CORRELATION-REGRESSION MODEL OF MIGRATION FLOWS OF EMPLOYED RURAL POPULATION IN SARATOV REGION, RUSSIAN FEDERATION

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Abstract

The problems of the migration outflow of the able-bodied population in the Russian Federation are reflected on the example of the Volga Federal District, which is leading in terms of these indicators. For a monographic study from the group of rural areas of the Saratov region, which is part of the Volga Federal District, the areas with high average and low levels of outflow of the able-bodied population were selected. Using the method of correlation analysis, the influence of a number of factors on the mechanical movement of the population of the three studied districts of the region was determined. For these districts of the Saratov region, a regression model of the influence of factors on the migration flows of the able-bodied population has been developed. Based on the regression model for regional and municipal authorities dealing with the development of rural areas, heads of agricultural organizations and peasant farms, a list of possible management decisions aimed at reducing the migration outflow for each group of districts was compiled.

*Key words***:** *labor migration, migration balance, outflow of working-aged rural population, correlation-regression model, rural area development*

INTRODUCTION

At present, in Russia as a whole and in the region in particular, the ratio of fertility, mortality and migration processes cause a steady decline in the population. This tendency is especially pronounced in rural areas, due to the fact that the socio-economic, engineering, household and cultural conditions of their development lag significantly behind cities of regional importance and from large industrial agglomerations.

Insufficient knowledge of the impact of socio-economic factors on the demographic development of rural areas, as well as the high scientific and practical significance of the development and implementation of models of socio-demographic development in the countryside served as the basis for the research [4].

The theory and methodology of socio-economic processes affecting the development of demography are disclosed in the works of many Russian and foreign scientists - economists, sociologists and demographers. Problems of migration dynamics taking into account socio-economic aspects were researched by G. Borias G. Borjas [1], W. Zelinsky [18], E.S. Lee [5], W.A. Lewis [6], D. Massey [7], E.E. Petras [8], S. Sassen [11], A. H Sjaastad [12], R. Skeldon [13], O. Stark [14], M.P Todaro [16].

In this context, the purpose of the paper was working out correlation-regression model of migration flows of employed rural population in Saratov region, Russian federation.

MATERIALS AND METHODS

To research the reasons for the migration of the able-bodied rural population, the method of correlation-regression analysis was used. When selecting independent variables, we relied on the network theory of migration by D. Massey [7], in which the level of wages is not the leading factor determining the intensity of migration flows, but is only one of

many. The advantages of using this theory are that the author takes into account both the economic conditions and the well-being of the population's life, focusing on the provision of social and household benefits. A peculiarity is that from a migration point of view, it is not a single person, but a household that is considered, that is, the basis for making a decision on migration is not only income maximization, but also minimization of risks for running a household.

Also, to systematize the variables that affect the migration balance, the theoretical and methodological provisions of T.I. Zaslavskaya [17], in which the influencing indicators are subdivided into factors-regulators and factors-conditions, L.L. Rybakovsky [10] - emphasis is placed on the provision of the rural population with the necessary objects of social infrastructure, and the works of R. Piras [9], I. Etzo [2], S. Ghatak and others [3] - the levels incomes of the population, social payments, the development of public consumption funds, etc.

In the correlation-regression model, the set of independent variables is made up of factor-regulators - indicators that determine the economic well-being of the rural population (the level of wages and disposable income, indicators of the development of agricultural production, the development of public consumption funds, etc.) and factor-conditions - indicators of the already achieved level development of social infrastructure (condition of the road fund, provision of medical specialists, etc.). The output data of the model made it possible to select those indicators that most closely influence the reduction of the outflow of the able-bodied rural population, to propose to the state authorities and the management of agricultural enterprises the sequence of effective management decisions.

RESULTS AND DISCUSSIONS

Over the past 20 years, until the active outbreak of the coronavirus pandemic in 2020, the trend in the migration inflow of labor migrants, mainly from the CIS countries, began to be noticeably traced in the Russian Federation (Table 1). Migration flows from Tajikistan, Ukraine and Armenia increased several times from the year 2000 to 2020.

