Advances in Social Science, Education and Humanities Research, volume 392
Ecological-Socio-Economic Systems: Models of Competition and Cooperation (ESES 2019)

Statistical and Cartographic Analysis of Demographic Burden in Municipal Districts of Lipetsk Region

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***Abstract*—One of the starting points in the planning of economic development and sustainability of the national economy is the analysis of the dynamics of the amount of labor available in the future (the volume of labor). The initial value of the volume of labor is determined, first, by the number of the population and the share of the able-bodied population in it, that is, by demographic factors. This study is aimed at studying the dynamics of demographic aging of the population in a separate region (subject of the Russian Federation) - Lipetsk region. It addresses the following research questions: how fast is the aging of the population of the region; how evenly is the increase in the demographic burden in different areas within the region. The main purpose of this study is to conduct statistical and cartographic analysis of spatial data describing the dynamics of aging at the level of the region and its municipal entities. The results obtained in this study provide an understanding of the differentiation of changes in the sex and age structure of the population within the municipal districts of one region from the standpoint of the burden on labor resources.**

Keywords—age and sex structure of the population, population aging, demographic burden, ranking of regions.

I. INTRODUCTION

According to the international population forecast released in June 2019 by the UN Department of Economic and Social Affairs, a key global demographic trend is the continuation of a steady slowdown in the birth rate for a century. The decline in fertility combined with the increase in life expectancy at birth leads to another global demographic trend - population aging.

A characteristic feature of this process is the highest population growth in the age group 65 years and older. The problem of increasing demographic burden is particularly relevant for European countries, as well as countries in North America, Australia, New Zealand, where birth rates were below the average of two births per woman in 1990 [1].

An important milestone in the development of mitigation measures for developed countries was the holding of the First World Assembly on ageing in 1982 (Vienna). The International plan of action on ageing, revised at the Second World Assembly in 2002 (Madrid), already focused on ageing in developing countries [2].

It is recognized that in the presence of a general trend of population ageing, the trends and rates of demographic change are very diverse, not only between countries, but even within countries [3]. In preparing the review materials for the UN Commission for Social Development to take into account these features, the bottom-up principle is applied - the collection of information starts from local and subnational (regional) levels, from which indicators of the national level are formed, then - the level of regions of the world and global level.

The article was written with the financial support of the Russian Foundation of Fundamental Research (project No. 18-410-48003 p_a "The Impact of Demographic and Migration Processes on the Regional Employment System and the Gross Regional Product").

II. LITERATURE REVIEW

A. Assessment of population ageing in EU countries

The identification of regional features of population aging provides reliable prospective estimates of changes in the age structure of the labor resources of the territory, the rate of reduction of its labor potential and serves as a justification for adjusting the work of regional health and social security systems [4]. For example, a joint project of the UN Economic Commission for Europe and the European Commission Directorate General for employment, social affairs and social integration to assess the untapped potential of older persons and promote its implementation through a combination of different policies and programs has been implemented in the EU since 2012.

The main evaluation tool of this project is the calculation of national and subnational levels of the active ageing index (AAI), proposed by A. Zaidi, and comprising four indicators domains: employment; community involvement; independent, healthy and safe lifestyle; potential and favorable conditions for active aging [5]. Within the framework of the project, calculations of national AAI for all EU member states and calculations of sub territorial levels of AAI in Germany and Poland have been carried out [6]. The dynamics of the regional indices of active ageing serve as a signal for changes in the EU policies related to active ageing.

B. Ranking of regions of the Russian Federation by the main age groups of the population: possible approaches

For a long time, Russia has been included in the group of countries where the age structure of the population has shifted to older ages, but the depth of aging is estimated to be less than in most European countries [7]. In the age structure of the Russian population, in accordance with current demographic trends, the share of older people in the total population will increase, and the share of people in the working age and younger ages will decrease. At the same time, if the country is characterized by downward demographic dynamics, the situation in the context of the subjects of the Russian Federation is not so unambiguous. Some regions of the Russian Federation have downward and

some - upward demographic dynamics [8]. Differentiation of the country's territories according to the forms of demographic dynamics as a result of natural and migration growth of population movement is the initial basis of most domestic studies of this direction [9]. For example, the researchers of the RDI HSE draw attention to the existence of a significant gap in life expectancy between the regions of Russia (for men in 2003-2016, the interval of minimum and maximum values ranged from 21.9 years to 29.4 years, and for women, respectively, from 18.7 years to 22.5 years) [10].

