Journal of Information Systems Engineering and Management
2025, 10(3s)
e-ISSN: 2468-4376
https://www.jisem-journal.com/

Research Article

Development of an Econometric Model of the Relationship between Migration Dynamics and Demographic Factors in Azerbaijan

Vilayat Ismayilov[1], Firana Mammadova[2], Gulnara Fataliyeva[3], Kamran Shykhyly [4]
[1]Azerbaijan Academy of Labor and Social Relations, Baku, Azerbaijan. E-mail: ismaylov1953@mail.ru
[2] Azerbaijan Academy of Labor and Social Relations, Baku, Azerbaijan. E-mail: firanam@mail.ru [3]Economic Institute of the National Academy of Sciences of Azerbaijan Baku, Azerbaijan.E-mail: feteliyevagulya@gmail.com
[4]Azerbaijan University of Architecture and Civil Engineering, Baku, Azerbaijan.E-mail: 19kamran95@gmail.com

ARTICLE INFO

Received: 06 Oct 2024
Revised: 29 Nov 2024
Accepted: 15 Dec 2024

ABSTRACT

Purpose: The purpose of the article is to build an econometric model of the relationship between the dynamics of migrants and the factors of the demographic process.

Theoretical basis: Individual counteracted equations are created to account for the components of demographic change -births, deaths, and net domestic and international migration. The fertility and mortality equations are easier to model because of the stable changes from period to period depending on income levels and national demographic trends. The net migration equations are more difficult to model because economic conditions, particularly labor market conditions, affect this process over time.

Method: The dialectical method was used to identify common approaches for studying a complex population. Methods of analysis and synthesis, comparison, induction and deduction, etc. were also used for demographic analysis. When developing regression models between the number of migrants and the three identified groups of factors directly influencing it, an econometric regression model was applied.

Results and discussion: A model of the relationship between the number of migrants and the system of demographic factors is built in a five-stage system. Independent variable demographic factors were combined in three groups. Based on the selected data, a correlation model of the relationship between the number of migrants and demographic factors was constructed and the adequacy of the model in the absence of autocorrelation was verified at the level of $\alpha=0.01$ (1%), $\alpha=0.05$ (5%).

Research results: The results of the study can be applied in regulating the flow of migrants and maintaining its pace at an optimal level.

Originality/value: The research contributes to the regulation of international migration, thanks to the theoretical and practical results obtained. The relevance and value of the study is confirmed by the influence of migration and demographic processes on the standard of living of the population.

Keywords: Econometric Model, Migration Dynamics, Demographic Factors

INPRODUCTION

Demography is a social science that studies the patterns and social conditionality of fertility, mortality, the number of registered marriages and divorces, the reproduction of married couples and families, and the reproduction of the population as a whole as a unit of these processes. Demography studies changes in the age, gender, and social structures of the population, the interrelation of demographic processes and structures, and develops methods of

description, analysis, and forecasting [1]. In practical terms, the field of demographic research includes a description of the demographic situation, an analysis of trends and factors of demographic processes in the country in different periods [2]. Based on the study of the characteristics of fertility and mortality in different generations, in different social groups and in different territories, demography estimates their most likely change in the future, developing demographic forecasts. The demographic and economic contribution of migrants to the lives of their countries of origin and host countries is a controversial issue and a typical example of a discussion in which logical or scientific arguments are not enough to convince public opinion. Demographers usually estimate the net migration rate, that is, the proportion of population growth due to net migration (the difference between inflows and outflows), based on the total number of residents at the beginning of the year. This indicator is usually expressed per thousand people and ranges from 1 to 6 per thousand in most Western countries [14, 25].

The unit of observation in demography is a person. Over the course of life, the characteristics of people gradually change, and with the change of certain characteristics of them, the characteristics of the population as a whole change. Thus, changing the specific characteristics of individuals from time to time changes the composition of the population and its size. Population is a dynamic concept and the study of the mechanism of its movement. The development of the population is associated with three forms of movement: -natural; -migration; -social.

The attempts made in the last three decades to build a general theory of population, as well as a general concept of population reproduction, have made it possible to determine the place of demography among the social sciences and presented general theoretical assumptions about the essential relationships that form the mechanism of population reproduction. In accordance with the above, a new theoretical design was created. The main indicators of the demographic situation include: the number and composition of the population, the number of births and deaths, the number of officially registered marriages and divorces, the number of citizens who arrived and left the country, as well as the number of arrivals and departures within the country and its regions. Based on the above indicators, derived and calculated indicators are formed that allow a comprehensive description of the structure and movement of the population, socio-demographic processes [13].

The most important source of data on the size and composition of the population at a certain point in time is the census. According to the terminology of the United Nations Statistical Commission, a population census is a single process of collecting, summarizing, evaluating, analyzing, and publishing, or otherwise distributing, demographic, economic, and social data relevant at a given time to all individuals in a country or a clearly limited part of the country. The basic principles of conducting population censuses are universality, simultaneous conduct, the existence of a single census program, naming, self-determination, confidentiality, centralization of management and disregard for the interests of the state [3, 4].

The relative increase in the working-age population is still ongoing and opens up opportunities for accelerated economic growth. The economic growth of demography in the economic sense is called a demographic dividend [19]. In this context, efforts to achieve the Sustainable Development Goals, such as ending hunger, ensuring a healthy life, promoting education and lifelong learning, creating jobs, improving social protection, and reducing inequality, can reinforce these trends and open up even more opportunities. At the same time, the growing number of young people may exacerbate problems in the public financial sector, which is currently struggling to provide services to young people, as well as the problems that society will face in the coming decades, trying to provide its aging population with everything they need.

The migration process is one of the three main demographic processes. Over time, migration has an even greater impact on population change than fertility or mortality. This reflects that migration is becoming the most dynamic of the three processes at the international level. In migrant families consisting of people of different genders, the decision to return also depends on gender roles and dynamics. In sociocultural contexts where the division of labor in the family and household depends on gender, women are more likely than as to return when family members in their country of origin need care.

