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FORECAST OF LABOR MIGRATION, REPRODUCTION OF POPULATION, AND ECONOMIC DEVELOPMENT OF RUSSIA

In the medium and long term, amid the insufficient development of labor-saving technologies, Russia will be forced to increase its economic capacity through the elements of extensive economic development by using the growing migration to meet its increasing demand for the labor force. In the current environment, an important task of public administration is to improve the effectiveness of regulation in the area of international labor migration in Russian regions by taking into account the characteristics of their demographic and economic development, which makes it more relevant to prepare the forecasts of interdependent development of migration, reproduction of population and the economy of Russian regions. The article for the first time proposes a model set that allows to perform such forecasting by using a dynamic system of equations, including the matching function, Cobb — Douglas production function, and other. To automate the implementation of the model set, the author developed a Java/Javascript-based computer program that ensures high-speed data exchange with statistical databases, calibration, and forecasting, and provides a wide range of services for presenting the results. The implementation of the model set allowed to build a statistical forecast of labor migration, reproduction of the population, and economic development of Russia for the period until 2030. In accordance with the forecast, even with the maximum use of potential labor migration from CIS, by 2030, the total labor force of Russia will decline by almost 5 % compared to 2016 and will be 74,684 thousand people. Moreover, the absolute shortage of labor resources will be accompanied by the hike in the unemployment rate from 5.8 % to 7.1 %. The forecasted situation indicates the growing structural imbalance of supply and demand in the labor market as a result of the discrepancy between the qualifications of job seekers and open vacancies. In addition to labor problems, Russia's GDP growth in the forecast period will be hindered by low labor productivity resulting from the labor-intensive type of economy with a high share of manual labor that dates back to Soviet times.

Keywords: labor migration, reproduction of population, labor market, labor force, economically active population, unemployment, wages, output, forecast, migration policy

Introduction

Amid increasing global mobility of the population, the participation in the world labor market has become a norm for most countries. In Russia, a surge in the influx of foreign labor occurred after the collapse of the USSR. The number of officially employed labor migrants in Russia has steadily increased since the late 1990s. As a result of such dynamics, it exceeded 1 million people in 2006 and, in 2014, it reached as many as 3 million people.

The dependence of Russian economy on the influx of labor from abroad is caused by two factors: 1) Decline in the number of economically active population as a result of reduced domestic opportunities for replacing the retiring generations by young people entering the labor market; 2) large number of low-skilled jobs that are unattractive for local population and continue to exist as a result of labor-intensive type of economy with a high share of manual labor that dates back to Soviet times.

The need to attract the foreign labor is not an issue in the current environment. At the present stage, the main task is to improve the effectiveness of regulation in the area of international labor migration in Russian regions by taking into account the characteristics of their demographic and economic development, which makes it more relevant to prepare the forecasts of interdependent development of migration, reproduction of population and the economy of Russian regions.

The paper is structured as follows. The genesis of methodological approaches to modeling the migration is presented in Section 1. The development of a model set to forecast the labor migration, reproduction of population and economic development of Russian regions is discussed in detail in Section 2. The composition and sources of initial data are provided in Section 3. Section 4 presents the results of forecasting the labor migration, reproduction of population and economic development in Russia. Conclusions and recommendations are provided in Section 5.

1. The Genesis of Methodological Approaches to Modeling the Migration

To obtain scientifically sound forecasts of labor migration, reproduction of population and economic development of Russian regions amid great uncertainty, it is necessary to use special mathematical models, a large number of which has been developed to date.

In the framework of the neoclassical theory, W. Strielkowski and F. Turnovec developed a migration model for two countries that allows to assess the tendency of a rational individual to migrate by comparing the expected income with migration costs [1]. G. Batishcheva proposed a model based on human capital theory, according to which a rational individual decides to migrate by assessing the expected net income in the host region, which can be defined as a discounted flow of payments based on wages in the host and home regions, unemployment benefits and probability of employment in the host region, as well as migration costs [2, P. 9–11]. The fact that these micro-models are designed to describe the behavior of a separate rational individual and are not suitable to forecast the migratory flows between regions or countries can be mentioned as their principal shortcoming.

Among the macro-models, it is worth mentioning the gravity model of migration proposed by G. Zipf [3], according to which the migration flow between the regions is directly proportional to the population in the regions of departure and arrival and inversely proportional to the square of the distance between them. The main advantage of the gravity model is its ease of use. As a shortcoming, one can note its assumption about the symmetry of migration flows, which is never observed in real life. In addition, the gravity model has a low explanatory power, because it considers only three factors. A common shortcoming of the above models that they allow to describe only two countries (departure and destination), which prevents modeling the changes in the composition of migration flows.

The model of spatial movement (Alonso model) [4] considers the fact that potential migrant can compare his/her place of residence not just with one region, but with all possible regions of destination. The model includes the equations that allow to assess the total migration flow between the regions of departure and destination, outflow from the region of departure and inflow into the region of destination. Therefore, the model eliminates the assumption on the symmetry of migration flows between the regions.

It should be noted that all above models reflect only one-way dependency of migration on various factors and do not consider its reverse effect on socio-economic processes. In reality, migration and socio-economic processes have both direct and reverse links.

The first models (1950s) describing the impact of labor migration on the host territory were designed to assess the migration effect on the Gross Domestic Product (GDP), the main indicator of national economy [5]. These models are based on the hypothesis stipulating that the economic growth depends directly on the amount of labor resources. Today's models describe the migration effects on GDP through various multipliers, including the labor market indicators. Among the latter, one can single out the model of the impact made by migration on the development of the economy during the periods of growth and decline through the change in the level of unemployment and labor productivity [6], model for calculating net income from migrants, which links GDP to the costs of keeping the foreign workers, elasticity of wages and share of migrants in the total number of employed [7].