In a separate group of studies works that assess the level of involvement of a particular region in the aging process can be identified. So, in the study carried out by V.A. Chereshnev and E.V. Chistova (Institute of Economics of the Ural branch of RAS), it is proposed to rank the regions of the Russian Federation by four stages of aging. The authors, assuming that the calculation of the share of older people in the total population (based on one or another criterion) is common, obvious, but insufficient to identify the features of this process, proposed their own methodology for assessing the extent of population aging in the region. The matrix used in the methodology includes four groups of indicators - the level of aging, the depth of aging, aging factors and the rate of aging. The authors, based on the processing of an array of statistical data for 2016, concluded that only 60% of the subjects of the Russian Federation have an old population (stage III) and a deeply old population (stage IV). The population of other subjects of the Russian Federation is at the I and II stages, that is young and aging population, respectively. The conclusions reached by V.A. Chereshnev and E.V. Chistova significantly differ from estimates of the level of aging according to the UN scale, according to which the population of 93% of the constituent entities of the Russian Federation is characterized as old [11].

The bulk of the work on demographic ranking of the subjects of the Russian Federation is the "Russian demographic sheet 2019" (developers - RANEPA, Rosstat, International Institute for Applied Systems Analysis), which, along with traditional demographic indicators, also presents indicators that were not previously calculated for the regions – "indicator of human life", "threshold of old age", "prospective demographic burden" [12]. The "threshold of old age" is the age at which the average life expectancy becomes less than 15 years.

The Appendix to the Demographic sheet provides an overview of the main demographic indicators for all 85 subjects of the Russian Federation [13]. The developers conclude that the regional values of demographic indicators are compared with similar indicators of different countries. At the same time, the calculations show extremely high differences between the regions of Russia in certain demographic indicators. In some cases, the differences correspond to those between the world's most developed and least developed countries.

A distinctive feature of the processes of population aging in Russia is a significant differentiation of their consequences not only between the subjects of the Russian Federation (by republics and regions), but, in many cases, within individual regions (between municipal districts). Analysis of intra-regional aging processes is the third group of studies. The number of such studies is small.

For example, S.A. Vasin, conducting a study of intra-regional processes of population aging on the example of the Samara region according to data for 2009, found that from a statistical point of view, intra-regional differentiation of indicators of the sex and age structure of the population is small [14]. But comparing the parameters of the age structure of the population of the districts of the region by the degree of deviation from the average for the region, the author identified five types of territories with unusual proportions of the population structure.

Similar results are given by research of V.N. Barsukov, which analyzes the indicators of the sex and age structure of the population of the Vologda region in 2013. The author revealed that the difference between the maximum and minimum value of the coefficient of ageing of the region is 9.3 percentage points and areas within the region can be divided into "old" and "young", although Vologda region in general at the region-wide proportion of elderly in the 21% refers to regions with old population [15].

III. MATERIALS AND METHODS OF RESEARCH

Studies show that the regional territory of the Russian Federation, even if they are comparable in terms of shares of different age groups of the population, can significantly differ in the qualitative characteristics of these groups, and, therefore, in the rate of demographic changes [16]. Therefore, there is a need to conduct in-depth studies of demographic processes both in individual regions and within regions to obtain relevant information. The obtained results can be used as a basis for the construction of statistical forecasting of the dynamics of the region's development and justification of demographic policy measures by local authorities.

The focus of the study was considered 18 municipal districts of Lipetsk region (Volovsky municipal district, Gryazinsky municipal district, Dankovsky municipal district, Dobrinsky municipal district, Dobrovsky municipal district, Dolgorukovsky municipal district, Yeletsky municipal district, Zadonsky municipal district, Izmalkovsky municipal district, Krasninsky municipal district, Lebedyansky municipal district, Lev-Tolstovsky municipal district, Lipetsk municipal district, Stanovlyansky municipal district, Usmansky municipal district, Terbunsky municipal district). district, Khlevensky municipal district, Chaplyginsky municipal district) and 2 cities of municipal significance (city of Lipetsk and city of Yelets).

Population data for 2013-2019 (all data at the beginning of the year) were used as statistical information [17].

During study of the gender and age structure of all municipal districts of the Lipetsk region, the proportion of persons older than working age in the total population was calculated for three groups (women, men, the entire population). To calculate the "rate" of aging, the average annual rate of change of this indicator for the seven-year period preceding the year for which the level of aging was calculated (January 1, 2019) was chosen. The use of such an indicator allows you to get rid of the possible volatility in the calculation for shorter periods, and corresponds to the "current" speed of the process at the time of the study.