Research shows that people migrate at a young age, which is also the reason why some studies show that immigrants make a positive financial contribution during their lifetime [15]. According to the author, in order to achieve a net financial effect, the ability of immigrants must integrate into the labor market and offer in-demand skills. However, immigrants have a real potential to improve the financial balance of the host country.

MATERIALS AND METODS

The theory and methodology of the research are based on the research of local and foreign researchers on the demographic process. The following methods were used in the study. The dialectical method was used to identify common approaches for studying a complex population. Methods of analysis and synthesis, comparison, induction and deduction, etc. were also used for demographic analysis. When developing regression models between the number of migrants and the three identified groups of factors directly influencing it, an econometric regression model was applied.

Also, using the analysis method, the current state of the number of migrants, natural growth, birth rate and death rate of the population, the number of valid marriages and divorces, the number of international migrants in Azerbaijan were considered. Using data on these indicators in the period 2000-2023, an econometric model of the relationship between the dynamics of migrants and the factors of the demographic process in the country was built.

To determine the adequacy of the econometric model, this indicator was tested on the basis of the Darbin-Watson criterion. At the end of the article, based on an analysis of the number of immigrants accepted by the countries, relevant suggestions and recommendations will be given.

RESULTS

3.1. Analysis of demographic and migration data

Some researchers are considering factors contributing to migration. Based on the results they obtained, we can note that the effects of migration affect the demographic process for both sending and receiving countries. Based on the results of the conducted research, we assume that a change in the trend of the demographic process structure depends on the migration process and vice versa [17, 18].

In some regions of the world, young people (aged 15 to 25) It makes up a significant and rapidly growing population group. In sub-Saharan Africa, where the total population is projected to double by 2050, the number of people of working age (25 to 65 years old) is increasing faster than in any other age group. Most countries in Asia and Latin America and the Caribbean are already experiencing a similar increase in the number of young people, followed by an increase in the number of people of working age.

According to forecasts from the United Nations and demographic experts, by 2050 the world's population will increase by about 26% and reach 9.7 billion. By the end of the century, despite the continued decline in the birth rate, it will reach a peak of almost 11 billion people. Forecasts show that during this period, more and more people around the world will choose cities as their place of permanent residence, and the number of children under the age of 5 will be inferior to the number of people aged 65 and older.

Calculations of the demographic situation in the world show that in 2024-2050, about 50% of global population growth will be accounted for by nine countries: India, Nigeria, Pakistan, the Democratic Republic of the Congo, Ethiopia, Tanzania, Indonesia, Egypt and the United States of America. And the population of Europe will decrease [29].

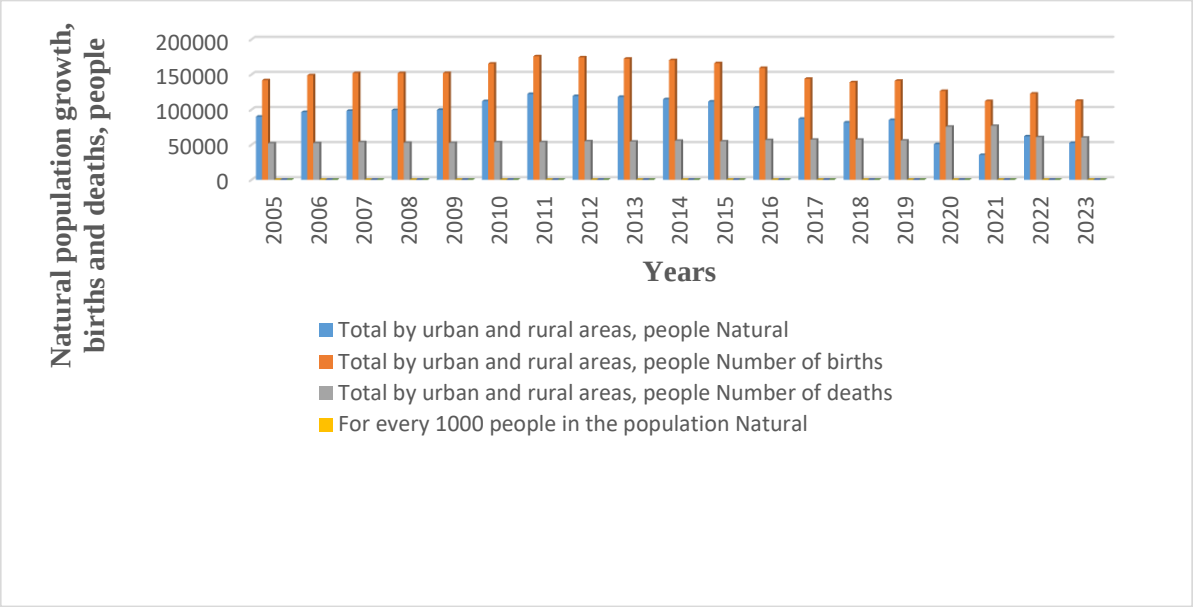
A number of researchers dealt with the problems of the labor market, the impact of the influx of immigrants, etc., and certain scientific results were obtained [17]. The International Organization for Migration (IOM) is the leading intergovernmental organization in the field of migration and the IOM includes approximately 87% of the world's States. The functions of the IOM include the promotion of humane (orderly) migration for the benefit of all. In carrying out these functions, the organization provides support to migrants, ensures the implementation of effective measures to respond to climate change and provide consultations on migration policy [10].

The World Migration Report 2024 recognized the IOM's ongoing duty to protect fundamental human rights and its mission to support those migrants who need help the most. It should be noted that such support is especially needed in three areas to which IOM provides special attention, as indicated in its strategic plan for 2024-2028: -saving lives and protecting people in motion; -finding solutions to the problem of risk in the movement of people; -facilitating ways for legal migration. According to the UN, the world had 281 million international migrants (3.6% of the world's population) in 2024.

Many factors contribute to the acceleration of migration: conflicts between countries, violence, political and economic instability, climate change, natural disasters, etc. In 2022, there were 117 million displaced persons in the world, 71.2 million of them internally displaced. The number of people forced to seek asylum due to the war between Russia and Ukraine, Israel and Palestine, etc., increased by 31.7% in 2022 compared to 2020 [16, 27].

