

Assessment of the impact of labor migration on the natural demographic movement of the region's population

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Abstract. Labor migration is a key factor in regional demo-economic processes. On the one hand, it plays a significant role in achieving balanced employment. In this sense, it plays a significant role in achieving of the labor markets efficiency. On the other hand, labor migration, as a leading factor in the general migration of the population, along with births and deaths, affects the demographic development of territories. The study of the dual nature of labor migration in the «economy-population» system is an important area of predictive analytics and population movement modeling. The article is devoted to the study of the factors of labor migration dynamics in the region and the assessment of its impact on the natural movement of the population. The object of the study is North Ossetia, as a Russian region with a stable negative migration balance and a deteriorating demographic situation. The work used the methods of a sociological survey, as well as cliometric, statistical, graphical and regression analysis. Sociological studies have shown that the level of development of the labor market has a decisive influence on the migration behavior of the young population. The results of the regression analysis performed in the Excel showed a high and strong inverse relationship between the indicators of the natural population movement and the labor migration of young people. The scientific novelty of the research lies in the development of a systematic methodology for studying the demo-economic processes of the region in order to model effective interregional labor migration in Russia.

1 Introduction

Labor force migration has been studied in economic science for more than a hundred years, as it is a historically determined complex process that forms international and regional labor markets, each of which has its own characteristics and trends [19]. One of the first attempts to systematize and explain migration processes, taking into account social and economic motives, are the works of E.G. Ravenstein. Based on the analysis of a large amount of empirical material in order to explain and predict the migration of the population, E.G. Ravenstein formulated the laws of migration [7]. Focus of attention in the studies were on

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internal migration. The laws of migration clearly highlight the basic characteristics of migration processes, which subsequently had a significant impact on work in the field of migration modeling within the framework of the system «population-economy». His works convincingly proved the conclusion that «migration reflects life and progress» [7, p. 288], defining labor migration as part of the life of society and as part of economic progress.

In the works of J.M. Keynes and other representatives of Keynesianism (M. Kalecki [22], R. Skidelsky [30], R.F. Kahn [32], M. Savoskul [25]), labor migration is considered in the system of state regulation of labor resources in various spheres of the state economy. J.M. Keynes considered the world economy as a certain set of state-run farms striving to ensure maximum employment, he showed that the basis of the world labor market is the migration of international and domestic labor.

The neoclassical theory of labor migration, presented in the works of W.A. Lewis [42], R.M. Solow, R. Dorfman, P. Samuelson [33], J. R. Harris, M. P. Todaro [15], J. R. Hicks, [16], proceeds from the presence of free competition and a perfect market for production factors. The main idea of this concept is the international difference in wage levels, which is manifested in the functioning of labor markets, and migration is seen as a decision of a rational individual, taken on the basis of complete and reliable information about the situation on the labor market. Consequently, the dynamics and direction of migration flows are formed depending on the economic characteristics of the territories: in economically developed and attractive territories there is a migration increase, in an economically underdeveloped territory there is an outflow of the population. It does not consider non-economic factors of migration.

Representatives of the institutional school of Economics I. Abella, H. Troper [12], R. Birrell [29], B. Roberts [4], R. Whitaker [31] emphasize a broader study of the interaction of social institutions and the market, while the legal basis for the functioning of migration is considered as the root cause, since within this approach the state is the most significant regulator of migration flows. When describing the migration of the population and the movement of labor resources between labor markets, it is emphasized that the social structure of the labor force is a significant factor in the segmentation of the labor market based on the separation of the primary and secondary labor markets, which, as a result, makes it possible to describe the socio-economic motivation of a potential migrant. However, the institutional approach does not take into account the role of state institutions in counteracting illegal migration, and does not describe the mechanism for taking into account changes in the attractiveness of territories for migration.

The shortcomings of the institutional school are solved within the push-and-pull theory, according to which in each territory of arrival and departure of migrants there are various groups of factors, which are described in the mathematical model of E.S. Lee [10]. These factors may have holding, pulling and pushing properties for population, determine the reasons for the arrival and departure of labor migrants. The factors of migration themselves are differentiated by the degree of impact and the level of coverage of the population. Push factors include economic factors: unemployment, low income, high taxes; social and political factors, including poverty, discrimination, wars, restrictions on freedom of conscience and religion; factors of unfavorable natural and climatic conditions. Pull factors for the destination area of migration are presented in the form of a high level of economic development, higher incomes, security and opportunities to gain access to the labor market [24]. Within the framework of this approach, it was found that pull factors have a more significant impact on people with a high level of education, who have a certain position in the region of departure and, at the same time, can receive more favorable conditions for work in the region of arrival [17]. Low-skilled workers, in turn, are more affected by negative push factors. At the same time, along with many rational reasons for population migration, there are irrational and personal reasons that are not taken into account in push-and-pull theory.

The principles of attraction of the econometric model of E.S. Lee are the basis of the gravitational theory of migration. One of the well-known modifications of the gravity model is the S. Stouffer approach, which takes into account the socio-economic factors of labor migration, including transport costs, local legislation that prevents migration, lack of awareness of the migrant about the situation in the labor markets, negative attitudes of the local population and etc. The measure of competition for labor resources in the gravity model is defined as the number of potential migrants in a circle located between the cities under consideration in such a way that the radius of the circle is the distance between the cities, and the center is in the city of migration attraction [23].

