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A HYPOTHETICAL FUNCTIONAL MODEL OF SOCIO-DEMOGRAPHIC DEVELOPMENT BASED ON THE RELATIONSHIP BETWEEN THE INCOME HETEROGENEITY OF THE RURAL POPULATION AS A FACTOR OF SOCIAL DYNAMICS

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Abstract

In modern Russia, the main features of the current demographic situation are: significant scale of population decline, low birth rate, continuing population aging. Currently, the Russian Federation is experiencing high mortality and low fertility. Using the tool of the space of value orientations, based on the methodology proposed by Urnov M.Yu., Kasamara V.A., the initial indicators were changed to economic ones and their influence on the socio-demographic development of rural areas was determined. The hypothetical substantiation of the dependence of economic indicators of value heterogeneity in terms of economic indicators of society and social dynamics was tested on the basis of a hypothetical model based on matrix algorithms. A model of socio-demographic development has been developed based on the relationship between the value heterogeneity of the rural population as a factor of social dynamics, uniting a system of economic and social indicators on the basis of a functional approach, stratification indicators of the value orientation of rural areas have been determined depending on the level of income of the population, which will determine the growth of job creation. places and size of wages. The verification of the economic indicators of a hypothetical model of the dependence of the socio-demographic development of rural areas in the region on the level of value heterogeneity of society in terms of wages, as a factor of social dynamics, has been carried out. The calculations showed that in agricultural enterprises of the Russian Federation, in the period f1 in relation to the period f0, the increase in income was: in the first group of districts 114,761.9 thousand rubles. or 75.07%, in the fourth group 1,043,889 thousand rubles (58.53%) due to a significant increase in capital productivity for the intensive type of development, and identified additional investments in the acquisition of fixed assets in the amount of 143,928.24 and 1,253,302.33 thousand roubles. Profit from intensive use of agricultural land is determined in 1-4 groups of districts in the amount of 73.26; 77.15; 70.16; 59.22%, respectively, of the total profit of enterprises in order to maintain the achieved level of profit, it is necessary to increase the area of agricultural land by 20% on average for groups.

Key words**:** *model, demography, income level, return on assets, profitability, production*

INTRODUCTION

A necessary condition for the existence and development of society is the process of human reproduction, which directly depends on the course of demographic processes. The processes of migration, mortality, fertility have a direct impact on the quantitative and qualitative composition of labor resources and its potential, which is reflected in the effectiveness of economic and social policy, both in the country as a whole and in its individual subjects [11]. The decline in the rural population is one of the pressing problems of Russian demography. The key factors in the development of the village are underdeveloped infrastructure, lack of a sufficient number of jobs, low wages, a low level of the cultural and leisure complex, a decrease in the birth rate with a simultaneous increase in mortality, and an outflow of the population.

The study was based on the latest work of world and Russian scientists in the field of mathematical modeling and sociological analysis.

In his works, Ao, Zou (2015) established the influence of the vector model in establishing errors in the impact of social expectations on the macroeconomic problems of Shanghai, which will allow, by assessing the situation, to determine the total volume of retail sales of consumer goods and the total volume of investment in fixed assets, and social expectations are indicated by the leading index in the system of indices of the economic climate [1].

Research by Sanchez-Fernandez, Raquel, Jimenez-Castillo, David, Iniesta-Bonillo, Angeles (2017) has identified a perceived model of sources of economic value that can improve satisfaction, organizational image and target audience identification using partial least squares (PLS) and, possibly It should be noted that the results obtained provide useful theoretical and practical conclusions and emphasize the importance of identifying the heterogeneity of structural models [5].

Mark Fossett (2006), in its research emphasized the importance of developing Schelling-style agent-based preference influence models when he described models that show decision-making about the location of individuals based on preferences determined on the basis of surveys, which can lead to integration or support it [4].

MATERIALS AND METHODS

Research results from Li, W., Li, J., Cui, J. (2020) showed that rural emigration has increased significantly in the Hubei province of Central China as a result of the aging of the rural population and the deterioration of educational levels. For the development of rural areas, the authors put forward well-calibrated and differentiated development strategies in eight categories, areas [6].

The study of the tasks in the field of the proposed topics was carried out based on the representative methodology of analysis in the study of the population proposed by Urnov M.Yu., Kasamara V.A., the main idea of which is to verify a hypothetical model of the dependence of social changes on the level of value heterogeneity of society as a factor of social dynamics [9] on the choice and justification of hypothetical models.

The study of the impact of the current economic situation in certain groups of districts will allow determining the intensive path of development of economic entities and finding out its impact on socio-demographic processes: fertility, mortality, migration processes [7]. To timely take into account the impact of the economic development of the region on demography, the average annual wage was selected as a criterion for the economic heterogeneity of the population and the grouping was carried out using the method of Herbert Sterzhes [2, 8].