Most of the models developed to date are designed to assess the impact of labor migration on the labor market, which is caused by the need to test the hypothesis claiming that the migrants are taking jobs from the local population [8]. Typically, these models are based on statistical methods of correlation-regression analysis, while the migration effect on the labor market is assessed in the medium term (5–10 years) and by using only one indicator, such as the level of unemployment among local population [9]. The structural models of the interrelationships between migration and unemployment [10] that additionally take into account the qualifications of workers have also gained widespread use. Another type of models in the area of the labor market is the model for assessing the elasticity in substitution of jobs by migrants [11], which considers the age and educational characteristics of migrants, and the duration of migration.

The experience of modeling the impact of migratory flows on the incomes of the population in the host country is widely represented in foreign literature. A significant contribution in this area was made by G. Borjas [12–14], who developed the models of labor by taking into account its heterogeneity in terms of qualifications. The same method was used by H. Brücker [15] to analyze the short- and long-term impact of labor migration on wages of the local population.

As shortcoming of the above models is the fact that their application allows to assess the impact of migration on the basis of just one indicator—GDP, unemployment, or wages (depending on the model). At the same time, with a positive impact on one indicator, the migration can produce strong negative effects in other spheres of life. Therefore, the modeling of migration effects should consider, in a comprehensive way, all of the substantial and most important consequences of migration.

This scientific gap was filled by X. Liu [16] and T. Palivos [17] who, within the search and matching model [18–19], analyzed the impact of immigration on wages and employment of local labor by taking into account its heterogeneity in terms of qualifications. By using the production functions resulting from the influx of immigrants, the authors also modeled the change in the marginal product of workers' labor at different levels of skills, which is considered when determining the wage rate in the process of bargaining between the firms and employees in accordance with the generalized Nash rule.

The conducted analysis led to the conclusion that none of the existing models allows to simultaneously forecast the labor migration, reproduction of the population and economic development of Russian regions. At the same time, it is necessary to note the methodological characteristics of reviewed models, which may be used in the development of the relevant model:

1) Comparison of wage levels in the regions of departure and destination of migrants as in the neoclassical model;

2) Consideration of direct costs of moving by using the indicator of distance between the regions of departure and gravitation in the gravity model;

3) Consideration of the influence of migration networks when replacing the population of the region of gravitation by the number of migrants on its territory in the gravity model;

4) Ability of potential migrant to compare his/her place of residence with all possible regions of destination as described in the spatial movement model of Alonso;

5) Determining the change in output of the region of destination resulting from the influx of migrants based on the production function; and

6) Determining the probability of finding a job and wage of a migrant as described in the search and matching model.

2. Model Set for Forecasting the Labor Migration, Reproduction of Population and Economic Development of Russian Regions

The proposed model set allows to forecast the following characteristics of labor migration:

1) The number of migrant workers in the regions of gravitation broken down by country of origin of migrants depending on the wage differential in the country of departure and region of destination, number of potential migrants in the countries of departure, number of migrants who previously arrived to the region of destination and are of working age, distances between the country of departure and region of destination;

2) Economically active local population in the regions of gravitation by taking into account the processes of reproduction and age structure of the population;

3) Economic effects resulting from changes in the number of labor migrants and economically active local population in the regions of gravitation (including the Gross Regional Product and average output of employee by taking into account the changes in aggregate labor in the region; number of unemployed and employed by taking into account the availability of jobs in the regional labor markets characterized by search frictions; wage by taking into account the negotiating power of the employee).

The structure of the model set reflecting the interdependence of dynamics in labor migration, reproduction of population and economic development at the initial and final point of the migration vector is schematically shown in Fig. 1. A detailed description of the model set is provided below.

Labor migration. Let's consider n regions of gravitation and m countries of the departure of migrants, which eliminated the obstacles to labor mobility. The number of labor migrants from the country of departure i in the region of gravitation j at the point of time t_p will be designated as $x_{ij}(t_p)$.

A rational individual makes a decision on migrating from the country of departure i to the region of gravitation j by comparing their wage levels (w_i and w_j, respectively). This decision will be positive, if the expected income from the wage gap between the country of origin and region of the destination of the migrant will be positive, that is $w_j - w_i > 0$. Since the purpose of developing the model set is to forecast the situation in the host region, to simplify the modeling problem, let's assume that the value