Gravitational and entropic models for predicting labor movements are also used in the concept of the new migration economy. Its representatives O. Stark, D.E. Bloom [28], E. Katz [8], J.E. Taylor [14] take into account at least two groups of factors as the goal of migration as a socio-economic phenomenon, firstly, minimizing potential risks of income fluctuations through their diversification, and secondly, the formation of a sufficient financial base for the effective provision of production processes. In accordance with the concept of the new economy migration, the result of territorial movements of the population is either the achievement of population equality in terms of well-being, or an unstable system characterized by constant movement of the population between territories. This approach makes it possible to apply models based on game theory, while it is necessary to calibrate the model parameters on short-term statistical trends, which limits the applicability of the concept in its pure form and requires a significant smoothing of the series of migration dynamics and the introduction of artificial constraints - model conditions in particular cases.

The synthetic theory of migration, also known as the theory of migration networks, was proposed by the sociologist D.S. Massey [6]. The author considers the phenomenon of international labor migration in developing countries. The main idea of the synthetic theory of migration is the globalization of the labor market, while the processes related to international migration operate at different levels of political and social structures simultaneously. Mobile groups of the population «sell» their labor in various markets, which explains the high level of migration to cities where wages are much higher, so large-scale international labor migration is not observed in the absence of a wage gap, while wage differentiation is also does not guarantee the development of international labor migration. One of the main provisions of the synthetic theory of migration is the assumption that migration is capable of self-continuation. Despite the restrictions of migration legislation, there are a number of companies that facilitate the arrival of immigrants to new territories, including illegal ones, as a result of which migration turns into a well-established network.

It should be noted that theoretical approaches to the study of labor migration presented above are widely used in the works of Russian authors. The foundations of the Russian theory of migration were laid by M.V. Lomonosov, who was the first to try to determine the main factors and causes of migration processes in the Russian Empire, and also created the prerequisites for its state regulation. He believed that a strict administrative impact on migration processes does not lead to the desired result and determined the directions for flexible state regulation in the field of migration, for example, in order to compensate for the demographic gaps in economic growth by attracting labor force [26]. Most of the modern Russian research is devoted to the analysis of the dynamics and directions of migration flows in Russia, as well as the reasons for the observed trends. In particular, an assessment of the impact of migration on the labor market in Russia as a whole and separately for groups of regions that attract, push and repel migrants was made [11]; it has been shown that the outflow of migrants from the region leads to an increase in wages and per capita income in it, however, the impact of migration on the unemployment rate has not been identified [18]; models and forecasts of labor migration between Russian regions have been developed [3]; substantiates the need to form an institutional mechanism for labor migration from lagging

regions to advanced ones for the full functioning of the labor market [2]; the socio-demographic characteristics of migrants have been deeply studied [36].

It should be noted that the internal migration of the labor force in these works is explained mainly within the framework of market-driven theories, without deeply taking into account the non-economic effects of migration, which are critically significant due to the high diversity of the Russian population [9], although confessional [41], ethno-psychological [35] and cultural [13] problems of interregional migration have been comprehensively studied. At the same time, there are still not enough works investigating the negative aspects of the demographic development of donor regions. At the same time, labor migration, while improving the economic situation in the receiving regions, significantly exacerbates the socio-demographic problems of large Russian territories, and regions with a decreasing population are threatened with their inevitable degradation within two generations. In the conditions of depopulation of Russia, studies of the demographic processes of territories with an intensive migration outflow of the able-bodied population become relevant. It is no coincidence that in the National Security Strategy of the country, approved by the President of Russia on July 2, 2021, the task of «saving the people of Russia and developing human potential» was put in the first place.

Insufficient elaboration of issues of demographically safe development of regions with a steady outflow of labor determines the need to develop the concept of a national labor market with effective labor migration.

The purpose of the study is to substantiate the hypothesis of a significant feedback between labor migration indicators and the natural movement of the population of the region on the example of North Ossetia, as one of the typical subjects of the Russian Federation with a stable negative migration balance and a deteriorating demographic situation.

2 Materials and Methods

To study the impact of labor migration on the natural demographic processes of the region, we used official data from the reference website Worldometers [5], data from Rosstat [20, 21, 27, 34, 37-40], as well as data from sociological researches.

By demographic processes we mean unregulated and regulated changes of the qualitative and quantitative composition of the population, due to the processes of fertility, mortality, migration, as well as socio-cultural characteristics of society and state policy. The adopted methodology is based on the understanding of the essence of migration according to Lomonosov, which consists in the fact that the structure of the population is represented by dualistic complexes of demographic processes: «emigration – mortality», «immigration – fertility» – inversely affecting the growth and development of the population of the state [26].

The dynamics of the population of the region is the first thing that people pay attention to when talking about demographic processes. The population of the region changes under the influence of natural and mechanical (migration) movement of the population, it is calculated by the equation of demographic balance:

$$P_t = P_0 + N - M + I - E \quad (1)$$

P_t u P_0 – population in current and base years

N – the number of births in current year;

M – the number of deaths in current year;

I – the number of arrivals in the region in current year;

E – the number of people who left the region in current year.