IV. RESULTS OF THE STUDY AND THEIR DISCUSSION

Figure 1 presents the results of calculations of the dynamics of the share of persons older than working age in the

Lipetsk region in general and its municipal entities. The study allows us to draw the following conclusions.

- In all districts of the Lipetsk region, a positive dynamic of the proportion of persons older than working age over the past 7 years was noted.
- The share of persons older than working age in the municipal districts of the Lipetsk region ranges from 27% (city of Lipetsk) to 37% (Dobrovsky district). These indicators exceed both the share of the population older than working age in Russia and in the Central Federal District, which includes the region (25.4% and 27.6% at the beginning of 2018, respectively) [18].
- The highest growth rates are observed in Dobrinsky district (3.3%) and Volovsky district (3.1%), the lowest – in Dobrovsky (1.1%) and Terbunsky (1.1%).
- The average values in the Lipetsk region are very close to the indicators of the city of Lipetsk, which is largely due to the large weight of the latter in the overall result.

If we consider the situation separately among women and men, it should be noted that the proportion of women on average is twice that of men, and the growth rate, on the contrary, is half that of women compared to men. This is largely due to the "low base effect". At the same time, the "picture" of women is largely similar to the "picture" of the entire population, and the "picture" of men has differences. For example, the lowest growth rate was recorded in Chaplyginsky district (1.6%).

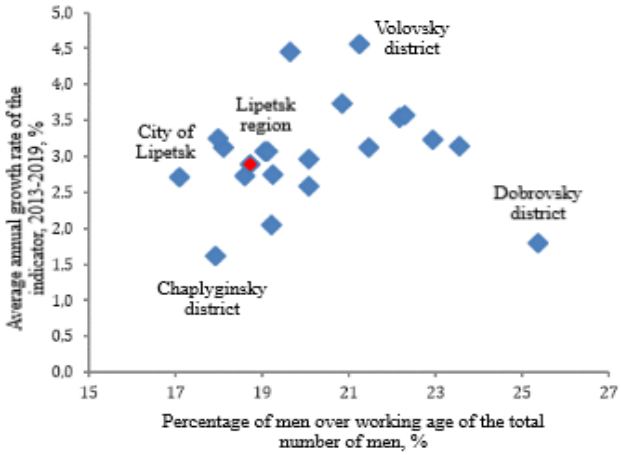
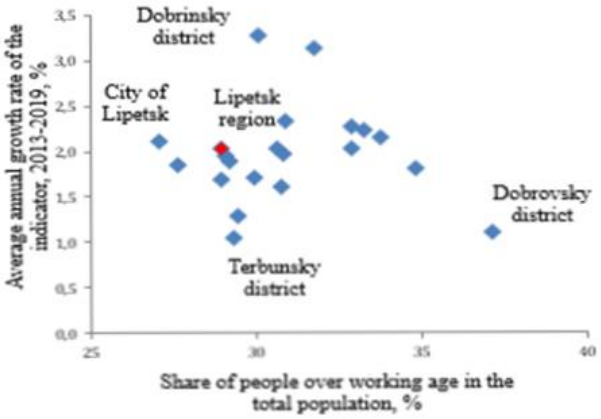
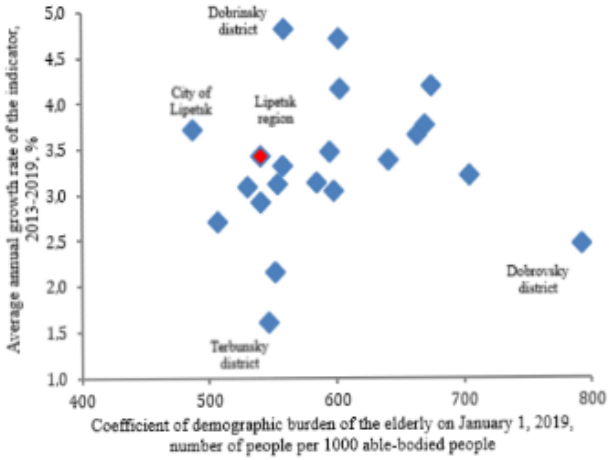
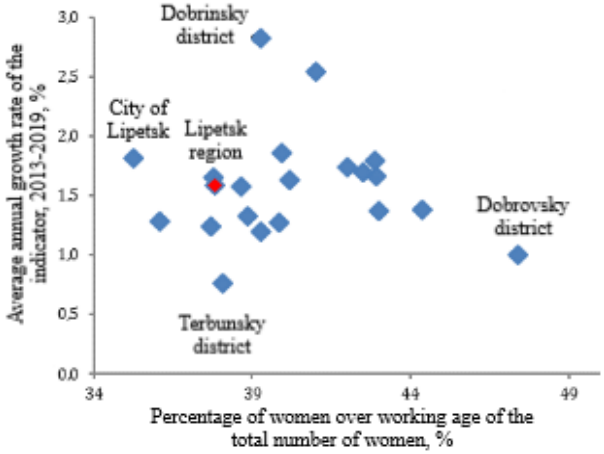


