Ukrainian migrants have become actively involved in the economy, especially in sectors with labor shortages. In countries such as Poland and the Czech Republic, Ukrainians make up a significant part of the workforce;

– Long-term prospects: many migrants plan to return to their home countries after the conflict ends, but some may remain in host countries due to integration into society and the labor market.

The main countries that have accepted Ukrainians are shown in fig.6 [7].

Migration of Ukrainians to Europe has profound social, economic and political consequences. On the one hand, it demonstrates the solidarity of European countries in the context of a humanitarian crisis, and on the other, it emphasizes the importance of creating sustainable support mechanisms in the context of long-term conflicts. The main directions of migration are determined by both the proximity and economic attractiveness of countries, which contributes to a change in the demographic and economic picture of the region.

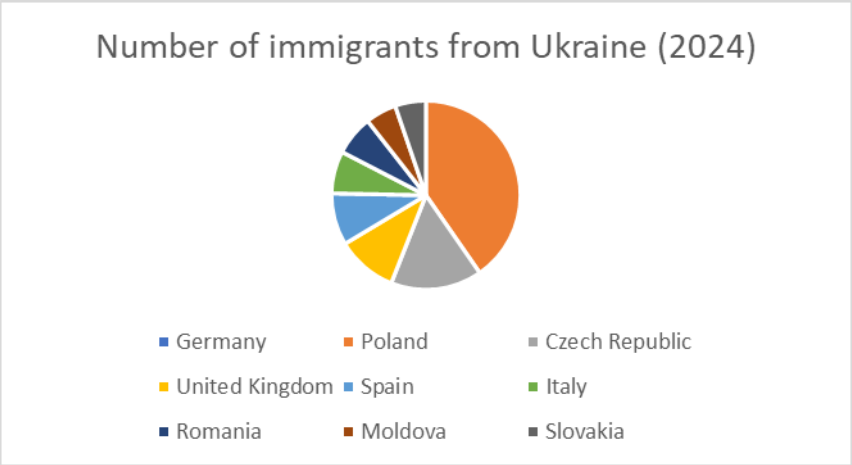

Figure 6 – Countries accepted Ukrainians

Source: compiled by the author

Migration data visualization tools allow us to explore and analyze complex relationships between regions, demographics, economic factors, and other variables. This work uses Microsoft Power BI as a tool for visualizing datasets with their further analysis and R studio for forecasting.

Microsoft Power BI is a powerful tool for data analysis, information visualization, and team collaboration. With Power BI, you can connect to multiple data sources, create interactive reports and dashboards, use built-in artificial intelligence, integrate with Excel and other Microsoft applications, and access your data from any device.

Figure 7 shows the original dataset. The dataset after cleaning is shown in the figure 8.

With the help of a suitable dataset, the program now allows you to create visualizations based on prepared data that can then be used for analysis (fig. 9). Data cleaning provides the basis for correct, understandable and reliable visualization.

	Data extracted on 27/11/2024 04:09:13 from [ESTAT]	Column2	Column3
1	Dataset:	Immigration by age group, sex and citizenship [migr_imm1ctz$default...	null
2	Last updated:	13/11/2024 23:00	null
3	null	null	null
4	Time frequency	null	Annual
5	Country of citizenship	null	Total
6	Age definition	null	Age reached during the year
7	Age class	null	Total
8	Unit of measure	null	Number
9	Sex	null	Total
10	null	null	null
11	TIME	2022	
12	GEO (Labels)		
13	European Union - 27 countries (from 2020)	6898752	ep
14	Belgium	208356	
15	Bulgaria	40619	
16	Czechia	347429	
17	Denmark	121183	
18	Germany	1943445	e
19	Estonia	49414	
20	Ireland	157537	
21	Greece	96662	
22	Spain	1258894	
23	France	431017	p
24	Croatia	57972	
25	Italy	410985	
26	Cyprus	31052	
27	Latvia	38708	
28	Lithuania	87367	
29	Luxembourg	31433	
30	Hungary	94148	
31	Malta	34964	
32	Netherlands	326798	
33	Austria	201622	