The increase in the population of the region over a period of time t is then calculated:

$$P_t - P_0 = (N - M) + (I - E) \quad (2)$$

$(N - M)$ – natural growth;
 $(I - E)$ – mechanical growth (migration growth, migration balance).

The modern paradigm of labor migration is based on the fact that the subjects of international and state administration are obliged to control migration processes and integrate labor migrants into the national economy, preventing the situation from aggravating. To develop recommendations for managing interregional migration processes, it is proposed to introduce the concept of effective labor migration. In accordance with the author's approach, effective labor migration is understood as the movement of labor to the regions of the country that lack it, in the quantity and quality necessary and sufficient for their sustainable and safe development.

3 Results and Discussion

Under the influence of a complex of political, social, economic and other factors, a demographic crisis is observed in modern Russia. As can be seen from Fig. 1, since 2018, the decline in the population of Russia has been steadily increasing, amounting to about 2 million people over a five-year period. Despite the fact that Russia is home to 11.8 million people (more than 8% of the country's population) legal and about 5 million people (more than 3% of the country's population) illegal migrants (<https://finexpertiza.ru/press-service/researches/2023/pritok-trud-migrant-2022>). The growing demographic crisis is explained by low birth rates, which, as in many European countries, do not provide simple reproduction of the population, and extremely high mortality, significantly exceeding not only European, but also global values.

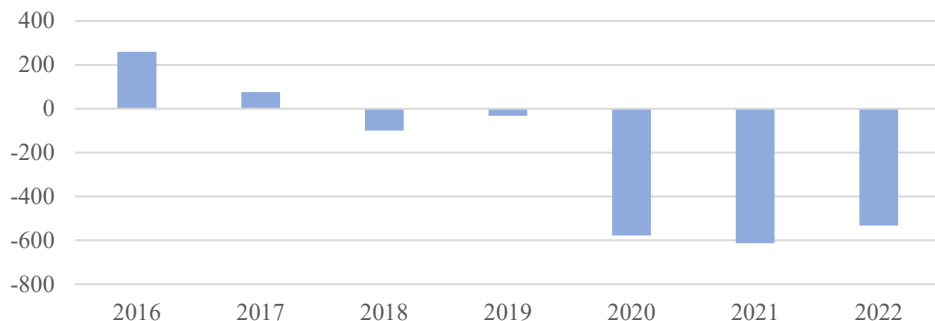


Fig. 1 General increase in the permanent population of Russia in 2016-2022, thousand people
Source: [37, 39]

Fig.2 shows the dynamics of the mortality rate of the population in the world and Russia in 2000-2021, calculated in ppm (the ratio of the total number of deaths in the world and the country per year to the average annual population, multiplied by 1000%). As can be seen from Fig.2, mortality rates in Russia are twice the global values for almost the entire analyzed period.

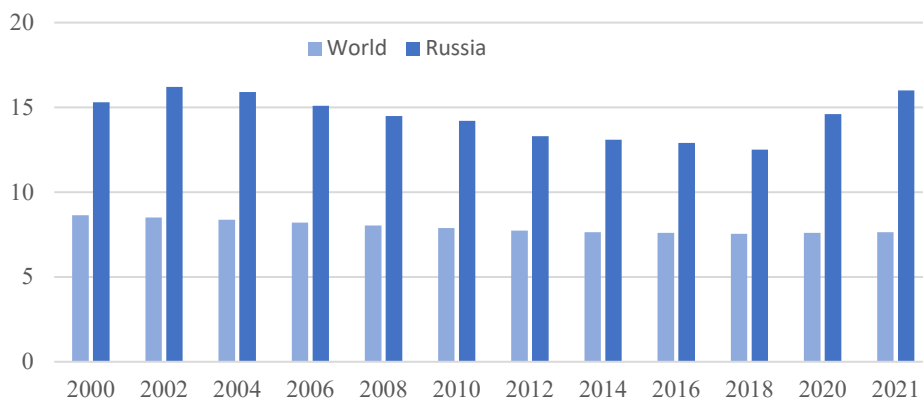


Fig. 2 Dynamics of the mortality rate in the world and Russia in 2000-2021, ppm (%)
 Source: [5,37]

Of course, in Russia, as the largest country in the world in terms of area, demographic processes have different intensity, volume, direction and dynamics. Table 1 presents a grouping of regions with typologically different qualitative characteristics of the population balance.

Table 1. Grouping of regions of the Russian Federation according to the degree of influence of indicators of natural movement and migration on population change in 2022

Group No	Natural and migration factors of population dynamics in Russian regions	Number of regions
Regions where the population has decreased, in total		72
including due to:		
1.	natural loss and migration outflow of population	57
2.	excess of natural loss over migration increase	10
3.	excess of migration outflow over natural increase	5
Regions in which the population has increased, in total		13
including due to:		
4.	natural and migration growth	3
5.	excess of natural growth over migration outflow	4
6.	excess of migration growth over natural loss	6

Source: [39]

As can be seen from Table 1, in 2022, the population increased only in 13 regions of Russia, of which only three regions had a mechanical and natural population growth – these are Ingushetia, the Khanty-Mansiysk Autonomous Okrug-Yugra, and the Tyumen Region. In Dagestan, Tyva, Chechnya and the Yamal-Nenets Autonomous Okrug, an excess of natural increase over migration outflow is recorded. In the Republic of Tatarstan, Kaliningrad, Leningrad, Moscow regions, Sevastopol and Moscow, the migration increase compensated for the natural population decline.