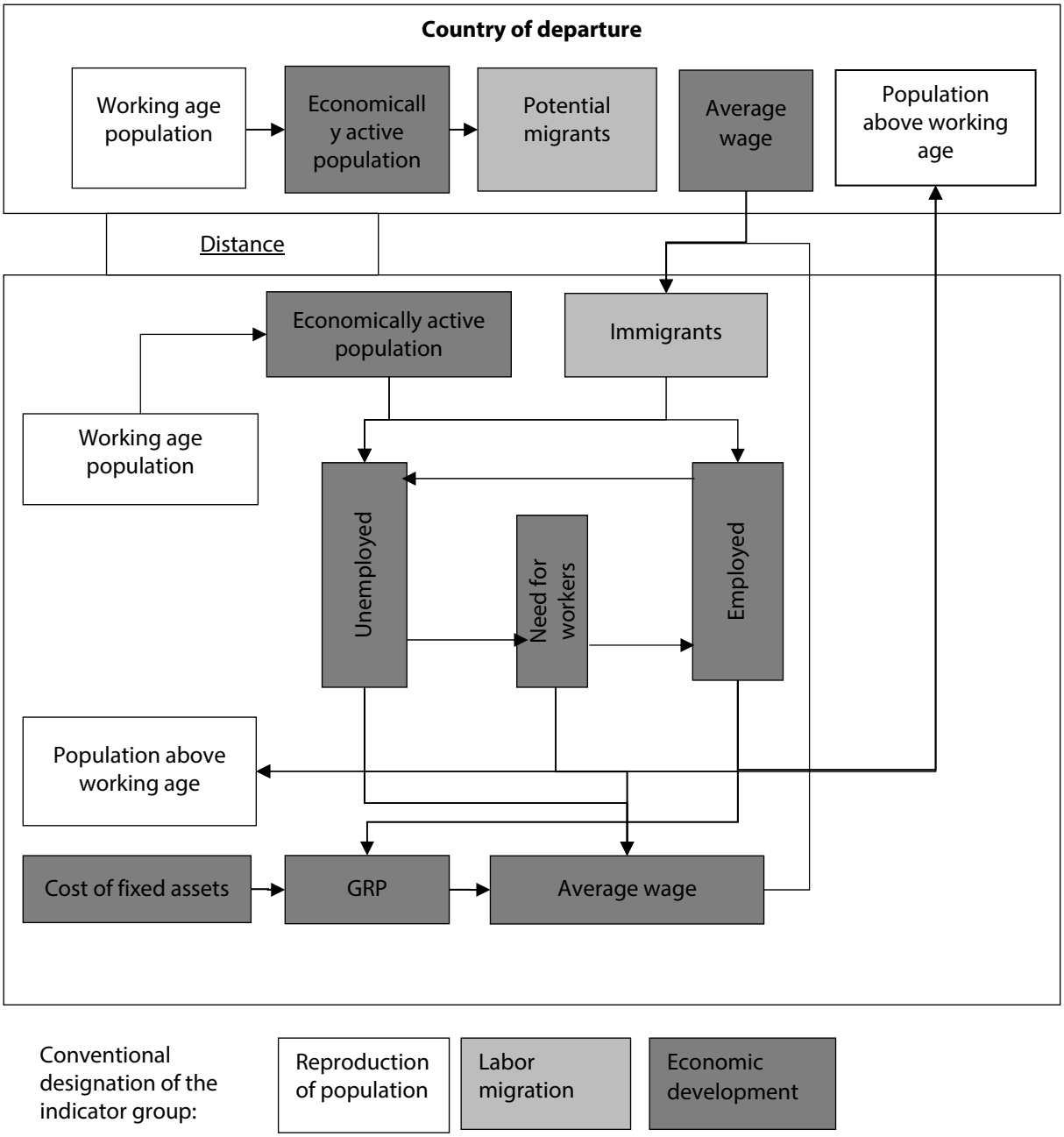

Fig. 1. *The structure of the model set for forecasting the labor migration, reproduction of population and economic development of Russian regions*

$w_j(t_p)$ changes over time as a result of migration, while $w_i(t_0)$ remains constant. Then the process of making a decision on migration can be presented as follows:

1) $w_j(t_p) - w_i(t_0) > 0$ — a decision adopted to migrate from country i to region j;

2) $w_j(t_p) - w_i(t_0) < 0$ — a decision adopted to return to country i or move to another region of gravitation $k \neq j$, which meets the condition $w_k(t_p) - w_i(t_0) > 0$.

When deciding to migrate, in addition to maximizing the expected income, a rational individual will tend to minimize the migration costs, including the direct costs of moving. Other things being equal, the individual will select among many potential migration regions n the one that is closer. In the model, the impact of this factor on the decision to migrate is reflected by the indicator d_{ij} (distance from the capital of the country of departure i to the regional center of gravitation j).

An important institution for self-regulation of migration processes is provided by migrant networks, which facilitate the migration of compatriots. The development of these networks directly depends on the number of migrants who previously arrived in the region of gravitation j from the same country of departure i; therefore, in our model, the impact of migration networks on the decision to migrate is reflected by the indicator $x_{ij}(t_p)$.

Translation

At the same time, the migration outflow from the country of departure i at the point of time t_p is limited by the number of its potential labor migrants $M_i(t_p)$, which include the economically active population, characterized by the psychological state of readiness to leave the country of departure i to seek a new job (1):

$$M_i(t_p) = RM_i \cdot EA_i(t_p), \quad (1)$$

where RM_i is the share of population over 15 years old characterized by the psychological state of readiness to leave the country of departure i; $EA_i(t_p)$ is the economically active population in the country of departure i at the point of time t_p which, in accordance with the age-shifting method at the constant level of economic activity, is replenished annually by 1/15 of the population under the working age (0–14 years old) and decreases by 1/45 of the working-age people (15–60 years). This can be described by the following function (2):

$$EA_i(t_{p+1}) = \frac{1}{15} \cdot P_{0-14\_i}(t_0) \cdot REA_i(t_0) + \frac{44}{45} \cdot EA_i(t_p), \quad (2)$$

where $P_{0-14\_i}(t_0)$ is the population of 14 years old and younger in the country of departure i; $REA_i(t_0)$ is the level of economic activity of the population in the country of departure i.

In the modeling, it is also necessary to consider the fact that $x_{ij}(t_p)$ will decrease because of labor migrants, who are over the working age at the point of time t_p.

Based on the above methodological provisions, the author developed a dynamic equation describing the flow of labor migrants from the country of departure i to the region of gravitation j at the point of time t_p (3):

$$x_{ij}\left(t_{p+1}\right) = x_{ij}\left(t_p\right) \cdot \frac{44}{45} + \sigma_j \cdot \frac{x_{ij}\left(t_p\right)}{d_{ij}} \cdot \left(M_i(t_p) - \sum_{j=1}^{n} x_{ij}(t_p) \right) \cdot \left(w_j\left(t_p\right) - w_i\left(t_0\right) \right), \quad (3)$$

where σ_j is the calibration factor for the region j.

Economy of the region. Let's consider the economy of the region of gravitation j, which includes many workers and jobs. The workers can be locals (N) or immigrants (M), who are the perfect substitutes in the labor market and production.