Figure 7 – Primary Dataset

Source: compiled by the author

Country	Value
European Union - 27 countries (from 2020)	6898752
Belgium	208356
Bulgaria	40619
Czechia	347429
Denmark	121183
Germany	1943445
Estonia	49414
Ireland	157537
Greece	96662
Spain	1258894
France	431017
Croatia	57972
Italy	410985
Cyprus	31052
Latvia	38708
Lithuania	87367
Luxembourg	31433
Hungary	94148
Malta	34964
Netherlands	326798
Austria	201622
Poland	275515
Portugal	167098
Romania	293024
Slovenia	35613
Slovakia	5463
Finland	49998
Sweden	102436
Iceland	14878
Liechtenstein	770
Norway	90475
Switzerland	167079
Montenegro	15989
Moldova	177875
North Macedonia	2452
Georgia	179778
Türkiye	494052

Figure 8 – Cleaned Dataset

Source: compiled by the author

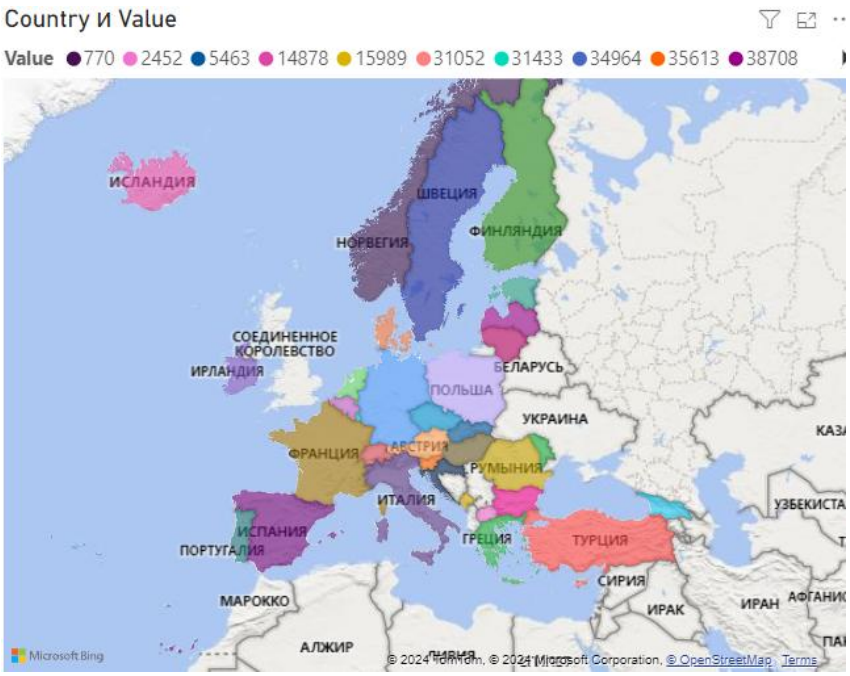

Figure 9 – Visualization of Dataset

Source: compiled by the author

As a result of applying Power BI, we obtained a visualization of immigration indicators. The data on foreign-born residents in various countries (fig. 10) reflects differing immigration levels, with some nations having significantly higher percentages of immigrants in their population than others.