The number of regions with a decreasing population, despite a significant migration increase, included 10 economically developed territories (St. Petersburg, Krasnodar and Krasnoyarsk Territories, Novosibirsk, Chelyabinsk Regions, etc.). In 5 regions, the migration outflow exceeded the natural increase, and demographic processes worsened. Finally, in 57 regions, including the Republic of North Ossetia-Alania, the decline in population occurred due to natural and migration loss.

Over the period 2001-2021, the total population decline in North Ossetia, one of the smallest border areas of Russia, amounted to 25.1 thousand people, or 3.5%, and over the period 2007-2021, the population decreased by 20.7 thousand people or by 3%, that is, the intensity of population decline increases despite the fact that during the analyzed period, the

natural population growth in the region amounted to 30.2 thousand people. As can be seen from Fig. 3, over the decades, the degree of intensity of birth has gradually decreased, and the death rate has oscillatingly increased – as a result of the prevailing trends in fertility and mortality, the total rate of natural population growth in North Ossetia-Alania fell by 6.2 ppm: from 3.7‰ in 2016 to – 2.5‰ in 2021. Since 2018, a dangerous trend of natural population decline has developed in the region.

The second most important factor in the decline in the population of North Ossetia is negative migration, because despite the fall in the birth rate in 2021 by 2.7‰ compared to the period of maximum birth rate in 2013-2014. (8.1‰ vs. 10.8‰), its average annual value in 2016-2021. was 8.8‰, which is 1.7‰ higher than the same indicator in the period 2001-2007.

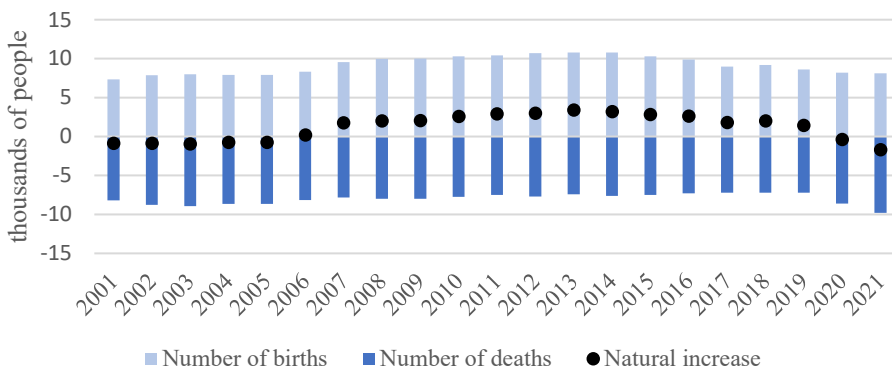


Fig. 3. Dynamics of the population natural movement of the RSO-Alania in 2001-2021, thousand people.

Source: [37,39]

On Fig. 4 shows the dynamics of the migration movement of the population, which indicates that for the period 2001-2021. the total negative balance of migration amounted to 61.8 thousand people. In 2022, North Ossetia entered the top 5 Russian regions in terms of the negative migration coefficient (-6.5‰), along with such regions as Kamchatka - 10.2‰, Sakhalin - 8.7‰, Magadan Region – 7.7‰.

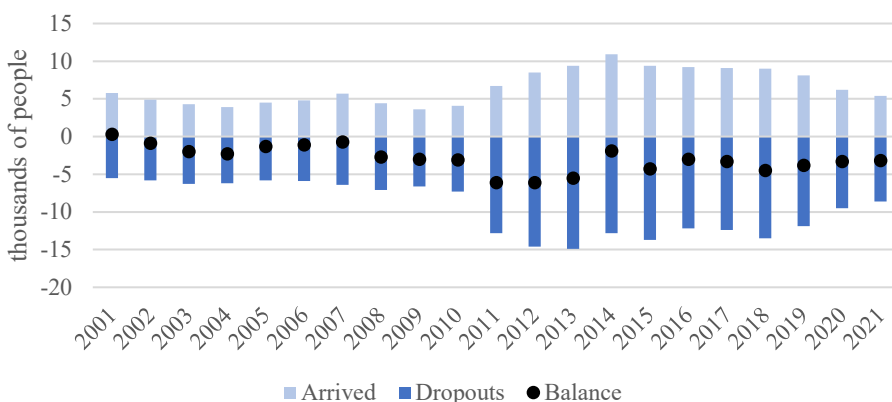


Fig. 4. Migration of the population of the RSO-Alania in 2001-2021, thousand people.

Source: [27]

The structural dynamics of the main directions of migration flows in North Ossetia in 2002-2021 is reflected in Table 2.