At any time, the worker may be unemployed (U) or employed (E). Let's introduce the designations $U_j^k(t_p)$ and $E_j^k(t_p)$ for the number of unemployed and employed in the region of gravitation j at the point of time t_p respectively, where $k = N, M$ indicates the origin of the worker (local, immigrant). Let's also introduce the designations for $U_j\left(t_p\right) = U_j^N\left(t_p\right) + U_j^M\left(t_p\right)$ the total number of unemployed in the region of gravitation j and $E_j\left(t_p\right) = E_j^N\left(t_p\right) + E_j^M\left(t_p\right)$ total number of employed in the region of gravitation j.

In turn, the jobs can be occupied (F) or vacant (V). The vacancies can be freely created at no charge and liquidated by firms, but a fixed amount C_j is spent to keep a job (employed or vacant) per unit time. At the same time, a job can be liquidated at the rate of $b_j > 0$ per unit of time. When an employee is hired to work, he produces an output in the amount of $AP_j(t_p)$ per unit of time and receives a wage in the amount $w_j(t_p)$. The economy assumes a perfect capital market; therefore, the interest (discount) rate r is constant.

Reproduction of population. It is necessary to note that the number of labor on the labor market of the region of gravitation j will be defined not only by the inflow of immigrants, but also by the dynamics in the number of economically active local population, which depends mainly on the processes of reproduction and the age structure of the population in the region of gravitation j. In accordance with the age-shifting method, the number of economically active population in the region of gravitation j at the point of time t_{p+1} at the constant level of economic activity of the population will be described by the following function (4):

$$EA_j(t_{p+1}) = \frac{1}{15} \cdot P_{0-14\_j}(t_0) \cdot REA_j(t_0) + \frac{44}{45} \cdot EA_j(t_p), \quad (4)$$

where $P_{0-14\_j}(t_0)$ is the population of 14 years old and younger in the region of gravitation j at the point of time t_p; $REA_j(t_0)$ is the level of economic activity of the population in the region of gravitation j.

Labor market: unemployment and employment. The flow of new hires (or filling vacancies) in the region of gravitation j at any point of time depends on the number of unemployed and vacancies, which can be formalized by the matching function [20] of the following type (6):

Translation

$$M(U_j(t_p), V_j(t_0) = \gamma U_j(t_p)^{\eta} V_j(t_0)^{\mu}, \gamma > 0, 0 < \eta < 1, 0 < \mu < 1, \quad (6)$$

where $V_j(t_0)$ is the number of vacancies in the region of gravitation j; γ is the efficiency parameter of search and matching technology; η is Coefficient of elasticity for the unemployed; μ is the coefficient of elasticity for the vacancies.

In turn, the number of unemployed in the region of gravitation j, in accordance with the Mortensen — Pissarides model [19], will increase as following the elimination of jobs and decrease as a result of filled vacancies (7):

$$U_j\left(t_{p+1}\right) = U_j\left(t_p\right) + b_j E_j\left(t_p\right) - M\left(U_j\left(t_p\right), V_j\left(t_0\right)\right), \quad (7)$$

Given that the labor market in the region of gravitation j is formed both by the economically active local population $EA_j(t_p)$ and the immigrants $x_j(t_p)$, we will obtain an equation describing the dynamics of the number of employed in the region of gravitation j (8):

$$E_j(t_p) = EA_j(t_p) + x_j(t_p) - U_j(t_p) \quad (8)$$

It should be noted that the processes of reproduction and the age structure of the population are taken into account when forecasting the number of unemployed in the region of gravitation j, because the formula (7) includes the number of economically active local population in the region of gravitation j, the dynamics of which can be determined by considering them in accordance with the formula (4).

Let's define the rate, at which unemployed people find jobs in the region of gravitation j, in accordance with the formula (9):

$$a_j\left(t_p\right) = \frac{M\left(U_j\left(t_p\right), V_j\left(t_0\right)\right)}{U_j\left(t_p\right)} = \gamma U_j\left(t_p\right)^{\eta-1} V_j\left(t_0\right)^{\mu}, \quad (9)$$

and the rate, at which are filled the vacancies in the region of gravitation j, in accordance with the formula (10):

$$q_j\left(t_p\right) = \frac{M\left(U_j\left(t_p\right), V_j\left(t_0\right)\right)}{V_j\left(t_0\right)} = \gamma U_j\left(t_p\right)^{\eta} V_j\left(t_0\right)^{\mu-1}. \quad (10)$$

Wages. When the employer in the region j finds a suitable worker for a vacancy, this gives rise to the problem of determining his/her wages acceptable to both parties, provided that they know the average output of the worker per unit of time $AP_j(t_p)$.

Let's introduce the designation J_j^k for asset value of each state of the worker and the job, where $k = V, U, F, E$ designates the state. If at any point of time, an employed worker considers his/her state of employment as an asset with the value of J^E, then the return on this asset $r \cdot J^E$ will be equal to dividends in the amount of wages per unit of time less the expected loss of capital value $J^E - J^U$ when he makes a transition to the state of unemployed:

$$rJ_j^E = w_j\left(t_p\right) - b_j(J_j^E - J_j^U). \quad (11)$$

Similarly, the return on the asset of an unemployed can be defined as the expected revenue in the case of his/her employment:

$$rJ_j^U = a_j\left(t_p\right)(J_j^E - J_j^U). \quad (12)$$

For the firm, the return on the filled job vacancy will be equal to the output produced by the employee per unit of time less the costs of labor and maintaining the job, and also less the expected loss following the elimination of the job:

$$rJ_j^F = AP_j\left(t_p\right) - w_j\left(t_p\right) - C_j - b_j(J_j^F - J_j^V), \quad (13)$$

In turn, the return on a job vacancy can be defined as the expected revenue in case of filling the vacancy less the cost of maintaining the job:

$$rJ_j^V = -C_j + q_j\left(t_p\right)(J_j^F - J_j^V). \quad (14)$$

When the worker finds an acceptable vacancy, and the firm finds the employee that meets its requirements, this gives rise to the problem of distributing the surplus generated by their mutually

beneficial collaboration. In the search and matching model, this means determining the wages in the process of "bargaining" between the parties that have different negotiating powers, in accordance with the generalized Nash rule (15):

$$(1-\beta_j)\cdot(J_j^E - J_j^U) = \beta_j \cdot (J_j^F - J_j^V), \tag{15}$$

where $\beta_j \in (0, 1)$ is the measure of the relative negotiating power of the employee in the region of gravitation j; $1 - \beta_j$ is a measure of the relative negotiating power of the employer in the region of gravitation j.