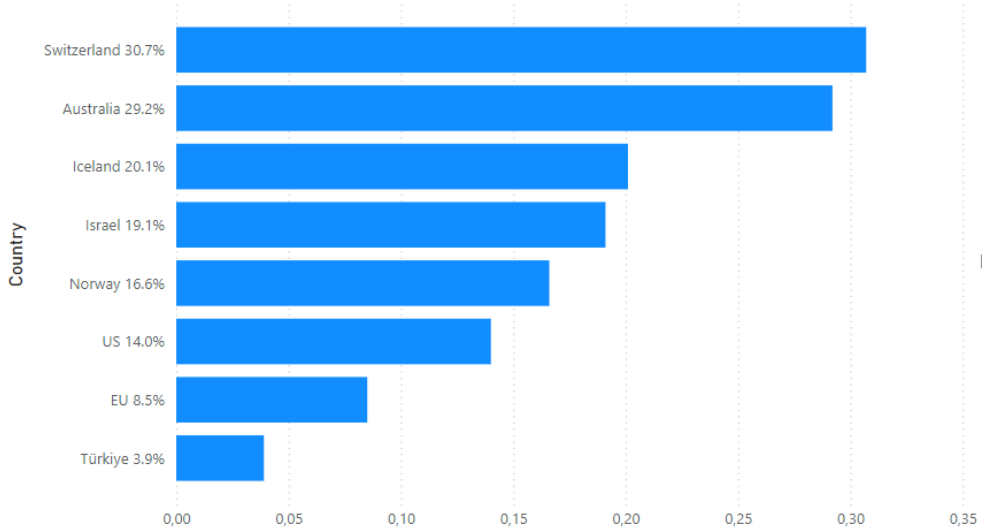

Figure 10 – Foreign-born residents per country

Source: compiled by the author

The data on residence permits by reason of migration in Europe at the end of 2023 provides valuable insights into the main factors driving immigration (fig. 11).

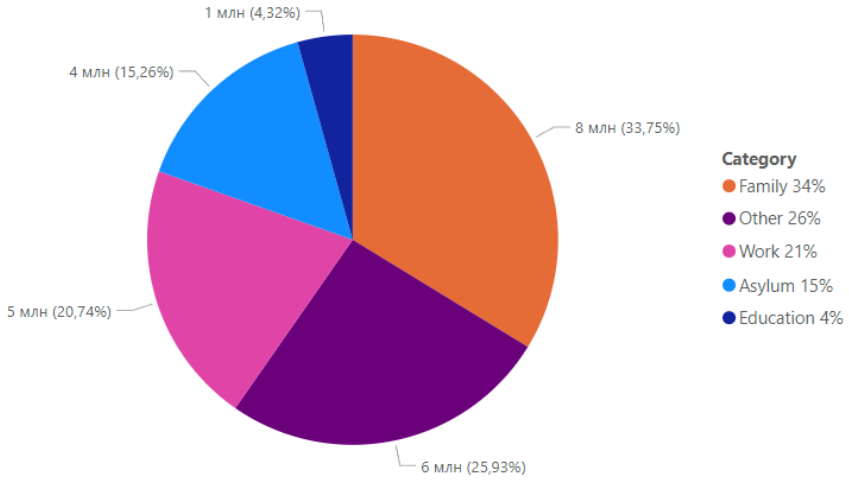

Figure 11 – Residence permits by reason

Source: compiled by the author

The data on legal and irregular migration to Europe between 2014 and 2023 provides important insights into migration patterns and the dynamics of border management (fig. 12). Here's a detailed analysis of the trends:

– 2015-2016 Migration Crisis: 2015 marks the peak of irregular migration, with over 1.8 million irregular migrants, a direct consequence of the Syrian Civil War and other conflicts in the Middle East and North Africa. This created a massive wave of migrants and refugees trying to reach Europe, many of whom entered irregularly. In 2016, the number of irregular migrants decreased to 511,047, still high, but reflecting better border control mechanisms after the crisis, including the EU-Turkey deal and the strengthening of the external borders of the EU;

– Post-2016 Stabilization and Increase: After 2016, the number of irregular migrants steadily decreased until 2019, when there was a slight increase. However, irregular migration numbers remained relatively controlled due to various EU agreements, better surveillance, and stricter asylum regulations. The 2019 figures show 3 million legal migrants, with irregular migration at about 141,741, indicating

better control and border enforcement compared to the peak of the migration crisis;