Table 2. The main directions of migration flows of the population of the Republic of North Ossetia – Alania in 2002-2021

Migration flows	2002		2010		2021	
	People	%	People	%	People	%
Arrivals - total, including:	9192	100	7037	100	7014	100
intra-regional migration	4329	47,1	2912	41.4	1604	22.9
external (for the region) migration	4863	52,9	4125	58.6	5410	77.1
from them came:						
from other regions of Russia	3171	34,5	2957	42.0	4555	64.9
from other countries	1692	18,4	1168	16.6	855	12.2
Those who left - total, including:	10149	100	10179	100	10224	100
intra-regional migration	4329	42,7	2912	28.6	1604	15.7
external (for the region) migration	5820	57,3	7267	71.4	8620	84.3
some of them left:						
to other regions of Russia	5536	54,5	7153	70.3	8078	79.0
to other countries	284	2.8	114	1.1	542	5.3

Source: [27,38]

These data allow us to conclude that in 2020-2021, the scale and proportion of intra-republican migration in the total migration turnover of the region greatly decreased, and on the contrary, the intensity of external migration increased. As Table 2 data show, in the total volume of migration turnover of the population of the republic in 2002, external (for the region) migration flows accounted for 57.3%, and in 2021 – 84.3%. Such a change in the ratio of flows occurs as a result of an increase in the scale and intensity of the outflow of population from the republic to other regions of Russia. Migration relations of North Ossetia population with other states are low-intensity and practically do not affect the population and labor force. At the same time, the republic has a positive migration balance in international migration. First of all, this is due to the fact that South Ossetia appears in statistical reports as another state and with which more people come to North Ossetia than leave. In addition, the positive balance of migration in North Ossetia is recorded with some republics of the former Soviet Union, including Georgia, Azerbaijan, Armenia, Tajikistan, etc. [27, 38].

Due to the large scale, interregional migration flows play a major and negative role in changing the population and labor force of the republic. The negative balance of migration of North Ossetia with other regions has been fixed for a long time. For example, in 1991-2001, its average annual size was 1.8 thousand people [27]. However, during this period more people came from other states than left, as a result of which the republic had an overall positive migration balance. Since 2002, the situation has changed radically – both the general negative balance of migration and the large-scale excess of outgoing flows to Russian regions over those arriving from them are recorded in the republic. According to Table 3, there is a clear trend of an increase in the total migration turnover of the population with the regions of Russia, an increase in the scale and intensity of the negative balance of migration. This trend is especially typical for 2002-2006. Subsequently, the volume of the negative balance of migration decreased somewhat.

Table 3. Migration relations of North Ossetia with other regions of Russia

Years	Absolute data (people)			For 1000 people		
	arriving	departing	balances	arriving	departing	balances
2002-2006	14.3	28.7	-14.4	-	-	-
On average for the year	2.9	5.8	-2.9	4.1	8.2	-4.1
2007-2011	15.7	39.3	-23.6	-	-	-
On average for the year	3.1	7.8	-4.7	4.4	11.0	-6.6
2012-2016	39.4	65.5	-26.1	-	-	-
On average for the year	7.9	13.1	-5.2	11.2	18.6	-7.4
2017-2021	32.7	52.7	-20.0	-	-	-
On average for the year	6.5	10.5	-4.0	9.3	15.0	-5.7
2002-2021- total	102.1	186.2	-84.1	-	-	-
On average for the year	5.1	9.3	-4.2	7.2	13.2	-6.0

Source: [27,38]

In general, during the period under review, 84.1 thousand people left North Ossetia for other regions of Russia. The average annual negative balance of migration for the specified period was 4.2 thousand people, or 6.0 ‰. Such a scale and intensity of the migration exchange of the population of North Ossetia with other regions of Russia greatly reduces the demographic and labor potential of the republic. Consequently, migration processes should be in the focus of constant monitoring and become objects of the socio-economic policy of the republic. In this context, it is important to determine the territorial directions of migration flows.

Statistical data indicate that North Ossetia has migration links with all federal districts of the Russian Federation. These relationships can be characterized using a variety of absolute and relative indicators. From the point of view of evaluating the results of population movement, the most capacious indicators are the balance of migration and the final performance coefficient of interregional migration relations (CIRM), which shows the number of departures per thousand arrivals. Therefore, the higher the level of CIRM, the more intensively people move from the donor region to the recipient regions.

Table 4 shows that over the past twenty years, the balance of migration of the population of North Ossetia is negative with all federal districts of Russia. The slight excess of migrants from the Siberian and Far Eastern regions over those leaving for these regions, observed in 2001, does not change the overall picture. The level and dynamics of migration indicators reflect that for 20 years North Ossetia has been a migration donor for all regions of Russia, and they have been its migration recipients.

Table 4. Performance Indicators of Interregional Migration Relations of North Ossetia for 2001 - 2021

	2001		2011		2021	
	Migration balance	CIRM	Migration balance	CIRM	Migration balance	CIRM
Total with Russian regions	-1886	1576	-7475	2431	-3523	1773
including:						
Central Federal District	-1093	3434	-1623	3136	-712	1489
North-Western Federal District	-223	2149	-659	3362	-345	1750
Southern Federal District	-616	2300	-1342	2468	-493	1583
North Caucasus Federal District	28	978	-3291	2458	-1444	2285

Volga Federal District	-12	1045	-134	1423	-164	2019
Ural Federal District	-45	1271	-142	1626	-111	1974
Siberian Federal District	69	739	-189	1636	-168	1672
Far Eastern Federal District	6	966	-95	1552	-86	1589

Source: [27;38]

In order to regulate migration processes and reduce the outflow intensity from North Ossetia, first of all, it is necessary to study the factors and causes of the outflow of the population to other regions. They can be established with the help of sociological research, official statistics on migration, a comparative analysis of migration factors in the regions of arrival and departure, etc.