By expressing the values for the assets of each state of the worker and the job from (11–14) and substituting them in (15), we can obtain a function that allows to forecast the wage rate in accordance with the generalized Nash rule in the process of bargaining between the firms and workers that have different negotiating power (16):

$$w_j(t_p) = \frac{\left(a_j(t_p) + b_j + r(t_0)\right) AP_j(t_p)\beta_j}{\left(1-\beta_j\right)\left(q_j(t_p) + b_j + r(t_0)\right) + \beta_j\left(a_j(t_p) + b_j + r(t_0)\right)}. \tag{16}$$

Output. Once the wage rate is agreed, this allows to start the production. The output $Y_j(t_p)$ in the region of gravitation j at the point of time t_p can be determined in accordance with the Cobb-Douglas production function (17):

$$Y_j(t_p) = A \cdot K_j(t_p)^{\alpha} \cdot E_j(t_p)^{\lambda}, A > 0, 0 < \alpha < 1, 0 < \lambda < 1, \tag{17}$$

where $K_j(t_0)$ is the aggregate capital in the region of gravitation j; $E_j(t_p)$ is the aggregate labor in the region of gravitation j; α is the coefficient of elasticity for capital; λ is the coefficient of elasticity; A is the input-output coefficient.

Then the average output of the worker used in calculating the wage rate (16) will be determined by the following formula (18):

$$AP_j(t_p) = \frac{AK_j(t_0)^{\alpha} E_j(t_p)^{\lambda}}{E_j(t_p)} = AK_j(t_0)^{\alpha} E_j(t_p)^{\lambda-1}. \tag{18}$$

To automate the implementation of the model set, a Java/Javascript computer program was developed to[1] provide a user-friendly execution of user queries to the database, mathematical calculations, and subsequent output of calculation results in the form of tables, graphs, diagrams, histograms, maps of the Russian Federation, which can be exported in a user-friendly format.

3. Data

The model set for forecasting the labor migration, reproduction of population and economic development of Russian regions was implemented by using the statistical data of the subjects of the Russian Federation and CIS countries.

The choice of only CIS countries as the countries of origin of migrants was caused by their dominant position in the structure of labor migration to Russia (more than 90 % of the total number of foreign labor). Given that no significant changes in the economic and demographic situation in Russia and other CIS countries can be expected, while the historical, cultural, and social ties between them are still fairly strong, it can be assumed that, for many years to come, Russia will be the main center of gravity for labor migrants from CIS.

Moreover, these countries provide the best match for the assumptions underlying the model set, such as the free access of immigrants to the regions of gravitation and opportunities for employment of foreign citizens on an equal basis with local workers. The free access of foreign citizens from CIS to the subjects of the Russian Federation is provided by the visa-free entry procedure. In turn, the number of barriers to their access to labor markets in the subjects of the Russian Federation was brought to its minimum in 2015, when the patent became the only permit required for the employment of foreign

[1] Vasilyeva, A. V., Kuklin, A. A. & Tarasyev, A. A. (2017). Certificate of State Registration of the Computer Program No. 2017610239 "Forecasting Labor Migration and its Economic Effects in the Region." Rospatent. Registered on January 9, 2017.

citizens from countries with a visa-free entry procedure, and the quotas for their employment were completely abolished.

All subjects of the Russian Federation were considered as the regions of gravitation, except for the Chechen Republic, the Republic of Crimea and the city of Sevastopol, for which there are no statistical data required for implementing the model set.

To identify the parameters of the model set, the author used a large data set, the composition and sources of which are provided in Table 1.

Table 1

Composition and sources of data

Indicator	Initial data
d_{ij}	Distance between the cities (km)[1*]
$r(t)$	Refinancing rate of the Central Bank of the Russian Federation (%)[2*]
for the subjects of the Russian Federation	
$x_{ij}(t)$	Registered at the place of stay (initially) for the purpose of entry "work"[3*]
$EA_j(t)$	Labor force (thousand people)[4*]
$P_{0-14\_j}(t)$	Average annual population below working age (thousand people)[5*]
$REA_j(t)$	Labor force participation rate (%)[6*]
$V_j(t)$	Need for workers reported by organizations to the state institutions of employment service (people)[7*]
$U_j^N(t)$	Number of unemployed (thousand people)[8*]
$M(U_j^N(t), V_j(t))$	Hired workers (people)[9*]
$E_j^M(t)$	Number of foreign citizens with a valid work permit (people)[10*]; number of foreign citizens with a valid patent for labor activity (people)[11*]; number of unofficially employed labor migrants (people)[12*]
$E_j^N(t)$	Average annual number of employed (thousand people)[13*]
$w_j(t)$	Average monthly nominal accrued wages (rubles)[14*], in constant prices of 2014, calculated using the consumer price index for goods and services (% from December of the previous year)[15*]
$Y_j(t)$	Gross Regional Product (million rubles),[16*] in constant prices of 2014, calculated using the deflator index of Gross Domestic Product (% from the previous year)[17*]
$K_j(t)$	Cost of fixed assets (million rubles)[18*], in constant prices of 2014, calculated using the deflator index of Gross Domestic Product (% from the previous year)[19*]
for CIS countries	
RM_i	Share of population over 15 years old desiring to leave for another country for temporary employment (%)[20*]
$EA_i(t)$	Economically active population (thousand people)[21*]
$P_{0-14\_i}(t)$	Permanent residents aged 0–14 years old (million people)[22*]
$REA_i(t)$	Level of economic activity of the population (% of the population of the corresponding age)[23*]
$wi(t)$	Average monthly nominal accrued wages (Russian rubles),[24*] in constant prices of 2014, calculated using the consumer price index for goods and services (% from December of the previous year)[25*]