Table 1. Dynamics of the migration balance of the Russian Federation with the CIS countries

Countries	Balance of interstate migration (persons)				
	2000	2010	2018	2019	2020
Total	246,051	150,734	129,076	256,000	118,864
1. Azerbaijan	11,719	13,389	8,737	17,005	10,893
2. Armenia	14,432	19,192	14,358	35,109	-1,844
3. Belarus	-3,002	1,995	7,191	6,283	-1,404
4. Kazakhstan	106,990	20,533	26,516	39,166	8,437
5. Kyrgyzstan	13,679	20,260	8,978	15,106	1,401
6. Moldova	9,415	11,197	7,688	5,385	3,493
7. Russia	9,885	17,494	31,028	48,374	39,420
8. Tajikistan	6,062	2,178	2,951	6,198	777
9. Uzbekistan	37,724	23,266	6,807	19,129	4,922
10. Ukraine	39,147	21,230	14,822	64,245	52,769

Source: calculated on the basis of data [15].

Along with the noted trend, it can be noted that from 2015 to 2019. stable migration flows within the country are traced from the Volga, Far Eastern, Siberian, Ural and North Caucasian Federal Districts to the Central and Northwestern Federal Districts. The Volga Federal District is in the lead (Table 2), in which the Saratov region makes a significant contribution to the outflow of the working population - from 2015 to 2019 the migration balance increased from - 4,368 to - 6,934 people. Consequently, part of the shortage of jobs is compensated by visiting migrants from the CIS countries.

Table 2. Dynamics of migration flows in the Russian Federation

Federal Districts (FD)	Migration gain (decline in population) in absolute expression, (persons)				
	2015	2016	2017	2018	2019
Central Federal District	119,382	126,734	85,226	124,902	90,511
Northwestern Federal District	35,771	38,351	38,537	45,072	39,263
Southern Federal District	18,234	20,117	36,989	17,373	16,243
North Caucasian Federal District	- 28,027	- 31,549	- 25,411	- 29,058	- 15,670
Volga Federal District	- 50,458	- 60,813	- 46,774	- 62,095	- 43,520
including Saratov region	- 4,368	- 7,169	- 5,609	- 7,810	- 6,934
Ural Federal District	- 13,432	- 20,450	- 15,879	- 20,013	- 20,508
Siberian Federal District	- 45,795	- 48,480	- 47,420	- 51,815	- 40,275
Far Eastern Federal District	- 35,675	- 32,816	- 25,268	- 24,366	-26,062

Source: calculated on the basis of data [15].

For this reason, the Saratov region was chosen as the object of a detailed study of the reasons for the outflow of the able-bodied population, including from rural areas. For a monographic study, from the group of rural districts of the Saratov region, districts with high (Piterskiy), medium (Ivanteevsky) and low (Voskresensky) levels of the outflow of the able-bodied population were identified. Using the method of correlation analysis, the influence of a number of factors on the mechanical movement of the population of the three studied districts of the region was determined.

As a result, the size of disposable income and official employment of the able-bodied population are significant indicators influencing the migration outflow of the population (direct correlation dependence - correlation coefficients from 0.5 to 0.8). In an area with a low migration outflow (Voskresensky district), disposable incomes increased by more than 2 times during the study period; with the middle (Ivanteevsky district) - almost 1.5 times; with intensive (Piterskiy district) - by 11%.

The following pattern was revealed: the smaller the outflow of the working-age population in the regions, the greater the number of factors that have a close or significant correlation with the migration balance. In Ivanteevsky and Voskresensky districts, in addition to the factors that determine the level of well-being of the population, there is a close connection between the dynamics of annual capital investments in agricultural production, gross regional product, the number of social benefits, the staffing of medical specialists, the state of the road fund, and budgetary spending on education.

For these districts of the Saratov region, a regression model of the influence of factors on the migration flows of the able-bodied population has been developed (Table 3).

We used linear regression model, which calculate on the base of formula:

$$Y(x,b) = b_0 + b_1 x_1 + b_2 x_2 + \ldots + b_k x_k,$$

where:
b_k – regression coefficients, x_k – model factors, k – quantity of factors.

The indicator of the migration balance was taken as the dependent variable (Y). When selecting multicollinear independent variables from the model, multiple correlation matrices were compiled for each of the regions. Variables were excluded from the calculation of the regression equation according to the

following principle: if they had a strong or noticeable relationship with other variables (correlation coefficients - more than 0.6 in absolute value), the remaining factors are the input data of the regression and are re-numbered. The models have a high level of statistical reliability: the determination coefficients were 95-98 %, the Fisher's calculated criteria exceeded their critical values. Based on the regression model for regional and municipal authorities dealing with the development of rural areas, heads of agricultural organizations and peasant farms, a list of possible management decisions aimed at reducing the migration outflow for each group of districts was compiled.