The acceleration of migration is influenced by many factors. Demographic factors play an important role among these factors: natural population growth, fertility and mortality; gender composition of the population; composition of urban and rural populations; deaths from common causes, etc. The natural growth, fertility and mortality of the population are presented below (Chart 1).

A comparative analysis showed that the natural population growth in the period under review decreased by 41.7% and amounted to 52470 people in 2023, there was also a decrease in the birth rate by 20.6%, and in mortality, on the contrary, there was an increase of 15.8%. The reason for the increase in mortality may be the pandemic years, which have claimed many lives in all population groups.



Graph 1. Natural population growth, births and deaths (Demographic İndicators of Azerbaijan. (2024), 618 P.

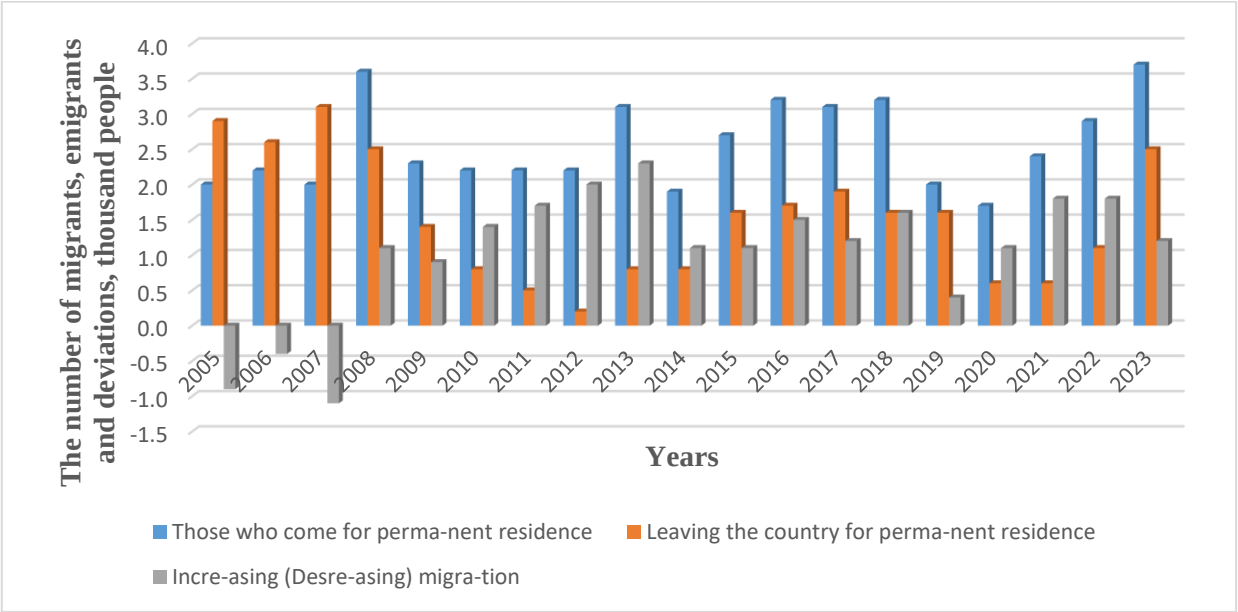
According to the Statistical Committee of Azerbaijan, the natural increase by gender among men decreased by 45.2%, and among women by 41.6% [21]. The decrease in natural growth ultimately has a negative impact on the number of migrants. Thus, the attempt of migrants to move to another country for permanent residence in search of higher wages will be reduced for the aforementioned demographic reason.

Recently, financial crises, climate change, military conflicts, etc. have been affecting the increase in the number of migrants. As a result of these factors, people change their permanent place of residence. And for this reason, migrants are forced to apply for asylum, which provides better conditions.

Одним из основных факторов действующих на количество мигрантов считается число погибших по общим причинам, что отрицательно может влиять на изменение их количества. Анализ данных показывает, что в рассматриваемом периоде этот показатель увеличился на 17.7% [21]. Таким образом, влияние произошедшего увеличения числа людей, умерших по разным причинам, на процесс миграции не позволяет многим семьям переехать в другую страну.

A decrease in the number of officially registered marriages and an increase in divorces also negatively affects the change in the number of migrants to worsen. Based on the analysis, it was revealed that during the study period in Azerbaijan, the number of officially registered marriages decreased by 12.8%, while the number of divorced families, on the contrary, increased by 3.14 times and also negatively affects the migration process [21]. Because families who set themselves the task of moving from their place of residence force them to change their thoughts related to leaving the country to live in other countries with higher secure living standards.

Information data for 2005-2023 on migration in the republic is presented below (Graph 2).



Grap 2. Migration indicators of Azerbaijan in 2005-2023 (Demographic İndicators of Azerbaijan. (2024), 618 P.

Based on statistics for 1970-2007, it can be noted that the largest decrease in the migration rate over these years occurred in 1985-1990 and amounted to 36.3-53.6 thousand people. During these years, the Soviet Union was already in danger of disintegration, and in the union republics of the former USSR, especially in Karabakh and the adjacent regions of Azerbaijan, the processes of criminalization of Armenians, deterioration of living standards and food security of the populations began to accelerate. After the collapse of the former USSR, there was a group outflow to foreign countries consisting of various segments of the population (mainly groups of the intelligentsia) with more acceptable working conditions and higher wages, which led to a negative migration balance. The highest level of reduction in the migration balance in 1991-2007 was 14.2-12.2 thousand people (1992-1993) and the lowest was 0.4 thousand people (2004-2006). After 2008, this indicator slowed down and a positive balance occurred, amounting to a minimum of 0.4 thousand people in 2019 and a maximum of 2.3 thousand people in 2013 [21]. The reason for the decrease in the number of migrants may be the creation of a good standard of living for the population compared to previous periods. Because during this period, the average salary increased from $195 to $549 in 2010-2023, i.e. 2.82 times. Despite the fact that the salary level increases every year, this level is not considered acceptable for a state that is considered an oil and gas country. In this regard, we must admit that the state pays great attention to the re-creation of infrastructure in the regions liberated from the Armenian occupation, which has damaged the country's economy by billions of dollars.