[1*] Avtomobilnyy portal gruzoperevozok [Automotive Portal of Cargo Transportation]. Retrieved from: http://www.avtodispetcher.ru/distance/ (date of access: December 15, 2012). (In Russ.)

[2*] Stavka refinansirovaniya Tsentralnogo banka Rossiyskoy Federatsii [Refinancing rate of the Central Bank of the Russian Federation]. Bank Rossii [Bank of Russia]. Retrieved from: http://www.cbr.ru/statistics/print.asp?file=credit_statistics/refinancing_rates.htm (date of access:May 15, 2014). (In Russ.)

[3*] Form 2-RD of internal reporting of FMS of Russia.

[4*] Regiony Rossii. Sotsialno-ekonomicheskie pokazateli 2016: stat. sb. [Regions of Russia: Socio-Economic Indicators. 2016. Statistical Book]. (2016). Rosstat. Moscow, 102–103. (In Russ.)

[5*] Chislennost naseleniya Rossiyskoy Federatsii po polu i vozrastu [Population of the Russian Federation by gender and age]. Federalnaya sluzhba gosudarstvennoy statistiki [Federal State Statistics Service]. Retrieved from: http://www.gks.ru/wps/wcm/connect/rosstat_main/rosstat/ru/statistics/publications/catalog/doc_1140095700094 (date of access: March 23, 2017). (In Russ.)

[6*] Regiony Rossii. Sotsialno-ekonomicheskie pokazateli 2016: stat. sb. [Regions of Russia: Socio-Economic Indicators. 2016: Statistical Book]. (2016). Rosstat. Moscow, 104–05. (In Russ.)

[7*] ibid. pp. 133.

[8*] ibid. pp. 184–185.

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[11*] ibid. pp. 206–207.

[12*] Determined in accordance with expert estimates.

[13*] Regiony Rossii. Sotsialno-ekonomicheskie pokazateli. 2016: stat. sb. [Regions of Russia: Socio-Economic Indicators. 2016: Statistical Book]. (2016). Rosstat. Moscow, 108–109. (In Russ.)

[14*] ibid. PP. 230–231.

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4. Forecast of Labor Migration, Reproduction of Population, and Economic Development of Russia

The application of the model set on the statistical data (Table 3) allowed to prepare a forecast of labor migration, reproduction of the population, and economic development of Russia for the period until 2030. Let's consider what situation will develop in Russia in general.

According to the forecast, following the decline of internal capabilities to replace the retiring generations by young people entering the labor market, in the period from 2016 to 2030, Russia is expected to experience the drop in the number of economically active local population in Russia from 73,728 thousand people to 67,457 thousand people, which represents the decline of this indicator by almost 9 % (Fig. 2).

The situation on the labor market will be exacerbated by the labor-intensive type of economy that has been preserved since the Soviet era, with its high share of manual labor, which results in a large number of low-skilled jobs that no longer meet the requirements of the local population. For example, according to All-Russian Data Bank of Vacancies, as of March 31, 2015, the demand for masons was 13 times higher than the supply of labor force with experience in this area and desire to find a corresponding job; for plasterers, the demand is 5 times higher; for seamstresses, 3.6 times, etc.[2] As a result, about 80 % of the vacancies reported to the employment service are working specialties. At the same time, in the total number of citizens registered with the employment service in order to find work, almost 60 % are specialists with higher education [21, P. 36].

Amid insufficient development of labor-saving technologies, Russia will be forced to increase its economic capacity through the elements of extensive economic development by using the growing

[2] Kontseptsiya gosudarstvennoy migratsionnoy politiki na period do 2025 goda: zayavlennyye plany i realnaya zhizn [The Concept of State Migration Policy for the Period until 2025: declared plans and real life]. (2015, March). Moscow, 25. Retrieved from: http://migrant.ru/wpcontent/uploads/2015/06/Концепция миграционной политики до 2025.pdf (date of access: May 23, 2016).