– Post-2020 Pandemic and Recovery: The COVID-19 pandemic in 2020 temporarily reduced both legal and irregular migration due to lockdowns, travel restrictions, and economic downturns. The number of legal migrants dropped to 2.29 million in 2020, while irregular migration also decreased significantly to 126,310 during the same period. As restrictions were lifted in 2021 and 2022, legal migration saw an increase, reaching 3.45 million in 2022, and irregular migration rebounded to 326,217;

– 2023 and Current Trends: In 2023, both legal and irregular migration increased again, with legal migration reaching 3.74 million and irregular migration growing significantly to 385,445. The rise in irregular migration can be attributed to several factors, including geopolitical tensions (such as the war in Ukraine) and continued migration from conflict zones like Syria, Afghanistan, and parts of Africa.

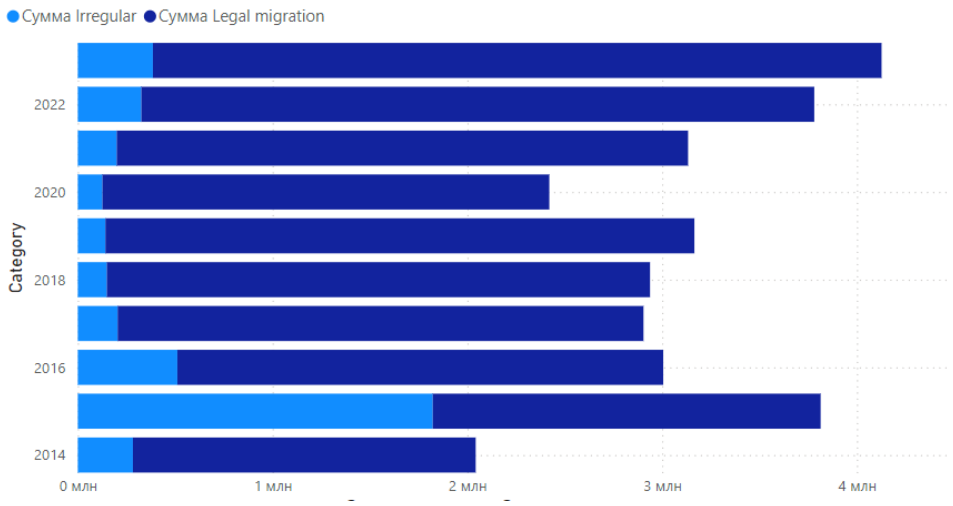

Figure 12 – Migration in the EU

Source: compiled by the author

And the last indicator will be the data on the top 10 nationalities of first residence permits issued in EU Member States in 2022 and 2023 which reveals several trends and shifts in migration patterns (fig. 13).

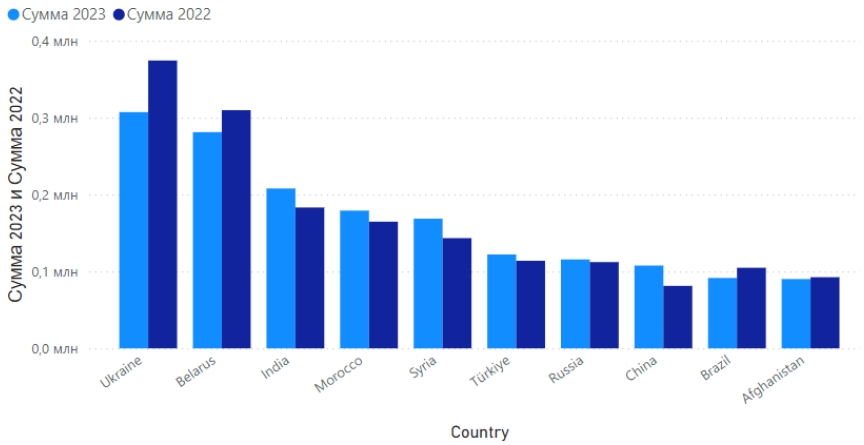

Figure 13 – Top 10 nationalities of first residence permits issued in EU

Source: compiled by the author

Also, a forecasting of future trends of immigration in Europe was held using R Studio. RStudio is widely used in data analysis to perform tasks such as importing, processing, exploring, transforming, visualizing, and modeling data. In addition, RStudio is actively used in machine learning tasks to build predictive models. RStudio is a versatile and feature-rich open-source IDE (integrated development environment) commonly used as a graphical interface for working with R, starting from version 3.0.1 and above. Moreover, it supports various other programming languages, including Python and SQL.