RESULTS AND DISCUSSIONS

The functional model of the intensity of socio-demographic changes, depending on the level of social heterogeneity of society, has the form:

$VHS_{S1}^{t0} > VHS_{S2}^{t0}$, then $SD_{S1}^{t1-t0} > SD_{S2}^{t1-t0}$ or
$VHS_{S1}^{t0} < VHS_{S2}^{t0}$, then $SD_{S1}^{t1-t0} < SD_{S2}^{t1-t0}$

where:

VHS - economic indicators for a certain period of time;

SD - social indicators for the same period of time.

The calculations and comparison of inequality indicators $VHS_{S1}^{t0} > VHS_{S2}^{t0}$, then $SD_{S1}^{t1-t0} > SD_{S2}^{t1-t0}$ or $VHS_{S1}^{t0} < VHS_{S2}^{t0}$, then $SD_{S1}^{t1-t0} < SD_{S2}^{t1-t0}$ allow us to assess whether the hypothesis is true. Rather «yes» than «no». The relative indicators of capital productivity, profitability of agricultural land, output per worker were selected as economic indicators for verification, and the general coefficient of demographic growth was selected as an indicator of socio-demographic development. [12, 10] To test the hypothesis put forward, we took the above-mentioned economic indicators for six groups of regions: S1, S2, S3, S4, S5, S6 in comparison S1-S2; S2-S3; S3-S4; S4-S5; S5-S6 for the period under review f0. As a socio-demographic indicator, the general coefficient of demographic growth (the deviation of its value for the periods f1 and f0 under consideration) was taken (Table 1).

The relationship of value heterogeneity is partially positive. This gives the basis for building a functional model for a separate group of indicators based on the IDEF0 (Integrated Definition Function Modeling) methodology (integrated modeling of definition functions). It is based on the idea of an indivisible particle - a block. Our hypothetical model consists of: on the left is an entry block, on the right is an exit, on the top is control, on the bottom is the result. Calculations were made using the method of two-row matrices

Table 1. Empirical testing of hypothetical model results

VHS		SD Total demographic growth rate
Return on assets, RUB/RUB		
S1-S2	1.147> 0.77	-10.34 < -9.93
S2-S3	0.77 < 1.05	-9.93> - 12.06
S3-S4	1.05< 1.09	-12.06 < -11.23
S4-S5	1.09> 0.97	-11.23 < -9.68
S5-S6	0.97< 1.28	-9.68 > -11.25
Efficiency of using agricultural land		
S1-S2	2.782 <3.34	-10.34 > -9.93
S2-S3	3.34<6.55	-9.93 <- 12.06
S3-S4	6.55<6.62	12.06 > -11.23
S4-S5	6.22 <9.08	-11.23 < -9.68
S5-S6	9.08 <12.31	-9.68 > -11.25
Generation, RUB/person		
S1-S2	2,178.79 < 2,736.93	-10.34 > -9.93
S2-S3	2,736.93 < 4,122.25	-9.93 <- 12.06
S3-S4	4,122.25 > 3,888.17	12.06 > -11.23
S4-S5	3,888.17 > 3,270.67	-11.23 < -9.68
S5-S6	3,270.67< 4,494.65	-9.68 > -11.25

Source: Calculated by the authors.