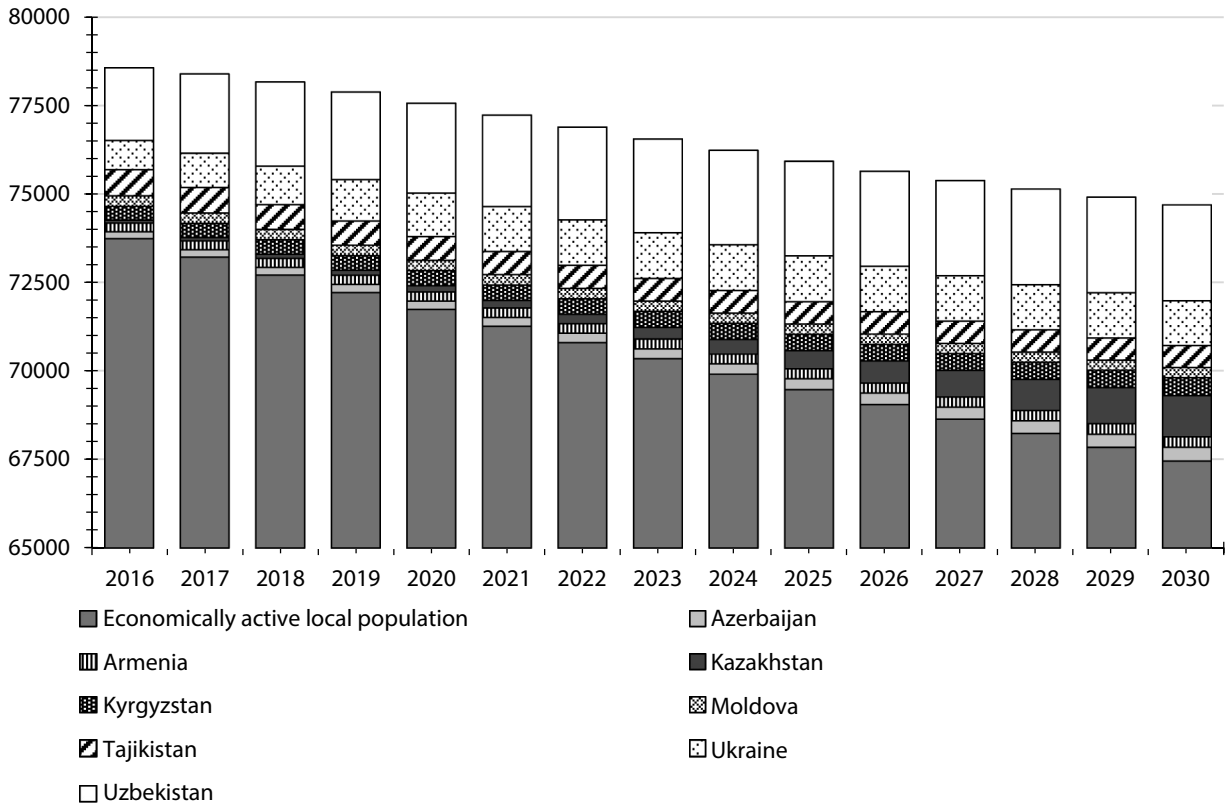

Fig. 2. *The forecast of the labor force in Russia, thousand people*

migration to meet its increasing demand for the labor force. As a result of continuing difference in economic development between Russia and other CIS countries, and given the high number of potential labor migrants in the latter (Table 2), the foreign labor force in the Russian Federation is expected to increase by 2402 thousand people by 2030 or by almost 50 % compared to 2016.

Table 2

The values of economic and demographic push factors for the CIS countries

CIS country	Average monthly nominal wage in constant prices of 2014	Number of potential labor migrants			
	2014 (fact)	2014 (fact)		2030 (forecast)	
	Russian rubles	thousand people	% of the total number	thousand people	% of the total number
Azerbaijan	21,268	929.5	9.6	882.9	9.1
Armenia	14,445	484.4	5.0	452.1	4.7
Kazakhstan	25,451	2,419.7	24.9	2,443.2	25.2
Kyrgyzstan	8,733	638.5	6.6	704.2	7.3
Moldova	11,029	391.8	4.0	340.5	3.5
Tajikistan	6,198	652.7	6.7	754.5	7.8
Ukraine	9,600	1,454.2	15.0	1,297.9	13.4
Uzbekistan	11,140	2,749.1	28.3	2,833.7	29.2
Total	—	9,719.8	100.0	9,709.0	100.0

It should be noted that the obtained number of potential labor migrants in the CIS countries for 2014 (9,719.8 thousand people) is lower than the assessments of Russian Ministry of Internal Affairs, which estimates the number of unregistered labor migrants in the Russian Federation at about 10 million people, and politicians mentioned the figure of 15 million migrants [22, P. 24]. Given that the number of the foreign labor force in Russia in now way can exceed its potential number, the fallacy of the above estimates advanced by the authorities is beyond doubt.

In 2030, the highest number of labor migrants to Russia will come from Uzbekistan (37.5 %), Ukraine (17.4 %), Kazakhstan (16.1 %), and Tajikistan (8.6 %). The first place of Uzbekistan in the

structure of foreign labor and the third place of Kazakhstan can be explained by the highest number of potential labor migrants among CIS countries, while the fourth place of Tajikistan can be explained by the lowest wages in that country. In turn, the results of forecasting labor migration from Ukraine were significantly affected by the fact that 2014 is used as a reference point in the simulation. In the month of April of that year, the fighting broke out in Donetsk and Lugansk Regions, which led to the influx of refugees from South-Eastern Ukraine to the Russian Federation. In this case, it can be assumed that, with the normalization of the political situation in Ukraine, the future number of foreign labor in the subjects of the Russian Federation will be somewhat lower than forecasted. It should also be noted that, in the post-Soviet space, Kazakhstan is more often considered by the experts [22, 23] as a center of gravity, rather than a donor of labor. Therefore, the number of labor migrants from Kazakhstan in Russia may be substantially lower than projected.

Moreover, the potential for labor migration from the "poor" CIS countries, the citizens of which are the most interested in it, is exhausted by 80–90 % (Table 3).

Table 3

Comparing the number of potential and real labor migrants from CIS countries in Russia in 2030

CIS country	Number of labor migrants in Russia, thousand people	Number of potential labor migrants in the CIS countries, thousand people	Share of potential labor migrants who realized their intention to move, %
Azerbaijan	390.6	882.9	44.2
Armenia	294.8	452.1	65.2
Kazakhstan	1,161.2	2,443.2	47.5
Kyrgyzstan	503.6	704.2	71.5
Moldova	283.4	340.5	83.2
Tajikistan	625.2	754.5	82.9
Ukraine	1,260.4	1,297.9	97.1
Uzbekistan	2,708.6	2,833.7	95.6
Total	7,227.8	9,709.0	74.4

With a high degree of probability, it could be assumed that the number of labor migrants in Russia in 2030 will be lower than the forecasted 7,228 thousand people. However, event with the realization of projected scenario, by 2030, the total labor force of the Russian Federation will be reduced by almost 5 % compared to 2016 and will be 74,684 thousand people.