The positive dynamics of migrant labor market indicators in Azerbaijan was observed after the pandemic (2020-2021), then slowed down compared to previous years. This process has had a disproportionately negative impact on the migration rate. However, the employment rate has improved at a faster rate, and in 2022 it is almost equal to the indigenous population. Also, the average employment rates of these population groups in the OECD countries amounted to 71-72%. Data analysis shows that in these countries the number of migrant workers is higher in percentage terms than the local population. One of the important aspects of immigration is the ethnic balance of the population, which is changing rapidly. Therefore, the role of migration in the labor market continues to become more controversial. According to experts, the dynamics of leadership development in countries is determined by the number of highly qualified specialists. These specialists are able to bring more and more ideas with the creation of new industries. The main mechanisms for assimilation of immigrants are the labor market and the comprehensive resources of the country's human resources potential. States are striving to develop and implement action plans in this direction in order to normalize the resolution of specific issues presented to them.

3.2. Identification of factors influencing the number of migrants

Determining the dependence of the number of migrants on a different group of factors is an important diagnostic issue that allows us to select the main influencing factors characteristic of any country in a certain period of time. The net benefits of migration include an increase in income generated by migration. This increase is

determined by the difference in income between the country of origin (where migrants move from) and the host country (where migrants move to). Workers in poor countries are very often looking for high wages and better employment opportunities. They usually have higher salaries in richer countries. As a result, econometric migration models take into account income differences. They consider them to be an important factor in explaining migration flows during a certain period. The influencing factors on migration can be divided into two groups: pushing and attracting. For example, low income levels may drive migrants away from their home country. Conversely, a high level of income attracts migrants to a certain country or region [23].

Regression models are the best tool (method) for analyzing, estimating and predicting the change in the number of migrants, including identifying the main factors directly affecting this indicator. Correlation analysis is a method of modeling and studying the properties of measured data. The initial data consists of a combination of values of the dependent variable and independent variables (explanatory variables). The model parameters are set in such a way that the model is as close to the data as possible. The qualitative criterion for approximating quantities (the objective function) usually shows the root-mean-square error. Here it is assumed that the dependent variable is the sum of the values of the given model and a random variable. The model is used for forecasting, time series analysis, hypothesis testing, and identifying hidden relationships in data [11].

Certain systems of factors should influence the amount of migration and be directly related to the degree of activity of the population, so their dynamics will reliably reflect the overall change in the number of migrants. When collecting materials, statistical data is the only source of information. In our opinion, calculating the average rate for the period under study, determining the minimum and maximum number of migrants will allow us to identify the constituent elements of the migration process and further identify the most likely scenarios. The following indicators are taken as independent variables: natural population growth, the number of employed people, nominal monthly wages, the number of deaths from common causes, GDP per capita and the number of specialists with higher education, and the number of migrants as a dependent variable. In the future, the realism of the model is checked by comparing the set and calculated values of the number of migrants, and a model of the change in the number of migrants and the influencing factor systems will be built.

In our opinion, the above approach will allow us to determine the equation of the relationship between the change in the number of migrants and groups of determining factors, assess the degree of influence of individual factors on the number of migrants and determine the level of migration in Azerbaijan. Also, as a result of making a forecast based on this indicator, it will be possible to establish alternative options for the level of migration in the country, due to the varying degree of influence of key factors.

3.3.Hypotheses for modeling the relationship between the number of migrants and groups of factors

The analysis period, the selection of the initial data. To build an econometric model that ensures a minimum number of migrants, we took a period covering the years 2000-2023. The source materials were selected from the statistical collections labor market and population of the State Statistics Committee of Azerbaijan [21] (Table 1).

Table 1.

Initial data and calculation results

	Y	X_1	X_2	X_3	X_4	X_5	X_6	$\bar{Y}$
2000	9.9	70.293	3855.5	143.5	46.701	595.1	24.488	6.5482
2001	7.3	65.072	3891.4	152.8	45.284	665.2	23.903	7.2703
2002	4.3	64.193	3931.1	160.4	46.522	752.9	27.795	5.6729
2003	3.8	64.466	3972.6	174.3	49.001	880.8	28.460	5.4042
2004	2.8	82.041	4016.9	180.1	49.568	1092.0	31.232	3.4801
2005	2.9	89.939	4062.3	218.4	51.962	1494.3	32.508	2.4572
2006	2.6	96.698	4110.8	227.3	52.248	2108.2	28.141	3.3089
2007	3.1	98.308	4162.2	246.4	53.655	3296.6	31.279	2.0861
2008	2.5	99.376	4215.5	269.5	52.710	4603.7	32.580	1.8395
2009	1.4	99.625	4271.7	294.4	52.514	4033.2	34.591	1.3926
2010	0.8	112.063	4329.1	331.5	53.580	4753.0	31.071	1.7172
2011	0.5	122.310	4375.2	357.1	53.762	5752.9	30.812	1.2662
2012	0.2	119.452	4445.3	394.2	55.017	5966.1	35.128	0.1116

2013	0.8	118.288	4521.2	422.5	54.383	6258.3	33.758	0.7865
2014	0.8	114.855	4602.9	442.4	55.648	6268.0	32.826	1.1030
2015	1.6	111.513	4671.6	466.9	54.697	5706.6	33.705	1.3025
2016	1.7	102.816	4759.9	484.3	56.648	6269.6	36.951	0.5218
2017	1.9	86.932	4822.1	515.4	57.109	7226.0	37.506	1.2877
2018	1.6	81.732	4879.3	595.7	57.250	8156.2	37.116	2.1094
2019	1.6	85.263	4785.6	635.1	55.916	8246.3	37.562	2.3402
2020	0.6	50.924	4721.2	707.3	75.647	7257.8	40.824	0.7005
2021	0.6	35.406	4831.1	732.1	76.878	9278.9	43.409	0.5875
2022	1.1	62.036	4901.1	840.0	60.810	13270.9	46.039	1.3799
2023	2.5	52.470	4963.3	933.9	60.150	12114.5	48.421	1.9260