Table 3. Correlation-regression model of migration flows of the able-bodied rural population (based on materials from the Saratov region)

Piterskiy district (high dynamics of migration outflow)		
Independent variables:	**Regression equation:**	**Conclusions on the results**
x1 - average monthly size of disposable income of the population; x2 - the level of official employment of the population,%; x3 - gross regional product per capita; x4 - amount of state aid agricultural enterprises; x5 - capital investments in agricultural enterprises.	$y = -418.35 + 9.08x_1 + 9.02x_2 + 0.86x_3 + 4.67x_4 - 1.53x_5$ **Reliability parameters:** $R^2 = 0.95$; $F_{critical} = 0.18$; $F_{fact} = 5.82$	high response y to an increase in xi by 1 unit: x1 will reduce y by 9 units, x2 - by 9 units; moderate response y to an increase in xi by 1 unit: x3 will reduce y by 1 unit, x4 - by 5 units; negligible or negative response y on variables: x5
Expected effect: reduction of the migration outflow from 270 to 179 people by 2025		
Ivanteevsky district (average dynamics of migration outflow)		
Independent variables:	**Regression equation:**	**Conclusions on the results:**
x1 - average monthly size of disposable income of the population; x2 - the level of official employment of the population,%; x3 is the share of private business; x4 - investments from the municipal budget; x5 - capital investments in agricultural enterprises	$y = -312.18 + 4,55x_1 + 9,30x_2 + 4.85x_3 + 0.64x_4 + 0.15x_5$ **Reliability parameters** $R^2 = 0.70$; $F_{critical} = 0.15$; $F_{fact} = 10.30$	high response y to an increase in xi by 1 unit: x1 will reduce y by 4 units, x2 - by 9 units, x3 - by 5 units; moderate response y to an increase in xi by 1 unit: 10X4 will reduce y by 6 units; 10X5 - for 2 units.
Expected effect: reduction of the migration outflow from 162 to 100 people by 2025		
Voskresensky district (low dynamics of migration outflow)		
Independent variables:	**Regression equation:**	**Conclusions on the results:**
x1 – average monthly size of disposable income of the population; x2 – the level of official employement for the population, %; x3 is the share of private business; x4 - investments from the municipal budget; x5 – amount of state aid agricultural enterprises x6 - capital investments in agricultural enterprises	$y = -43.01 + 0.60x_1 + 2.11x_2 + 0.19x_3 + 0.02x_4 + 1.87x_5 + 0.50 x_6$ **Reliability parameters** $R^2 = 0.98$; $F_{critical} = 0.17$; $F_{fact} = 68.00$	high response y to an increase in xi by 1 unit: x1 will reduce y by 1 unit, x2 - by 2 units; moderate response y to an increase in xi by 1 unit: 10X6 will reduce y by 5 units, x5 – by 2 units; negligible or negative response y on variables: x3,x4
Expected effect: reduction of the migration outflow from 25 to 11 people by 2025		

Source: calculated by authors.

In areas with a high and medium migration outflow, in addition to universal solutions (using the reserves of available vacancies, developing standard and non-standard forms

of employment, subsidizing part of the cost of paying interest on loans, as well as maintaining the existing growth rates of disposable income of the population), it is advisable to introduce tax incentives, strengthen support all types of businesses (including small ones), self-employed citizens who create jobs, and diversify the rural economy.

Forecast calculations of the expected effect from a decrease in migration outflow show that due to the reserves for the growth of disposable incomes of the population in the Piterskiy district, this indicator will decrease by 91 people or 33.7%; in Ivanteevsky district - by 62 people (by 38.3%); in the Voskresensky district - for 14 people (by 56%).

CONCLUSIONS

Correlation analysis of the influence of factors-regulators and factors-conditions on the mechanical outflow of the rural population according to foreign and domestic methods of their selection, carried out in three studied districts of the Saratov region of the Russian Federation, showed that the size of wages and official employment of the able-bodied population is the main indicator of decision-making on the population's residence in the countryside.

As a result of constructing a correlation-regression model, reflecting the influence of regulating factors and factors-conditions on the migration outflow of the working-age population of rural areas of the Saratov region, it was revealed that in all the studied regions the greatest response of the dependent variable to the independent ones was found in terms of growth in disposable income and the level of official employment. As predicted calculations show, by 2025 the migration outflow will decrease by 14-91 people, depending on the analytical gradation. Also, according to the simulation results, it was found that for a more radical solution to the problem and achieving a positive mechanical increase in the economically active population in rural areas, a more extensive list of management decisions is needed, especially in

areas with a high and average outflow of the able-bodied population, it is necessary to reduce the tax burden of producers and processors of agricultural products through the introduction of property tax incentives in order to increase the volume of the regional product, as well as to strengthen support for all types of businesses and self-employed citizens.

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