Using RStudio's graphing and forecasting capabilities in the context of migration can be extremely useful for analyzing, visualizing, and predicting trends. Here are some examples of how this can be applied:

1. Analysis of migration flows:

– Constructing heat maps to show the number of migrants moving between regions;

– Using line charts or time series to analyze changes in migration over the years;

– Visualizing demographic characteristics of migrants (age, gender, education).

2. Forecasting migration trends:

– Using time series models (e.g. ARIMA) to predict future changes in migrant stocks;

– Assessing the impact of factors such as economic development, climate change or political crises on migration;

– Building machine learning models to predict migration flows based on multiple factors.

– Resource optimization:

– Visualization of forecasts for planning the allocation of resources in receiving regions, such as housing, health services or training;

– Building scenarios to assess the need for infrastructure changes in regions with high migrant flows.

3. Informing Policy:

– Create visual charts to present migration data to policymakers, international organizations, and the general public;

– Analyze the impact of migration on the labor market or health care system, accompanied by visual materials.

4. Evaluating the success of measures and strategies:

– Plotting graphs before and after the implementation of migrant support programs to assess their effectiveness;

– Visualization of statistical models showing how migration flows have changed in response to new laws or agreements.

For example, R code that uses a linear regression method was used to predict the number of migrants for the next year based on historical data. As a result, the code will display graphs, the regression equation, and the predicted number of migrants for the next year (fig. 14).

forecast_result	List of 10
model	List of 12
values	
data	Time-Series [1:5] from 2019 to 2023: 13000…
migrants	num [1:5] 1300000 400000 700000 5000000 11…
next_year	2024
prediction	Named num 2960000
years	num [1:5] 2019 2020 2021 2022 2023

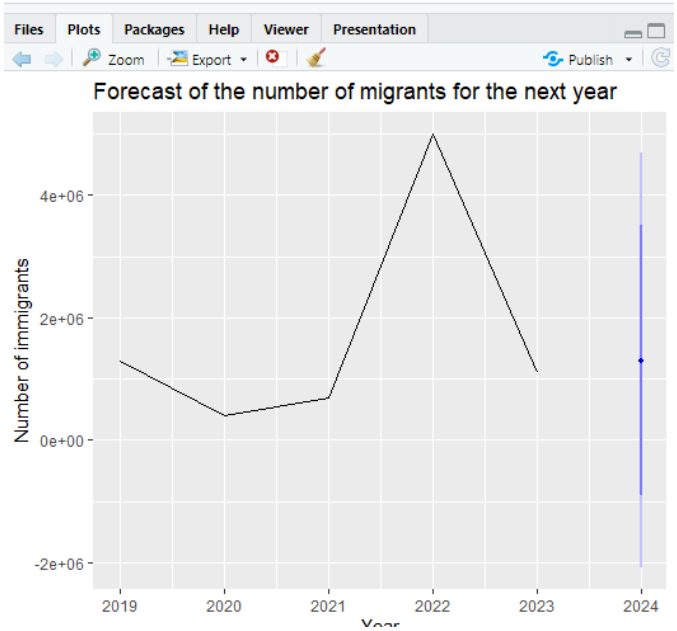

Figure 14 – Visualization of a chart and prediction

Source: compiled by the author

Thus, preparing the dataset for use in Power BI allowed us to integrate data from various sources and create clear visualizations of key migration indicators, such as foreign-born residents per country, reasons of migration, over-presented sectors, and their geographic distribution. Using Power BI provided easy access to data and its dynamic analysis, which significantly improved the understanding of current trends.