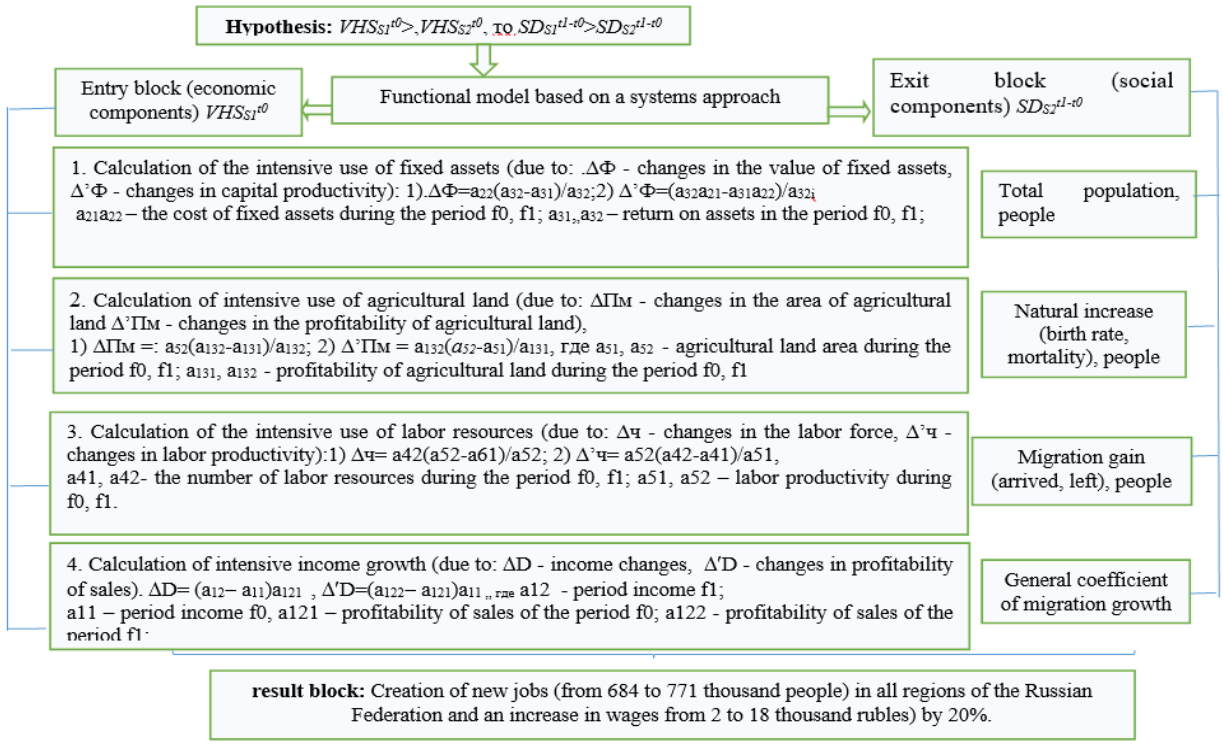

Fig. 1. A hypothetical model of socio-demographic development based on the relationship of social heterogeneity in terms of income of the rural population, as a factor of social dynamics
Source: Developed by the authors.

Verification of economic indicators by regions established an increase in revenue from groups 1 to 4 according to the intensive type of development and amounted to 457,041.83, 29,460.7, 95,407.46, 161,502.18 thousand rubles, respectively.

The studies found that agricultural producers of the Russian Federation during the f1 period compared to the f0 period increased labor productivity by 60.47% on average from groups 1 to 4 and only 0.3% increased the number of employees, which resulted in an increase in income by 2,074,745.84 thousand rubles. in total due to the use of intensive factors of production (fixed assets, agricultural areas), which account for 42.19% of the total. These indicators testify to the optimization of the number of employees according to the intensive type of development and the possibility of providing 596 (49 + 135 + 133 + 279) thousand people with new jobs. An increase in employment of the country population by 615 thousand people (43 + 153 + 122 + 297) contributed to an increase in output by 4,832.009 (868.759 +1,006.100 +1,468.884+ 1,494.266) thousand rubles/person. In the 5-6 group of agricultural enterprises of the Russian Federation in the period f1, in order to maintain the achieved income from the sale of products due to intensive factors, there is a reserve of workers for 586 thousand people (Table 2).

Table 2. Results of determining the number of creation of additional jobs

Estimated indicators	The values
1st group	
ΔΦ Efficiency of use of labor resources (due to changes in the number)	48.98
Increase in income, thousand rubles	106,718.31
ΔΦ Efficiency of use of labor resources (due to changes in labor productivity)	42.84
Increase in income, thousand rubles	-13,377.77
2nd group	
ΔΦ Efficiency of use of labor resources (due to changes in the number)	134.55
Increase in income, thousand rubles	368,261.39
ΔΦ Efficiency of use of labor resources (due to changes in labor productivity)	153.04
Increase in income, thousand rubles	50,594.16
3rd group	
ΔΦ Efficiency of use of labor resources (due to changes in the number)	133.28
Increase in income, thousand rubles	549,394.27
ΔΦ Efficiency of use of labor resources (due to changes in labor productivity)	121.83
Increase in income, thousand rubles	-47,176.84
4th group	
ΔΦ Efficiency of use of labor resources (due to changes in the number)	279.46
Increase in income, thousand rubles	1,086,580.34
ΔΦ Efficiency of use of labor resources (due to changes in labor productivity)	297.29
Increase in income, thousand rubles	69,339.09
5th group	
ΔΦ Efficiency of use of labor resources (due to changes in the number)	147.91
Increase in income, thousand rubles	483,756.81
ΔΦ Efficiency of use of labor resources (due to changes in labor productivity)	145.91
Increase in income, thousand rubles	-6,541.34
6th group	
ΔΦ Efficiency of use of labor resources (due to changes in the number)	441.69
Increase in income, thousand rubles	1,985,244.13
ΔΦ Efficiency of use of labor resources (due to changes in labor productivity)	453.57
Increase in income, thousand rubles	53,373.97

Source: Calculated by the authors.