Source: the calculation is based on [21] data using the “Vizual Studio Code” program

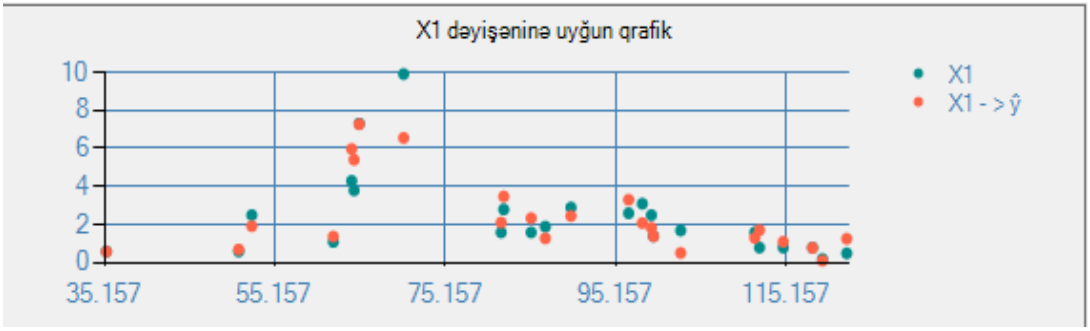
To present the results of the analysis in a comparative form for 2000, all cost indicators fully cover the following years. Here: X1-natural population growth, thousand people; X2- number of employed people, thousand people; X3 –nominal monthly salary, manat; X4- number of deaths from common causes, thousand people; X5-GDP per capita, manat; X6-number of specialists with higher education, thousand people.

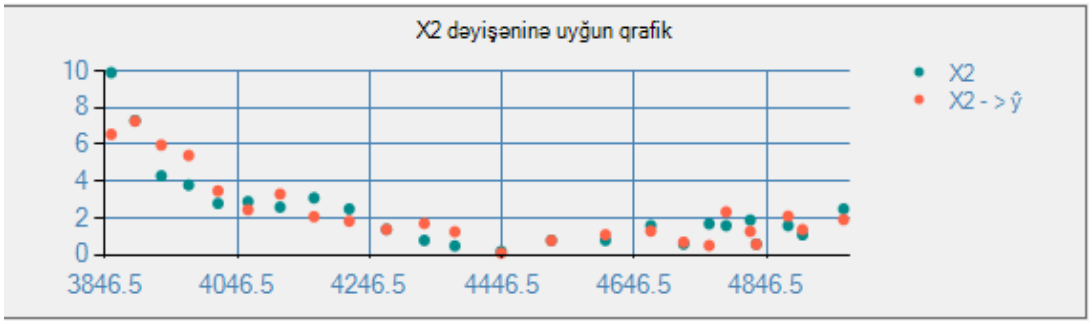
Independent factors. The following factors are considered as a possible set of factors influencing the migration process: *1. Demographic factors*: X1- natural population growth, thousand people; X4-the death toll, one thousand people. *2. Employment and human resources:* X2 is the number of employed people, thousand people; X6- number of specialists with higher education, thousand people *3. Factors of the standard of living of the population:* X3- nominal salary, manat; X5- GDP per capita, manat.

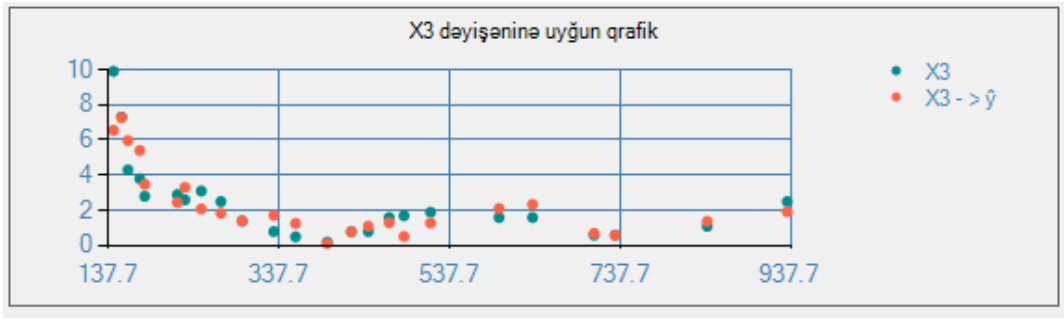
Each of the selected factors is tested for the possibility of using it as an independent variable in the regression model. The closeness of the relationship between the selected demographic, personnel, and standard of living and migration of the population at the first stage using the pair correlation coefficient was tested in the specially developed program “Vizual Studio Code". Two rules were used during the check: • if the correlation coefficient for two variables (migration and each influencing factor) has a value close to ±1, then the relationship between them is considered strong and the factor used in the model is; • if the correlation coefficient has a value close to 0 (corr ≤ 0.3), then the relationship between the values used is considered weak and the factor is not taken for use in the model.

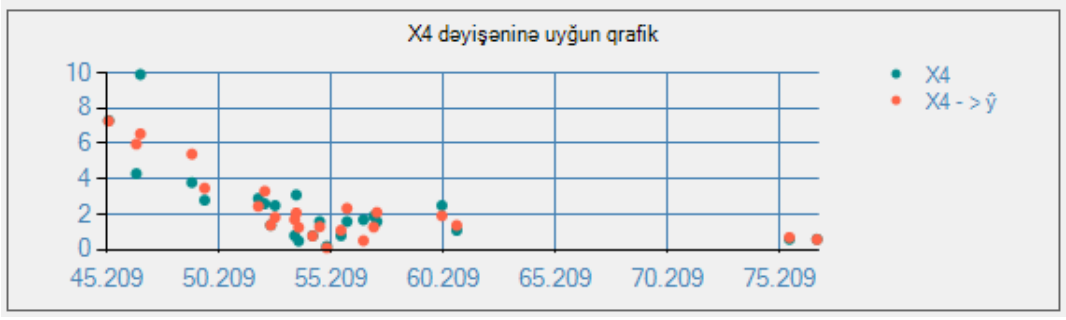
Diagrams 2.1-2.6 dispersion, the number of migrations influenced by the selected model factor, and the values of the pairwise correlation coefficients are presented below. As can be seen from the presented diagrams, all the correlation coefficients between the amount of migration and the independent factors selected for analysis were significant, i.e. capable of having a noticeable effect on the amount of migration. It should be noted that a small number of observations (n = 24) allows us to obtain an average high quality model. In addition, the quality of the model depends on the degree of mutual influence of independent factors: ideally, there should be no mutual influence. In the real economy, it is extremely difficult to find alternative development factors due to their complex indirect effects on each other.