The reasons for migration recorded in statistical reports are not sufficiently informative. For example, the absolute majority of migrants from North Ossetia leave for «personal and family reasons» and «for other reasons» (Table 5). Based on such general information, it is difficult to draw objective conclusions, however, it can be concluded that from North Ossetia, as well as from many other regions, people mainly leave due to lack of work or labor market inefficiency, expressed in mismatches between supply and demand in the labor market - skills mismatch, which is offering an unattractive, low-paid, or unpromising job for overqualified stuff. At the same time, the proportion of people leaving for this reason is constantly and rapidly increasing. Thus, 10.3% of migrants left North Ossetia «in connection with work» in 2004, and in 2021 twice as many – 20.7%. Therefore, we can conclude that the intensive migration outflow from the region indicates an unfavorable situation in terms of employment opportunities, especially for educated youth.

Table 5. The main reasons for departure from North Ossetia according to official migration statistics

	2004		2012		2021	
	People	% to the total	People	% to the total	People	% to the total
Total retirees aged 14 and older, including due to:	9910	100	11615	100	6330	100
In connection with studies	529	5.3	580	5.0	460	7.3
In connection with work	1022	10.3	1368	11.8	1308	20.7
Return to the previous place of residence	668	6.7	445	3.8	237	3.7
Due to the aggravation of interethnic tensions	62	0.6	70	0.6	17	0.3
Due to the aggravation of the criminal situation	24	0.2	18	0.2	3	0.04
Environmental distress	6	0.1	6	0.1	10	0.2
Due to natural and climatic conditions	19	0.2	13	0.1	16	0.26
Personal, family reasons	7091	71.6	7719	66.4	3449	54.4
Other reasons	499	5.0	1396	12.0	830	13.1

Source: [27;38]

In the course of our research in 2022, a sociological survey was conducted among 650 senior students of three state universities of North Ossetia: North Ossetian State University, North Caucasus Technological University and North Ossetian Medical Academy. The survey showed that 54.7% of the respondents were ready to leave for other regions to start their work (the top 3 included Moscow, St. Petersburg and Krasnodar), and 24.5% reported their plans to leave North Ossetia immediately after graduation. At the same time, 87.3% of respondents assessed the problem of finding a well-paid job in their specialty in the republic as critical.

33.5% of those who were not going to leave were ready for any well-paid job not in their specialty.

Thus, the problems of labor market inefficiency and the observed gaps in the supply and demand of professional skills had a decisive impact on the migration mood of young graduates in 2022. However, this problem is chronic, which is confirmed by a comparative analysis of the results obtained with some previous studies. The importance of the problem lies in the fact that the inefficiency of the labor market as a cause of migration from North Ossetia for almost 20 years is more often referred to as young people with the highest childbearing potential. As can be seen from Table 6, in all the above three age groups, the proportion of those leaving due to the lack of suitable work in the region is high and is rapidly increasing. All this testifies to the tense and deteriorating situation in the labor market of the republic and, especially, in its youth segment.

Table 6. Outflow of young people from North Ossetia due to «work-related» reasons

Age groups, years	2004		2012		2022	
	Total	Of these in connection with work	Total	Of these in connection with work	Total	Of these in connection with work
Absolute data, people						
20-24	1559	206	2786	514	775	203
25-29	1466	220	2836	569	888	283
30-39	2081	317	3836	695	1730	447
% to total						
20-24	100	13.2	100	18.4	100	26.2
25-29	100	15.0	100	20.1	100	31.9
30-39	100	15.2	100	18.1	100	25.8

Source: [27;38]

The conclusion that the unemployment rate is the main factor pushing population migration out of North Ossetia is confirmed by relevant statistical information, namely: in all migration recipient regions, the overall unemployment rate is much lower than in North Ossetia (Table 7). The inefficiency of the labor market is also a significant factor: in the course of the above-mentioned sociological survey, 82% of respondents planning to leave the republic due to work related reasons are confident in the possibility of finding a job in other regions corresponding to the profile of their education.

Table 7. Unemployment rate in North Ossetia and its migrant recipient partners

	2002		2012		2021	
	Unemployment rate, %	Rank among regions	Unemployment rate, %	Rank among regions	Unemployment rate, %	Rank among regions
Russian Federation	8.0		5.5		4.8	
North Ossetia	12.5	61	7.9	46	13.4	81
Moscow	1.4	1	0.8	1	2.6	5
Moscow oblast	4.3	4	2.9	3	3.4	8
St. Petersburg	3.4	2	1.1	2	2.0	1
Leningrad Region	7.0	21	3.2	4	3.7	13
Krasnodarskiy kray	7.6	28	5.6	24	5.0	51
Rostov region	11.7	56	6.0	30	4.0	22
Stavropol Territory	9.6	47	5.4	22	5.3	54

Source: [20,21,34]

On the basis of Russian population survey on employment problems, the Federal State Statistics Service ranks the regions according to various indicators of socio-demographic development, including the level of unemployment. In this list, North Ossetia constantly appears among those regions where a very high unemployment rate is recorded. According to 2021 data, the republic was ranked as 81 among 85 regions of the Russian Federation in terms of unemployment.