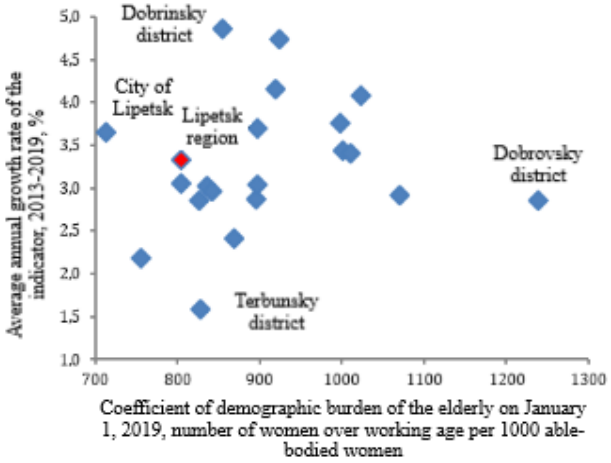
Fig. 1. Analysis of the proportion of persons older than working age in municipal districts of Lipetsk region among the total population, women and men.

The share of people older than working age largely reflects the problem of "aging" of the population, but from the point of view of the impact on the production potential of the economy of the region, the ratio of the demographic burden of the elderly is more reliable. It shows the number of people over working age to 1000 people of working age. Based on the same approach "pictures" for the analysis of municipal districts of the Lipetsk region on dynamics of coefficient of demographic burden by elderly were received (Fig. 2).









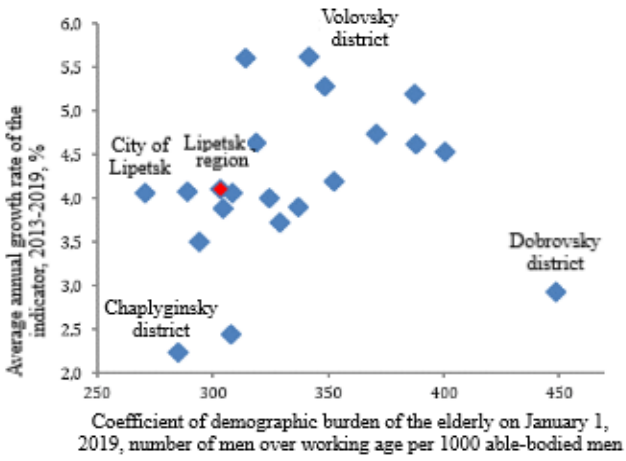
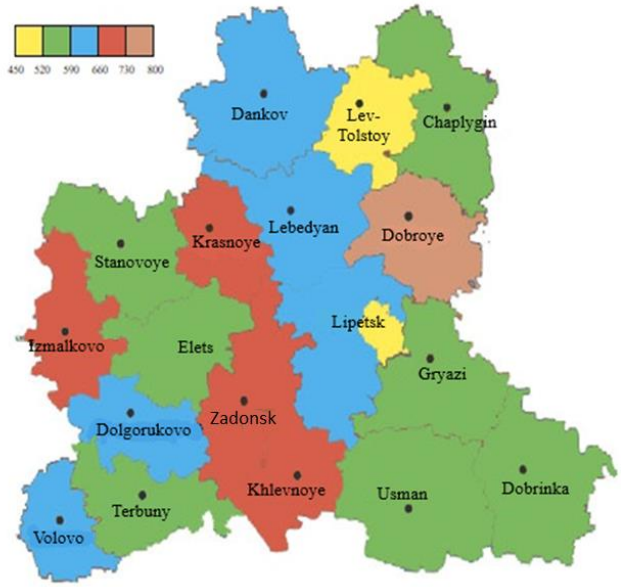


Fig. 2. Analysis of the coefficient of demographic burden in the municipal districts of the Lipetsk region among the entire population, women and men.