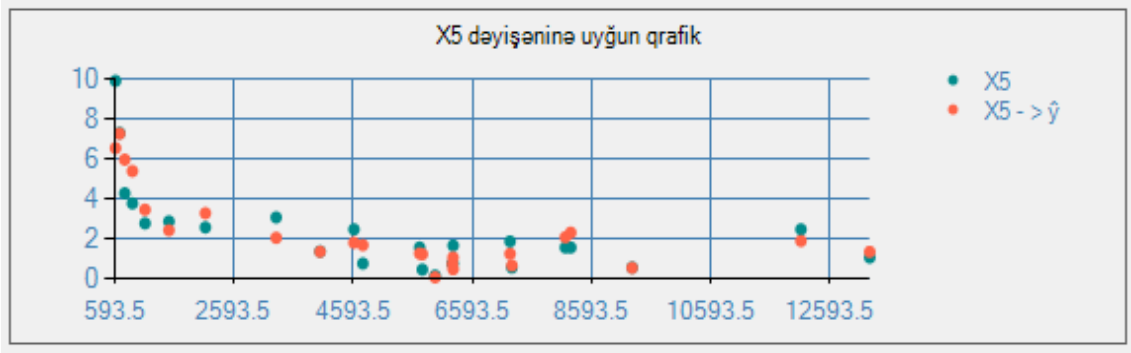
Diagrams 2.1-2.6

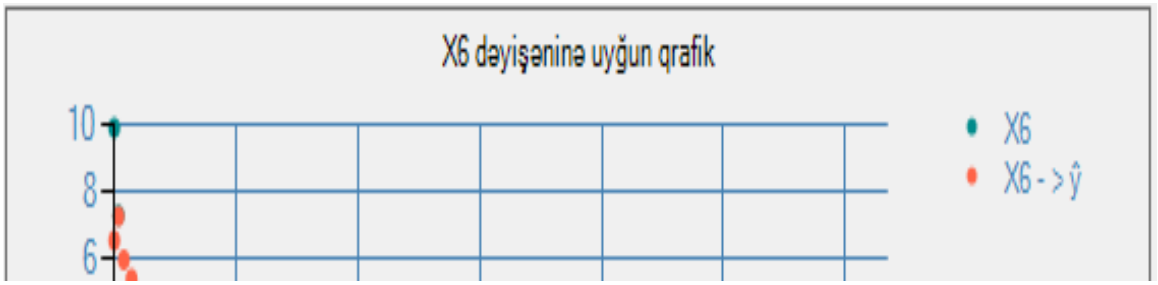












In order to circumvent these problems, the number of migrations should be separated, and subsequently the influence of all groups of factors should be generalized based on the geometric mean. To do this, you need to perform the following modeling steps: 1) to build three regression models, each of which establishes the relationship between migration and the corresponding groups of factors; 2) evaluate the sensitivity coefficients of the growth or decrease

in the number of migrants from the rate of change of factors in each group presented above; 3) to estimate the generalized rates and level of migration from the combined influence of all groups of factors, i.e. the construction of a multifactorial correlation model.

3.4. Description of the results of the econometric model construction

A linear regression model was chosen as an econometric model to study the impact of the identified development factors on migration, which generally looks like this:

$$Y=a.X+b, \quad (1)$$

where: Y is the number of dependent migration observations (number of observations n=24) from independent factors (k=6); a is the regression coefficients, a=1,2, … ,6.

To determine the relationship between the number of migrants and groups of factors, the “Vizual Studio Code” program was used, and the results are presented in Table 2.

Table 2.

Matrix of coefficients of regression models

Groups of independent variables	Leveling up	R_i^2, i=1,2,3	Coefficients of the model					
			a_1	a_2	a_3	a_4	a_5	a_6
1. Demographic factors	$M^1=a_1^1 x X_1+ a_4^1 x X_4 + b^1$	0.6961	-0.0608	-	-	-0.2459	-	-
2. Employment and human resources	$M^2=a_2^2 x X_2+ a_6^2 x X_6 + b^2$	0.6542	-	-0.0035	-	-	-	-0.0347
3. Factors are the standard of living of the population	$M^3=a_3^3 x X_3+ a_5^3 x X_5 + b^3$	0.3944	-	-	0.0067	-	-0.0008	-

Source: The coefficients are calculated using the "Vizual Studio Code” program

Coefficients of determination R^2 by groups: $R_1^2 = 0.6961$; $R_2^2 = 0.6542$; $R_3^2 = 0.3944$. It can be seen from the value of R^2 that in the first and second groups of factors, the coefficients of determination are sufficient to confirm the high reliability of the results obtained. And in the third group, this indicator does not have a very high result, but in order to build a model, we need to take into account the third group of factors. This shows that all the factors used to influence the migration rate are taken into account in the models. In the study, based on the selected data, a correlation model was constructed for the change in the number of migrants (Y) depending on many factors (X_i, i= 1.2,..., 6 factor) and the formula is expressed as:

$$Y=a_0x_{0+} a_1x_{1+} a_2x_{2+} a_3x_{3+} a_4x_{4+} a_5x_{5+} a_6x_{6+}u, \quad (2)$$

where: $x_0=1$; u is the deviation from the regression function (i.e. dissatisfaction).

Based on the calculation, the coefficients (a_1, a_2,...,a_6), R^2, and the DW criteria were obtained. The calculation results are: $a_0=28.215$; $a_1= -0.0567$;$a_2= -0.001$; $a_3=0.0066$;$a_4= -0.162$;$a_5=0$; $a_6= -0.2966$.