The scale and intensity of the outflow of the population from North Ossetia is influenced by a large number of factors and reasons. Determining the role of each of them in this process is almost impossible. However, the significant impact of unemployment on the formation of a negative balance of migration is undoubted. Consequently, reducing the unemployment rate should become a priority for demographic and, in particular, migration policy, and labor market policy in the region. In turn, labor force migration, especially at a young age, leads not only to current, but also to future demographic losses, since recipient regions receive not only demographic dividends in the form of a massive increase in the labor force, but also a fertility dividend, since young people, who left North Ossetia for other regions, sooner or later create families and give birth to children.

In order to determine the degree of mutual influence of indicators of the natural movement of the population of the region and the number of labor migrants, we carried out a regression analysis. The calculations were made using the linear regression method in Excel, which made it possible to determine the analytical form of the relationship in which the change in the resultant attribute - natural population movement - is due to the influence of the factor attribute - labor migration (Table 8). The number of labor migrants who left the region is taken as the number of their current households, calculated taking into account the average annual birth rates for 20 years of the analyzed years.

Table 8. Demographic factors affecting natural population dynamics

Y	Natural increase (decrease) of the population, thousand people	Dependent variable
X 1	Birth rate of the population, thousand people	Independent, explanatory variables
X 2	Mortality of the population, thousand people	
X 3	Increase (decrease) of labor migrants, thousand people	

Pairwise correlation calculations for variables are shown in Table 9.

Table 9. Pair correlation matrix of variables

Variable	Correlations of Regression Coefficients b; DV: Y			
	X1	X2	X3	Y
X1	1.000000	0.471471	-0.791870	0.978716
X2	0.471471	1.000000	0.150941	0.565010
X3	-0.791870	0.150941	1.000000	-0.705399
Y	0.978716	0.565010	-0.705399	1.000000

The calculation of the standard deviation error and the Fisher criterion is presented in Table 10. The Fisher criterion shows that the explained variance is significantly greater than the unexplained one, and the desired model is significant.

Table 10. Calculation of the standard deviation error

Statistic	Summary Statistics; DV: X 3
	Value
Multiple R	0.791870172
Multiple R ²	0.62705837
Adjusted R ²	0.607429863

F (1,19)	31.9463103
p	0.000018931627
Std.Err. of Estimate	0.0486212991

The estimation of the parameters of the regression equation is presented in Table 11.

Table 11. Estimation of parameters of the regression equation

Effect	Analysis of Variance; DV: X3				
	Sumsof Squares	df	Mean Squares	F	p-value
Regress.	0.075522	1	0.075522	31.94631	0.000019
Residual	0.044917	19	0.02024		
Total	0.120439				

To construct an equation for the dependence of indicators of natural increase (loss) of the region's population on the number of labor migrants, an empirical correlation ratio was calculated (Table 12).

Table 12. Empirical coefficient of determination

N=3	Regression Summary for Dependent Variable: Y R= 0,79187017 R ² = 0,627 Adjusted R ² = 0,607 F(1,19)=31,946 p<0,00002 Std.Error of estimate: 0,04862					
	b*	Std.Err. of b*	b	Std.Err. of b	T (20)	p-value
Intercept			0.30277	0.023307	12.99015	0.000000
X3	-0.791870	0.140102	-2.97270	0.525946	-5.65211	0.000019

The coefficients of determination are obtained: $b = -2.9727$, $a = 0.3028$, on their basis we build a linear regression equation, which looks like:

$$y = -2.973 x + 0.303 \tag{3}$$

To assess the quality of the regression equation, standard coefficients of correlation analysis are calculated.

1) The degree of relationship between two variables is usually estimated by the Pearson correlation coefficient (r), which is a measure of the linear relationship between two indicators: r^2 is the proportion of the total variance of Y , which can be explained by linear regression of Y to X . The possible values of the correlation coefficient vary from 0 to ± 1 . The greater the absolute value of r_{xy} , the higher the closeness of the connection between the two values ($r_{xy} = 0$ indicates a complete absence of communication, $r_{xy} = 1$ indicates the presence of an absolute or functional connection).

Using the formula for calculating the indicator $r_{xy} = b (S_x/S_y)$ and the data from Table 11-12, we obtain the value of the correlation coefficient $r_{xy} = -0.792$:

$$r_{xy} = -2.973 (0.0202/0.757) = -0.792.$$

That is, the relationship between the variables is quite strong. For a qualitative assessment of the strength of the connection, we use the popular Cheddock scale (Table 13)

Table 13. Cheddock Correlation Score Scale

Absolute value of r_{xy}	Tightness (strength) of the correlation
0-0.1	Practically absent
0.1 – 0.3	Weak
0.3 – 0.5	Moderate
0.5 – 0.7	Notable
0.7 – 0.9	High

0.9-0.99	Very high
0.99-1	Practically functional

Thus, the relationship between the indicators of population dynamics and labor migration is high and inverse.