The study of the empirical-factual base of the main economic indicators of rural regions of the Russian Federation showed the presence of favorable conditions for an intensive increase in the production of raw materials and the development of human potential. At agricultural

enterprises, the volume of production in the period f1 (2020) compared to the period f0 (2019) increased by 20,762,313.50 thousand rubles. and amounted to 64,944,892.00 thousand rubles. In general, in the country, the increase in production was 46.99%. The source of natural increase (decrease) of the population is migration flows, mortality and fertility rates (Table 3).

Table 3. Natural increase (decrease), thousand people

Region groups	2019	2020	+,- 2020/2019	% 2020/2019
1	-100.20	-162.00	-61.80	280.91
2	-153.71	-217.00	-63.29	55.16
3	-292.22	-395.44	-103.22	54.01
4	-514.00	-872.83	-358.83	47.24
5	-240.89	-363.33	-122.44	205.53
6	-132.00	-258.50	-126.50	98.53

Source: Federal statistic service [3].

For all groups of regions, the population is declining to a large extent due to an increase in the outflow of its rural part in 2020. C1 for 6 groups, respectively, -2.07; -1.65; -2.43; -2.32; -1.43; -2.04% compared to 2019 in the intensively-oriented group of districts (1-4), due to an increase in natural decline (increase in mortality over births) from 47.24 to 280.91% and migration gain (decline) from -49.24 to 83.52%. And in 5-6 groups of districts, the same indicators were -33.57 and + 21.97% due to the influx of labor into the suburbs of urbanized regional centers, respectively, for the analyzed period. A stable negative overall coefficient of natural increase (decline) of the rural population will not allow at least partially to compensate for the natural decline.

CONCLUSIONS

A functional hypothetical model of the socio-demographic development of rural areas on the example of regions of the Russian Federation is proposed. A grouping by wages was carried out, as a criterion of economic heterogeneity, in a breakdown of 6 groups by the Sterzhes method. An increase in income due to an increase in the scale of production or profitability of sales, and the verification of the calculation results was carried out. A functional model was built according to the IDEF0 (Integrated Definition Function Modeling) method, which includes 4 blocks (input, output, management decisions, result), combining economic and social indicators. allowing to determine the possibility of creating new jobs from 43 to 453 thousand people and an increase in wages from 14 to 49 thousand rubles.

REFERENCES

[1]Ao, Z., 2015, Dynamic Impacts of Social Expectation and Macroeconomic Factor on Shanghai Stock Market: An Application of Vector Error Correction Model. Advances in Global Optimization, Springer Proceedings in Mathematics & Statistics, Vol.95. 489-496.

[2]Dawid, A.P., Musio, M., Ventura, L., 2016, Scandinavian journal of statistics, Vol.: 43 (1): 123-138

[3]Federal State Statistic Service. https://www.fedstat.ru/, Accessed on 02.06.2021.

[4]Fossett, M., 2006, Including preference and social distance dynamics in multi-factor theories of segregation. Journal of mathematical sociology, Vol.30 (3-4): 289-298.

[5]Jimenez-Castillo, D., Sanchez-Fernandez, R., Iniesta-Bonillo, A., 2017, Economic value for university services Modelling and heterogeneity analysis. International journal of market research, Vol.59 (5): 671-690.

[6]Li, W., Li, J., Cui, J., 2020, Exploring rural decline with the perspective of demographics: Case study of Hubei, China. Physics and Chemistry of the Earth, 120.

[7]Scott, D.W., 2001, Parametric statistical modeling by minimum integrated square error. Technometrics, Vol.: 43 (3): 274-285.

[8]Scott, D.W.,2009, Sturges' rule. Wiley interdisciplinary reviews-computational statistics, Vol,: 1 (3): 303-306.

[9]Sobolev, I.V., Urnov, M.Yu., Kasamara, V.A., et al., 2011, The value heterogeneity of society as a factor of social dynamics - building an empirical model. Ed. House of the Higher School of Economics, 63.

[10]Volokhova, M.A., 2020, Stimulation of labor in the system of social development of a rural settlement. Scientific Review: Theory and Practice, Vol. 10 (7): 1408-1418.

[11]Volokhova, M.A., Novikov, I.S., 2020, Rural development in the context of social wealth: aspects of the regional labor market. Scientific Papers Series

«Management, Economic Engineering in Agriculture and Rural Development», Vol.20 (3): 635–648.
[12]Volokhova, M.A., Novikov, I.S., 2020, The concept of a decision-making strategy to improve the material situation of households in rural settlements. Scientific Review: Theory and Practice, Vol. 10 (4): 699-711.