Given the calculated data in (2), we obtain:

$$Y=28.215-0.0567 X_1 -0.001X_2 +0.0066X_3 -0.162X_4+0.000 X_5 -0.2966 X_6. \quad (3)$$

$R_m=0.89007$; $R^2=0.79222$; $S_e=1.04094$; DW=2,09.

The Darbin-Watson test is used to test the hypothesis that there is no first-order autocorrelation in the remainder vector of the model. The Darbin-Watson criterion (DW), which is an indicator of the adequacy of the model obtained from the calculation. In practice, the hypothesis H_o about the absence of autocorrelation of residuals is tested by comparing the statistics of DW with the theoretical values of dl and du for a given number of observations n =24, the number of independent variables of the model k =6 and the significance level α. When calculating based on data from a certain period, we chose the theoretical values of d_L=0.652 and d_u=1.797 in the case of α=0.01 (1%). Also, it was determined at the significance level of the statistical quantities d_L =0.837 and d_u=2.035 in the case of α=0,05 (5%) [33].At the same time, three hypotheses of the autocorrelation residue in the model were tested:

1. When DW>d_L, the hypothesis is rejected in the absence of a true autocorrelation residue.
2. In the case of d_L≤ DW≤ d_u, the hypothesis remains open.
3. When DW > d_u, u is taken as a hypothesis.

If we look at the hypothesis, DW >d_u, or 2.09>1.797, at the level of α =0.01 (1%) of the Darbin-Watson criterion, the absence of an autocorrelation balance in the real price is assumed. Also, at the level of α=0.05 (5%), then DW >d_u, or 2.09>2.035, the absence of an autocorrelation residue in the real value is also assumed.

Thus, the change in the number of migrants in Azerbaijan and its projected value can be solved based on the long-term data of the factors selected for the case under consideration. Note that the model justifies itself in determining the change in the number of migrants in any country from multinational factors. The model allows us to determine the form of impact, reflecting the dependence of changes in quantities in any period on the influence of various factors.

DISCUSSION

The first studies of the patterns of demographic phenomena were conducted at the end of the 17th century. The Renaissance brought with it a new philosophy and a new value system. Under these conditions, the attempt to apply the mathematical method to the analysis of social phenomena has become logical. In the book by J. Graunt's "Natural and Political Observations made on Mortality Bulletins" (1662) suggests an approach where it became possible to study society through numbers [24].

In 2003, the International Union for Academic Population Research (IUSSP) organized a special group on the demography of conflict and violence. Here, the first concern of demographers is focused on how and why people die in conflicts (Brunborg and Urdal, 2005; Brunborg and Tabeu, 2005). Therefore, many demographic researchers propose the following reasons for the structure of demographic development: ethnic fragmentation, social inequality, youth growth, migration (Homer Dixon, 1991; Urdal, 2004; Neupert and Prum, 2006; de Walque, 2005; Heuveline, 1998; Vervimp and Bavel, 2005). Both in the past and in the present, epidemiological situations have led researchers on these issues to take an active interest in conflict-related mortality, especially in the causes of death [5].

Some scientists have found that the structural and demographic transformations in post-conflict societies during the war, the rate of decline in the proportion of children and demographic aging were higher than the European average. The long-term dynamics of the age structure of the population of modern post-conflict countries of the former Yugoslavia does not differ in basic parameters from other European countries [9]. In our opinion, the reason for the decrease in the number of births in these 3 countries was due to large migratory losses of reproductive cohorts in the population. In research, some authors argue that immigration does not reduce the capital intensity of the economy, but rather allows firms to expand and investments to adjust, as well as promotes innovation and economic growth, especially when highly skilled immigrants are accepted. There is also little evidence that immigration leads to displacement of jobs or lower wages in host countries [12].

There is increasing evidence that aging societies are increasingly reluctant to adopt open immigration policies, and older people systematically have a more negative attitude towards immigrants than young people [22]. This is paradoxical, since they are the ones who will benefit most from immigration: the pension system will become more stable, working immigrants will not threaten their jobs, and immigrants will work in services that are often targeted at them, such as nursing. Studying the relationship between population aging and international migration in many studies, they approach the selection of key factors determining migration in different ways, such as increased supply and demand due to the impact of population aging. These studies analyze the impact of migration on labor markets, the level of healthcare and the state budget in a political and economic context in the context of population aging [29]. Although, in our opinion, immigration is sometimes proposed as a solution to the problem of aging, its role and potential should be deeply appreciated in modern literature. Many approaches note that large-scale selection can

help reduce the demographic pressure of immigration. In general, however, these approaches conclude that migration alone will not play a significant role.

According to T.M. Fullerton et al., individual integrated equations are created to account for the components of demographic changes - births, deaths, net domestic and international migration [6]. There are many economic and non-economic factors involved in solving the migration of the country's citizens. In their own country, migrants are displaced by deteriorating economic conditions or the confrontation of political forces within the country. On the contrary, migrants are drawn to move to other countries that need high-class specialists in their specialties with high salaries, better service in all service sectors of the economy, linguistic proximity, etc. [23]. In this situation, people make a decision by comparing the net benefits of migration. This situation is also influenced by specific factors such as migrant flows (for example, migration to other countries), demographic characteristics (migrant networks and economic conditions), and developed policies with policy makers aimed at identifying (or reducing) certain types of migrants.

Practice shows that the arrival of migrants to their destination countries is diverse. This process depends on numerous factors, including the motivations of migration, migration status, integration processes, etc. The migration process sometimes provides some key results for the integration of migrants, depending on different points of view: integration into the labor market, remittances, level of professional training and housing provision, etc.

And these results are still closely related to the benefits and privileges granted to migrants depending on the length of their right to stay in the destination country. Summarizing the opinion of scientists on the conducted research, it should be noted: -the change in the number of labor migrations confirms the fact of dependence of the countries of the world; - the number of international migration depends on numerous factors such as: NTP, free movement of labor, change of residence, etc.; -the migration process is influenced by the development of multinational corporations; -population migration is an important component in modern processes in the global economy; -a decrease in the number of immigrants and a decrease in the growth of local populations does not meet the demand of the labor market.