As can be seen from figure 2, the "pictures" with the coefficients of demographic burden are in many respects similar to the "pictures" of shares in the location of municipal districts, and in the spread of values of indicators as of January 1, 2019. The only difference between the results obtained is the similar rate of increase of the coefficient of both men and women.

Based on the obtained calculations, the municipal districts were divided into 5 groups according to the burden coefficient (from 450 to 800 with a step of 70) and the growth rate of this indicator (from 1.5 to 5 with a step of 0.7). This grouping is shown in figure 3.



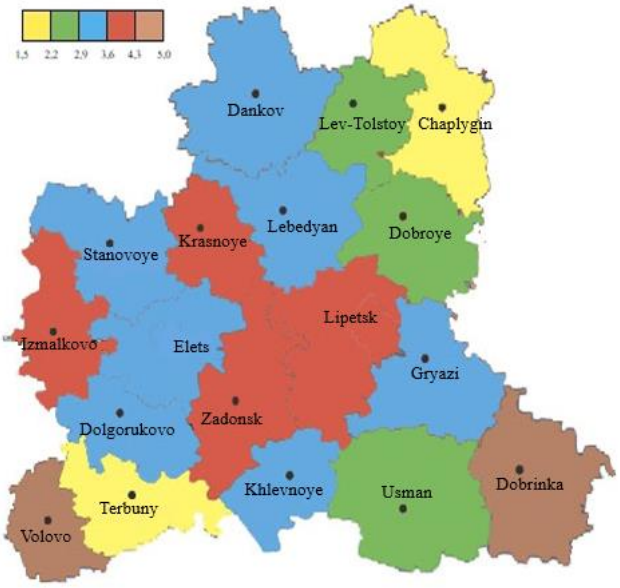


Fig. 3. Grouping of municipal districts of the Lipetsk region by the coefficient of demographic burden (upper figure) and by the growth rate of the coefficient of demographic burden (lower figure).

The performed grouping allows to draw the following conclusions for each of the municipal districts of the Lipetsk region.

- The city of Lipetsk has the best indicators of the demographic burden of the elderly, which is largely due to the concentration of production forces, high income and quality of life, which attracts enough able-bodied population. At the same time, rather high growth rates of the coefficient over the past 7 years are cause for concern.
- Lev-Tolstovsky, Chaplyginsky, Usmansky and Terbunsky districts have quite low values of both the burden coefficient and the rate of its growth. All this makes it possible to classify these areas as relatively "successful".
- The "stable" districts include Gryazinsky, Yeletsky, Stanovlyansky, Dankovsky, Lebedyansky, Dolgorukovsky districts and the city of Yelets. These are obvious middle peasants of the Lipetsk region.
- Those regions that in general still have a burden coefficient of average and below average, but the growth rate of this indicator is higher than the average for the region, can be attributed to the "stopping" districts. These are Lipetsk, Volovsky and Dobrinsky districts. Authorities in these districts need to carry out further in-depth analysis to prepare measures to reduce this trend.
- The "crisis" districts include districts with coefficients above the regional average. Some of these areas have high, some low growth rates. These are Izmalkovsky, Krasninsky, Zadonsky, Khlevensky and Dobrovskiy districts. In these districts, it is necessary to actively carry out state measures to reduce the demographic burden.

V. CONCLUSION

Carried out study showed that the problems of "aging" of the population and increasing the burden on labor resources are inherent in the Lipetsk region.

According to the ranking of regions given in the study of V.A. Chereshnev and E.V. Chistova, the population of the Lipetsk region is at stage III, that is, refers to the old population, which is generally consistent with our own calculations.

However, you should pay attention to the following points:

- In one third of the municipal districts of the Lipetsk region, the population in terms of the proportion of persons older than the able-bodied in the total population can be attributed to deeply old population.
- Only in two municipal subjects of the region indicators of demographic burden by elderly correspond to the average values of similar indicators in the Russian Federation and the Central Federal District (454 and 492 per 1000 people of working age, respectively) [18].

Thus, the analysis of intraregional differentiation allows to define those regions of the region which can be "examples" of competent demographic policy, and those which first of all need corrective actions from regional and local authorities.

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