In the same period, the unemployment rate will increase from 5.8 % to 7.1 % despite the decline in the supply of labor on the national labor market. The projected situation indicates the aggravating problem of simultaneous combination of the excessive labor force in some sectors of the economy and acute shortages of labor in other sectors as a result of a mismatch between the vocational qualifications of applicants and open vacancies. The reason of these problems lies in the strengthening of the double structural imbalance between the demand and supply of jobs in the national and regional labor markets in terms of the education level and vocational qualifications.

Currently, the number and list of specialties and professions used for training the workers and specialists are often planned on the basis of outdated or insufficiently verified information that does not reflect the nature of structural changes in the labor market and does not fully take into account the forthcoming structural changes in the labor market. As a result, some graduates risk obtaining specialties that are no longer demanded on the labor market [24, P. 73].

At the same time, there is an increasing imbalance of supply and demand on the labor market related to the ratio of professional education levels. At the top level of education, we can observe the emergence of a very large overhang, which by one and a half time exceeds the actual demand. The system of vocational education produces 56 % of specialists with higher education, while the share of such specialists among the employed is 38.2 %[3].

As a result of the decline in the labor force and increase in the unemployment rate, in 2030, the total number of employed in Russia will be 69,927.3 thousand people, which is almost 6 % less than in

[3] Kontseptsiya gosudarstvennoy migratsionnoy politiki na period do 2025 goda: zayavlennyye plany i realnaya zhizn [The Concept of State Migration Policy for the Period until 2025. Declared Plans and Real Life]. (2015, March). Moscow, 31. Retrieved from: http://migrant.ru/wpcontent/uploads/2015/06/Концепция миграционной политики до 2025.pdf (date of access: May 23, 2016).

2016. However, given the low elasticity of production in terms of labor ($\lambda = 0.0000048$), the decrease in the number of employed in the economy will not make a noticeable effect on the output in Russia. By 2030, overall for the Russian Federation, the GRP will decrease by less than 0.0002 % compared to 2016 and will amount to 60,819,925 million rubles (in constant prices of 2014). At the same time, in 2030, the GRP per one employed in the economy will amount to 72,479.9 rubles (in constant prices of 2014), which corresponds to an increase by 6.2 % compared to 2016.

Despite a substantial increase in the number of unemployed (11.3 %) along with the average increase of GRP per one employed in the economy (6.2 %), the average monthly nominal salary will increase by 6.7 % in 2030 compared to 2016 and will be 35,327 rubles. It should be noted here that the above processes have a divergent impact on the dynamics of wages. While the growth in the number of unemployed increases the competition in the labor market and forces them to accept lower wages at the hiring, the increase in the average output per employee allows the employers to establish a higher salary in order to attract the desired workers. It should also be noted that the model set does not take into account the qualifications of employees. But since most migrants are engaged in low-skilled jobs, their projected inflow will mostly affect the wages of unskilled labor.

5. Conclusions and Recommendations

The article presented a model set, the implementation of which allowed for the first time to build a statistical forecast of labor migration, reproduction of population, and economic development of Russia for the period until 2030. The obtained results have a high practical value.

Based on the fact that, in the forecast period, the reduction in the number of employed in the economy by almost 6 % will be accompanied by the decline of GRP of Russia by less than 0.0002 %, one can conclude that the labor productivity is extremely low as a result of labor-intensive type of economy with a high share of manual labor and inefficient use of technology and equipment that dates back to Soviet times.

Amid insufficient development of labor-saving technologies, Russia will be forced to increase its economic capacity through the elements of extensive economic development by using the growing migration to address its increasing shortage of labor force. However, even with the maximum use of potential labor migration from the CIS countries in the period up to 2030, Russia will not be able to escape the shortage of labor. The obtained results allow to conclude that in the medium and long term, in order to facilitate the needs of the Russian economy in the labor, it is necessary to simplify procedures for access of labor migrants to the national labor market in Russia.

At the same time, the absolute shortage of labor resources will be accompanied by higher unemployment. The obtained results testify to growing structural imbalance of supply and demand in the labor market, where job seekers do not possess the professional qualities necessary for employers. Therefore, the modernization, innovative development and increasing competitiveness of economic sectors in the Russian Federation are impossible without addressing two main tasks:

1) Bringing the structure of the human resources prepared by the system of Russian vocational education in line with the needs of the labor market in terms of the qualification level and professional structure;

2) Developing and implementing the differentiated approach to attracting, selecting and using foreign labor depending on qualifications of migrants.

In conclusion, it should be noted that the proposed model set does not consider the qualification of workers. However, since most migrants are engaged in low-skilled labor, they could be considered as competitors only for the local workforce of relevant qualifications. At the same time, the contribution of a worker to the economic development of the country differs significantly depending on the level of his/her qualifications. In addition, the balance of supply and demand of labor resources can substantially differ when the labor force is considered by qualification groups. Therefore, the results of forecasting would be more realistic, if model set considered the qualifications of workers, including local ones and immigrants, unemployed and employed.

Currently, the model set to forecast the labor migration, reproduction of population and economic development of Russian regions is updated in order to separately consider the skilled and unskilled workers. This update involves, first, the use of the new production function that describes the contribution made by the workers belonging to different qualification groups and, secondly, the division of the labor market into two sectors, including one sector for skilled workers and the other for

unskilled workers with no cross employment allowed between two sectors (unskilled unemployed can occupy only unskilled vacancies, and skilled unemployed can occupy only skilled vacancies). It should be noted that this update will allow to significantly expand the scale of the dynamic system.

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