The constructed graphs, diagrams and maps clearly reflected the dynamics of migration flows, the geographical distribution of migrants and their demographic characteristics. The analysis of visualizations allowed us to identify key trends, such as changes in the direction of migration flows, the dependence of recipient countries on labor migration and the influence of social and economic factors on migration processes.

Forecasting the number of migrants using statistical methods and time series can be useful in several aspects of migration processes. Here are the key benefits:

– resource and infrastructure planning: Forecasts allow governments and international organizations to estimate the volume of migration flows in advance. This helps to plan the accommodation of migrants, including: Temporary detention centers, Social services (education, health care) and Transport infrastructure;

– economic planning: Understanding migration trends helps to assess the impact on the labor market, that is especially important for countries facing labor shortages. The predictability of such flows helps to adjust migration policy, for example, to increase or decrease quotas for issuing work visas;

– humanitarian aid: Forecasting helps to distribute humanitarian resources, such as medical aid and food, in regions where migration flows are most intense. This is important to prevent humanitarian crises in regions where immigrants cross borders;

– migration Policy Management: Forecasts allow migration strategies to be adjusted based on expected changes, for example, the increase in migrants from conflict regions (Syria, Ukraine) requires flexible policies for providing asylum and integration;

– crisis prevention: Early detection of increased migrant flows helps countries prepare for potential problems such as: Increased irregular migration, Pressure on border services, Conflicts in local communities due to social tensions;

– analytics for long-term decisions: Such forecasts provide information for long-term planning, such as the integration of migrants into society. This is especially important for countries that seek to minimize cultural and social conflicts while simultaneously extracting economic benefits from new residents.

The analysis of the nature of migration processes indicates that this is a complex system of social order, which includes a number of interconnected stages, the functioning of which ensures the integrity of the object under study and requires the formation of effective mechanisms for regulating labor migration flows at different levels of management. Therefore, the formation of a mechanism for regulating labor migration processes contributes to increasing the effectiveness of

state migration policy measures in the conditions of openness of the national labor market.

The conducted analysis of migration indicators emphasized the importance of an integrated approach to studying this topic, taking into account both quantitative and qualitative aspects of migration processes. The results obtained and the conclusions presented in the work can be used to formulate effective migration management strategies aimed at minimizing its risks and using opportunities for socio-economic growth.

Thus, a systemic analysis of migration processes allows not only a deeper understanding of their nature, but also contributes to the adoption of informed decisions at the level of individual states and Europe as a whole.

References

1. First permits by reason, length of validity and citizenship. URL: https://ec.europa.eu/eurostat/databrowser/view/migr_resfirst/default/table ?lang=en.

2. First permits issued for family reasons by reason, length of validity and citizenship. URL: https://ec.europa.eu/eurostat/databrowser/view/ migr_resfam/default/table?lang= en&category=migr.migr_man.migr_res.migr_resval.

3. First permits issued for education reasons by reason, length of validity and citizenship. URL: https://ec.europa.eu/eurostat/databrowser/view /migr_resedu/default/table?lang=en&category=migr.migr_man.migr_res.migr_resval.

4. Migration and Migrants: Regional Dimensions and Developments. URL: https://worldmigrationreport.iom.int/what-we-do/world-migration-report 2024-chapter-3/europe.

5. Migration management: Welcoming refugees from Ukraine. URL: https://home-affairs.ec.europa.eu/policies/migration-and asylum/migration-management/migration-management-welcoming refugees-ukraine_en.

6. Ukraine: Over 6 Million Refugees Spread Across Europe. URL: https://unric.org/en/ukraine-over-6-million-refugees-spread-across europe.

7. Ukraine Refugee https://data.unhcr.org/en/situations/ukraine.