CONCLUSIONS

The demographic and economic contribution of migrants to the lives of their countries of origin and host countries is a controversial issue and a typical example of a discussion in which logical or scientific arguments are insufficient to convince public opinion. To determine the relationship between the number of migrants and the selected group of factors, the program “Vizual Studio Code” was used and matrices of coefficients of regression models were compiled. Also, the constructed model justifies itself in determining the change in the number of migrants in any country.

The amount of international migration depends on numerous factors that push them to move to other countries. Immigration does not reduce the capital intensity of the economy, but promotes development when highly qualified immigrants are accepted. Migrants have even a minor impact on job displacement or lower wages in host countries.

REFERENCES

[1] Agadjanian V. and N. Prata (2002). War, Peace, and Fertility in Angola. Demography, 39(2), 215–231.
[2] Bolshakova P. N. (2019). Analysis of demographic features in Azerbaijan. Problems of standardization in health care. Number 1-2, 34-39
[3] Brunborg H. and Tabeau E. (2005). Demography of Conflict and Violence: An Emerging Field. European Journal of Population. Revue europ´eenne de D´emographie, 21(2), 131–144.
[4] Brunborg H. and Urdal H. (2005). The Demography of Conflict and Violence: An Introduction. Journal of Peace Research, 42(4), 371–374
[5] Debarati G.S., Olivia D. (2011).Demographic and health consequences of civil conflikt.World Development Report 2023
[6] Fullerton T. M. etc. (2015): An Econometric Approach for Modeling Population Change in Doña Ana County, New Mexico. Published in: Journal of Finance & Economics, Vol.3, №1, 20-28.
[7] Heuveline P. (1998). Between one and three million: towards the demographic reconstruction of a decade of cambodian history. Population studies, 52(1), 49– 65
[8] Homer-Dixon T. F. (1991). On the Threshold: Environmental Changes as Causes of Acute Conflict. International Security, 16(2), 76–116

[9] Hudzelyak I. (2024). Demographic development of Post-Conflict societies: The experience of the countries of the former Yugoslavia.Economicha ta Sotsialna Geografiya. №2, 19-29
[10] İsmayilov V. etc. (2024).The impact of the integration of international immigrants on the cost of labor in the labor market. Journal of Lifestyle & SDG'S Review. Vol.4.No 4, 1-25
[11] Kremer N.S. (2001). Probability theory and mathematical statistics. Moskou:UNITY. 543.
[12] Lewis E. and Peri G. (2015). Immigration and the Economy of Cities and Region. In Regional and Urban Economics *(vol. 5 in* Handbooks in Economics*),* edited by G. Duranton, J. V. Henderson, and W. C. Strange, 625–85. Amsterdam: North-Holland.
[13] Matching Economic Migration with Labour Market Needs. European Union (2014), Matching Economic Migration with Labour Market Needs, OECD Publishing.382
[14] Neupert R. and Prum V. (2006). Cambodia: reconstructing the demographic stab of the past and forecasting the demographic scar of the future, dans The demography of armed conflict , edit´e par H. Brunborg, Tabeau E. and Urdal H. Springer, The Netherlands, p. 247 – 277
[15] Orrenius P. M. (2017). New Findings on the Fiscal Impact of Immigration in the United States. Working Papers 1704, Federal Reserve Bank of Dallas, Dallas, TX.
[16] Ortega F. and Peri G. (2016). The Effect of Income and Immigration Policies on International Migration. In G. Peri,The Economics of International Migration (vol. 49 in World Scientific Studies in International Economics), 333–60. Singapore: World Scientific.
[17] Peri G. (2016). Immigrants, Productivity, and Labor Markets. Journal of Economic Perspectives *30* (4), 3–30.
[18] Peri G. (2020). Immigration can solve the demographic dilemma—but not without the right policies. Finanse and Development Magazine.№3
[19] Richard K.T. (2024). Demographic process: Migration. Demography: An inproduction to publikation Studies, №3, 163-185
[20] Schotte S. and Winkler H. J. (2014). Will Aging Societies Become More Averse to Open Immigration Policies? Evidence across Countries. SSRN Working Paper Series.
[21] State Statistical Committee of the Republic of Azerbaijan. Demographic İndicators of Azerbaijan. Baku. 2024, 618 P.
[22] Szymanska A. (2025). Demographic changes in the countries of the Western Balkans-A comparative analysis with the European Union. Comparative economics research Central and Eastern Europe. №3, 161-182
[23] Simpson N.B. (2022). Push and pull factors drive the decision to stay or move. Demographic and economic determinants of migration. №4, 25-39
[24] Thomas R.K. (2024). Demographic process: Migration. Demography: An inproduction to publikation Studies. Springer Texts in Social Sciences. Springer, Cham. №4, 3-9
[25] Urdal H. (2004). The Devil in the demographics: the effect of youth bulges on domestic armed conflict, 1950 – 2000. Report, Social Development Papers, Conflict, prevention and Reconstruction.
[26] de Walque D. (2005). Selective Mortality During the Khmer Rouge Period in Cambodia. Population and Development Review, 31(2), 351–368
[27] World migration report 2024. International Organization for Migration 17 route des Morillons P.O. Box 17 1211. Geneva 19 .Switzerland, -386 P.
[28] World Development Indicators. Updated on DB.nomics on June 29, 2024
[29] Zaiseva A., Zimmermann K.F. (2016). Migration and the Demographia Shift. Handbook of the Economic of Population Aging. №1, 119-177
[30] 30. https://www.rosstat. gov.ru/b An electronic resource. Date of request: 11.06.2024
[31] 31. https://www.un.org/ru/un75/shifting-demographics. An electronic resource. Date of request: 18.09.2024
[32] 32. https://rosstat.gov.ru/bgd/free/B99_10/IssWWW.exe/Stg/d000/i000030r.htm. An electronic resource. Date of request: 02.11.2024
[33] 33.https://real-statistics.com/statistics-tables/durbin-watson-table/