2) Let's estimate the multiple correlation coefficient, which is a measure of how well Y can be predicted by a linear combination of several predictors. It is defined as the square root of the multiple coefficient of determination. In the case of a one-factor correlation model, this coefficient is equal to the pair correlation coefficient r_{xy} . The multiple correlation coefficient can also range from 0 to 1, where 1 means that Y can be perfectly predicted by a linear combination of multiple predictors, and 0 means that multiple predictors cannot be used to determine Y . In our case, the correlation ratio for linear connection is equal to the correlation coefficient r_{xy} . A high value of the multiple correlation coefficient indicates sufficient reliability of the model.

3) The quality of the regression equation is also characterized by the coefficient of determination. For a linear relationship, the coefficient of determination is equal to the square of the correlation coefficient r_{xy} : $R^2 = r_{xy}^2$, which is often determined as a percentage. Calculated above $r_{xy} = -0.792$, then $R^2 = 0.6271$. Thus, in 62.71%, the dynamics of labor migration negatively affects the natural increase in the population of the region. Despite the accepted conditional assumptions - the number of households of labor migrants based on average birth rates of 20 years, it can be concluded that the accuracy of fitting the regression equation is above average.

Thus, the proposed research hypothesis is proven. The regression analysis, despite the average accuracy of the obtained regression equation, showed that there is a high and strong feedback between the indicators of the natural and mechanical movement of the population of North Ossetia. We believe that the identified trend should be taken into account in the implementation of employment regulation policy and improving the efficiency of the functioning of the regional labor market.

4 Conclusion

The study allows us to draw a number of theoretical and practical conclusions. The development of migration theory is based on a set of interrelated and supplemented scientific theories and concepts: classical school, Keynesianism, neoclassical school, new economics of labor migration, institutional theory, push-and-pull theory, gravitational and entropy concepts of migration, etc. An analysis of approaches evolution to the essence of labor migration showed that modern works by Russian and foreign authors most widely use the provisions of approaches and theories that focus on maximizing the welfare of migrants and on differences in the levels of economic development of regions that generate migration flows under the influence of pushing and pulling predominantly economic factors. However, the migration processes taking place in modern Russia cannot be fully and comprehensively explained solely by economic conditions, without taking into account its spatial scale, because Russia occupies 1st place in the world in terms of area, and only 9th in terms of population with a high probability of falling even more low positions in the global demographic ranking. The spatial patterns and proportions of labor migration that have developed over decades of market reforms have led to serious demographic problems in most regions of Russia. Thus, according to the latest statistics, in 73 regions of the country the population has decreased: in 5 regions this happened due to the excess of migration outflow over natural increase, and in 57 regions due to natural decline and migration outflow of the population. The Republic of North Ossetia-Alania is one of the latter.

In the course of the study, a hypothesis was formed about the significant mutual influence of indicators of the natural and mechanical movement of the population of the region. To prove it, a regression analysis was carried out in the work, which made it possible to determine the analytical form of the relationship in which the change in the resultant sign – the natural movement of the population – is due to the influence of the factor sign – labor migration. The relationship between labor migration (X) and natural population movement (Y) was estimated using the paired linear regression method, and the regression equation $y = -2.973x + 0.303$ was obtained. The multiple regression coefficient b_j shows by what amount the resultant attribute Y will change on average if the variable X_j is increased by a unit of measurement. From an economic point of view, this means that the growth of labor migration by 1 unit leads to a natural decline in the population by an average of more than 2 units. Statistical significance was tested using the coefficient of determination and Fisher's test. As a result, calculations showed that in 62.71% Y changes under the influence of X changes. Taking into account the accepted conditions and restrictions, the model parameters are statistically significant. Thus, the results of the regression analysis showed a high and strong relationship between indicators of natural population loss and labor migration in North Ossetia, which is based on the educated youth of the region.

To develop recommendations for the management of interregional migration processes, it is proposed to introduce the criterion concept of effective labor migration. In accordance with the author's approach, effective labor migration is understood as the movement of labor from one region to other regions of the country that lack it, in the quantity and quality necessary and sufficient for their sustainable and safe development, which is expressed in the following conditions:

- balancing demand and supply in the regional labor markets through motivated regulation of directions, as well as the quantitative and qualification composition of labor migration flows;
- increasing the share of migrants employed in the formal sector of regional labor markets, which will increase the revenue side of the budgets of the recipient regions and reduce the negative impact of irregular migration in the receiving regions;
- increasing the economic benefits from labor migration for the economies of the regions of arrival and departure of the able-bodied population, which consist in a more efficient use of specialists, faster economic growth and positive dynamics in the income of the working population;
- maintaining a sustainable level and quality of life of the population through the redistribution of labor between regions, taking into account the needs of local labor markets in terms of education levels and age categories;
- preserving the spatial parameters of Russia's population as a result of historical progress through the development of regional labor markets that compensate for the number of outgoing labor migrants by incoming ones, and the implementation of proactive measures to prevent the natural decline in the region's population.

The practical significance of proposals to regulate interregional migration movement of the population based on the principles of effective labor migration is not only to increase the efficiency of the functioning of regional labor markets, the growth of the economy and incomes of the employed population, but also in ensuring balanced demographic development of Russian regions.

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